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INSTITUTO DE ESTRATEGIAS AGROPECUARIAS

THE ROLE OF AGRICULTURE IN ECUADOR'S ECONOMIC DEVELOPMENT

An Assessment of Ecuador's Agricultural Sector

Quito, Ecuador
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The findings, conclusions and recommendations of this study, plus any errors are entirely the responsibility of the authors and do not necessarily represent the position of USAID, IDEA the government of Ecuador or any of the other sponsoring agencies.

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PREFACE

This Assessment of Ecuador's agricultural sector addresses critical issues that must be faced if the country is to fully benefit from its superb agricultural potential. The Sector Assessment analyzes the role of agriculture in economic development, identifies constraints to progress and makes recommendations for faster growth and development in agriculture and the economy more generally. The conceptual foundation that undergirds the assessment comprises three interrelated elements: the induced innovation model of agricultural development, the pervasive effect of macroeconomic polices on agricultural growth, and the emergence of a new global economic order. Specific analyses and studies of the agricultural sector include: an overview of theoretical constructs; macroeconomic and sectoral policies; agricultural growth, trade and nutrition; renewable natural resources; population growth and the labor market; the production milieu and factor use; public irrigation projects; marketing; credit; social institutions and gender; public sector institutions; and the human capital and science base.

We conclude that the principal challenge facing Ecuador's economy is to make the transition from a low-productivity agriculture primarily dependent on natural resources to a highly-productive, science-based sector. The specific analyses tend to reveal the same major constraints: discriminatory macroeconomic policies that subsidize industry, home goods and urban people at the expense of agriculture, tradeables and rural people; and major deficiencies in the human capital and science base resulting in low agricultural productivity. An outward-oriented growth strategy is proposed with two principal recommendations: (1) rationalize the inward-oriented macroeconomic policy matrix by reducing and eliminating trade barriers, reducing government expenditures and deficits, unfettering capital markets and unifying the exchange rate; and (2) substantially strengthen the science base for agriculture by making research autonomous, paying competitive salaries for scientists, greatly increasing research funding, consolidating extension services, technical high schools and university faculties, linking the various components of the science base both nationally and internationally, and improving rural education.

Work on the Agricultural Sector Assessment began in February 1988 as part of the Agricultural Sector Reorientation Project (ASRP) sponsored by the U.S. Agency for International Development (USAID). The Institute for Agricultural Policy (IDEA) provided direct support with complementary support from the Ministry of Agriculture's (MAG) Policy Analysis Unit (PAU). A series of 21 working papers were revised and integrated into the fourteen chapters of the Sector Assessment.

The working papers are based on results of other studies and original analyses from secondary and primary data. There are a relatively large number of published and unpublished studies, reports, theses and documents about specific and more global aspects of economic and agricultural development in Ecuador. The methodology employed was to review and interpret these studies and to synthesize and incorporate their findings into the assessment. Only the most important and germane studies are cited in the references; many more were reviewed and are reported in an annotated bibliography by Dale Colyer issued as a working paper.

Analyses based on primary and secondary data were made to fill in gaps and substantiate findings from other studies. Most secondary data series are for the period 1965 through the late-1980s. Inconsistent data series on agricultural production and lack of current data on social indicators constrained the analysis.

Ecuador has not taken an agricultural census since 1974 and the methodology for gathering production statistics was changed in 1986. Primary data were gathered to complement secondary sources for analyses of irrigation and social institutions and gender.

The working papers provided the basis, along with other studies by IDEA, MAG/PAU and USAID, for a series of seminars and round-table discussions under auspices of IDEA. These fora served to communicate important preliminary findings and recommendations of the Sector Assessment to key public and private sector decision-makers and provided critiques of the working papers.

The Agricultural Sector Assessment is jointly authored by several people associated with USAID/Ecuador and its contractors, IDEA and MAG/PAU. Dr. Morris D. Whitaker (current agricultural economist for USAID/Ecuador) is the senior author and editor and Dr. Dale Colyer (former agricultural economist with USAID/Ecuador) and Mr. Jaime Alzamora are co-authors and editors. Contributing authors include Drs. Rae Lesser Blumberg, Duty Greene, Hugo Ramos, Harold Riley, Lindon Robison, Douglas Southgate (agricultural economist joining IDEA's staff in mid-1990) and David Tschirley. The study is unique in that nine of the ten authors are agricultural economists (Dr. Blumberg is a rural sociologist). Ecuador has only a few agricultural economists and two are co-authors (Dr. Hugo Ramos and Mr. Jaime Alzamora); this is the first global study of agricultural development in Ecuador by agricultural economists.

The authors have a substantial base of experience in Ecuador. Two are native Ecuadorians with long professional experience in various parts of the public and private sectors. Six of the U.S. authors have served long-term assignments in Ecuador totaling over 16 years and all have worked on short-term assignments, some on a recurring basis for decades. Interpretation of the data were greatly enhanced by these prior professional activities and common basis for interaction among the authors.

The Ecuadorian economy has been stagnant for nearly a decade with per capita output at a lower level in 1989 than in 1980. The country is heavily dependent on petroleum exports but is expected to become a net importer of petroleum products shortly after 2000. As petroleum reserves become increasingly exhausted, dependence on agriculture as the principal economic sector will grow. This will place increasing stress on already degraded natural resources. Unless substitute inputs--improved technical knowledge and modern, industrial inputs--become broadly available in the next 5-10 years the likely outcome will be eventual destruction of renewable natural resources followed by economic stagnation. We believe the recommendations of the Agricultural Sector Assessment provide the basis for producing these indispensable substitute inputs and rejuvenating the economy. Implementing these recommendations will allow Ecuador to exploit opportunities for growth in the emerging world economy, lead to a healthy, growing agricultural sector, reduce dependence on natural resources, create higher-paying jobs and result in faster and more equitable economic growth among all productive sectors of the economy. Our hope is that the Assessment will serve to focus debate and discussion and help lead to the development of improved policies for agricultural development.

The Authors
Quito, June 1990

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We recognize the important contributions of other colleagues who reviewed drafts of the Assessment and provided access to data: Manuel Jaramillo of the Catholic University; Victor Mendoza and Guillermo Ojeda of CEDEGE; Patricio Leon of the Central Bank; Patricio Toledo of CLIRSEN; Nelson Toledo of DINAF/MAG; Manuel Durini of ENDESA; Jorge Chang, Francisco Muñoz, Tomas Dousdebes, Bolívar Navas and Jorge Uquillas of FUNDAGRO; Pablo de la Torre of IDEA; Carlos Criollo of INEC; Jorge Sotomayor, Arturo Orquera and César Sarmiento of INERHI; Juan Vega of INIAP; Carlos Basantes of MAG/Marketing; Mario Lalama, Mónica Acosta and Mauricio Cuesta of MAG/PAU; Franklin Maiguashca of the Office of the President; Ralph Franklin, Rigoberto Stewart, Kelly Harrison and Lloyd Brown of Sigma One Corporation; Patricio Izurieta, Ricardo Izurieta, Galo Izurieta, Antonio Teran, Nícolas Guillen and Ignácio Pérez of the private agricultural sector; and William Goodman, Guillermo Jauaregui, Fausto Maldonado, Patricio Maldonado, Robert Mobray and David Nelson of USAID. We express apreciation to the large number of other contributors who provided information and access to data sources, introduced us to other knowledable people and helped clarify murky issues and concepts.

Finally, we express our heartfelt thanks to Mses. Cecilia Ortiz and Teresa Santelí S. who served as research assistants and computer specialists. The Sector Assessment could not have been completed without their highly professional work and loyal service.

While many people and institutions have contributed to the Sector Assessment, it contains the viewpoints of the authors alone and does not necessarily reflect the official positions of USAID/Ecuador, IDEA, MAG/PAU or the government of Ecuador. Any errors of fact, omission or interpretation are solely our responsibility.

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ACRONYMS

AIMA	Wood Industry Association, Asociación de Industriales Madereros.
AFABA	Feed Manufacturers Association, Asociación de Fabricantes de Alimentos Balanceados.
ANCO	National Association of Sheep Growers, Asociación Nacional de Criadores de Ovejas.
APPY	Association of Producers and Processors of Cassava, Asociación de Productores y Procesadores de Yuca.
ASA	Agricultural Service Agency, Agencia de Servicios Agropecuarios.
BCE	Central Bank of Ecuador, Banco Central del Ecuador.
BNF	National Development Bank, Banco Nacional de Fomento.
CAF	Andean Development Corporation, Corporación Andina de Fomento.
CAME	Ecuadorian Agrarian Military Draft, Conscripción Agraria Militar Ecuatoriana.
CARE	Cooperative for American Relief Everywhere, Cooperativa Americana para Ayuda Mundial.
CEA	Center for Studies and Analysis, Centro de Estudios y Análisis.
CEDEGE	Study Commission for the Development of the Guayas River Basin, Comisión de Estudios para el Desarrollo de la Cuenca del Rio Guayas (MAG).
CEDIG	Ecuadorian Center for Geographic Research, Centro Ecuatoriano de Investigación Geográfica.
CELADE	Latin American Demographic Center, Centro Latinoamericano de Demografía.
CENDES	Center for Industrial Development, Centro de Desarrollo Industrial.
CEPAL	Economic Commission for Latin America, Comisión Económica para América Latina (U.N.).
CEPE	Ecuadorian State Petroleum Corporation, Corporación Estatal Petrolera Ecuatoriana (predecessor agency of PETROECUADOR).
CEPLAES	Planning and Studies Center, Centro de Planificación y Estudios.
CESA	Ecuadorian Center for Agricultural Services, Centro Ecuatoriano de Servicios Agrícolas.
CFN	National Finance Corporation, Corporación Financiera Nacional.
CGIAR	Consultative Group on International Agricultural Research, Grupo Consultivo para la Investigación Agrícola Internacional.
CIAT	International Center for Tropical Agriculture, Centro Internacional de Agricultura Tropical (CGIAR).
CIM	Interamerican Commission on Women, Comisión Interamericana de Mujeres (MAG).
CIP	International Potato Center, Centro Internacional de la Papa (CGIAR).

CLIRSEN	Center for the Survey of Natural Resources by Remote Sensing, Centro de Levantamientos Integrados de Recursos Naturales por Sensores Remotos (IGM).
COFIEC	Ecuadorian Finance Company for Development, Compañía Financiera Ecuatoriana de Desarrollo.
CONACYT	National Council on Science and Technology, Consejo Nacional de Ciencia y Tecnología.
CONADE	National Development Council, Consejo Nacional de Desarrollo.
CONFCA	National Council of Agricultural Science Faculties, Consejo Nacional de Facultades de Ciencias Agropecuarias.
CONUEP	National Council of Universities and Polytechnic Schools. Consejo Nacional de Universidades y Escuelas Politécnicas.
CORDES	Corporation for Development Studies, Corporación de Estudios para el Desarrollo.
CREA	Center for the Economic Recovery of Azuay, Cañar and Morona-Santiago, Centro de Reconversión Económico del Azuay, Cañar y Morona Santiago (MAG).
CRM	Center for the Rehabilitation of Manabi, Centro de Rehabilitación de Manabí (MAG).
CRS	Catholic Relief Services, Servicios Católicos de Ayuda.
DAC	Development Assistance Committee, Comité para la Ayuda al Desarrollo (OECD).
DINAC	National Directorate for Valuation and Cadastrals, Dirección Nacional de Avalúos y Catastros.
DINAF	National Forestry Directorate, Dirección Nacional Forestal (MAG).
DRI	Integrated Rural Development, Desarrollo Rural Integral.
EMSEMILLAS	National Seed Company, Empresa Mixta de Semillas.
EMBRAPA	Brazilian Public Corporation for Agricultural Research, Empresa Brasileña de Investigación Agropecuaria.
ENAC	National Agricultural Storage and Marketing Company, Empresa Nacional de Almacenamiento y Comercialización (MAG).
ENDES	National Semen Company, Empresa Nacional de Semen.
ENPROVIT	National Company for Basic Products, Empresa Nacional de Productos Vitales (MAG).
EXPOFLORES	Association of Flower Producers and Exporters, Asociación de Productores y Exportadores de Flores.
FAO	Food and Agriculture Organization, Organización para la Agricultura y la Alimentación (U.N.).
FAB	National Fertilizer Factory, Fábrica de Abonos.
FECOAC	Credit Union Federation of Ecuador, Federación de Cooperativas de Ahorro y Crédito del Ecuador.
FEI	Ecuadorian Indian Federation, Federación Ecuatoriana de Indios.
FENACOMI	National Federation of Retail Merchants, Federación Nacional de Comerciantes Minoristas.

FENOC	National Federation of Campesino Organizations, Federación Nacional de Organizaciones Campesinas.
FERTISA	Ecuadorian Fertilizer Company, Fertilizantes Ecuatorianos, Compañía de Empresa Mixta.
FIDA	International Fund for Agricultural Development, Fondo Internacional de Desarrollo Agrícola.
FODERUMA	Fund for Marginal Rural Development, Fondo de Desarrollo Rural Marginal (BCE).
FONARYD	National Fund for Irrigation and Drainage, Fondo Nacional para Riego y Drenaje.
FOPEX	Export Promotion Fund, Fondo de Promoción de Exportaciones (BCE).
FOPINAR	Small Industry and Handcraft Fund, Fondo para la Pequeña Industria y Artesanía (BCE).
FUNDAGRO	Foundation for Agricultural Development, Fundación para el Desarrollo Agropecuario.
GDP	Gross Domestic Product, Producto Interno Bruto.
GOE	Government of Ecuador, Gobierno del Ecuador.
GTZ	Agency for Technical Cooperation, Sociedad para Cooperación Técnica (West Germany).
IBRD	International Bank for Reconstruction and Development (World Bank), Banco Internacional de Reconstrucción y Desarrollo (Banco Mundial).
ICNND	Interdepartmental Committee on Nutrition for National Defense, Comité Interdepartamental de Nutrición para la Defensa Nacional (U.S.).
IDA	International Development Association, Asociación Internacional para el Desarrollo (World Bank).
IDB	Inter-American Development Bank, Banco Interamericano de Desarrollo.
IDEA	Agricultural Policy Institute, Instituto de Estratégias Agropecuarias.
ICDR	International Center for Developmment Research, Centro Internacional para la Investigación de Desarrollo (Canada).
IEOS	Ecuadorian Institute of Sanitary Works, Instituto Ecuatoriano de Obras Sanitarias (MOP).
IERAC	Ecuadorian Institute for Agrarian Reform and Colonization, Instituto Ecuatoriano de Reforma Agraria y Colonización (MAG).
IESS	Ecuadorian Social Security Institute, Instituto Ecuatoriano de Seguridad Social.
IETEL	Ecuadorian Institute of Telecommunications, Instituto Ecuatoriano de Telecomunicaciones.
IFPRI	International Food Policy Research Institute, Instituto de Investigación de Política Alimentaria Internacional (CGIAR).
IGM	Military Geographic Institute, Instituto Geográfico Militar.
IICA	Interamerican Institute for Agriculture Cooperation, Instituto Interamericano de Cooperación para la Agricultura (OAS).
IMF	International Monetary Fund, Fondo Monetario Internacional.

INAMHI	National Institute of Meterology and Hydrology, Instituto Nacional de Metereología e Hidrología.
INCAP	Nutrition Institute of Central America and Panama, Instituto de Nutrición de Centro América y Panamá.
INCCA	National Institute for Rural Training, Instituto Nacional de Capacitación Campesina (MAG).
INCRAE	Institute for the Colonization of the Amazon Region, Instituto Nacional de Colonización de la Región Amazónica Ecuatoriana (MAG).
INEC	National Institute of Statistics and Census, Instituto Nacional de Estadísticas y Censos.
INECEL	Ecuadorian Electrification Institute, Instituto Ecuatoriano de Electrificación.
INEM	National Employment Institute, Instituto Nacional de Empleo.
INEN	Ecuadorian Institute of Grades and Standards, Instituto Ecuatoriano de Normalización (MICIP).
INERHI	Ecuadorian Institute of Water Resources, Instituto Ecuatoriano de Recursos Hidráulicos (MAG).
INIAP	National Institute of Agricultural Research, Instituto Nacional de Investigaciones Agropecuarias (MAG).
ININMS	National Institute for Nutritional Research and Social Medicine, Instituto Nacional de Investigación Nutricional y Medicina Social (MSP).
INNE	Ecuadorian National Institute of Nutrition, Instituto Nacional de Nutrición del Ecuador (predecessor of ININMS).
IRRI	International Rice Research Institute, Centro Internacional de Investigación del Arroz (CGIAR).
ISNAR	International Service for National Agricultural Research, Servicio Internacional para la Investigación Agrícola Nacional (CGIAR).
ISS	Institute of Social Studies, Instituto de Estudios Sociales (Holland).
JUNAPLA	National Planning Commission, Junta Nacional de Planificación (predecessor of CONADE).
MAG	Ministry of Agriculture, Ministerio de Agricultura y Ganadería
MBS	Ministry of Social Welfare, Ministerio de Bienestar Social
MEC	Ministry of Education and Culture, Ministerio de Educación y Cultura
MICEI	Ministry of Industry, Trade and Integration, Ministerio de Industrias, Comercio e Integración (predecessor of MICIP).
MICIP	Ministry of Industry and Commerce, Ministerio de Industrias, Comercio, Integración y Pesca.
MOP	Ministry of Public Works, Ministerio de Obras Públicas.
MSP	Ministry of Public Health, Ministerio de Salud Pública
OAS	Organization of American States, Organización de Estados Americanos.
OECD	Organization for Economic Cooperation and Development, Organización para el Desarrollo y la Cooperación Economica.

OMS	World Health Organization, Organización Mundial de la Salud (U.N.).
OPEC	Organization of Petroleum Exporting Countries, Organización de Países Exportadores de Petróleo.
ORSTOM	Office of Overseas Science and Technology Research (France), Office de Recherche Scientifique et Technique d'Outre-Mer.
PAU	Policy Analisis Unit, Unidad de Análisis de Políticas (MAG).
PETROECUADOR	Ecuador Petroleum Company, Petroleos del Ecuador (successor agency of CEPE).
PIP	Product Research Program, Programa de Investigación en Producción (INIAP).
PNUD	U.N. Development Program, Programa de Desarrollo de las Naciones Unidas.
PREALC	Regional Employment Program for Latin America and the Caribbean, Programa Regional del Empleo para América Latina y el Caribe (U.N.).
PREDESUR	Regional Program for the Development of Southern Ecuador, Programa Regional para el Desarrollo del Sur (MAG).
PROCIANDINO	Cooperative Program for Agricultural Research in the Andean Subregion, Programa Cooperativo de Investigación Agrícola para la Subregión Andina (IICA).
PROFOGAN	Livestock Development Project, Proyecto de Fomento Ganadero (GTZ).
PRONAMEC	National Program for Agricultural Mechanization, Programa Nacional de Mecanización Agrícola (MAG).
PRONAREG	National Program for Agrarian Regionalization, Programa Nacional de Regionalización Agraria (MAG).
PROTECA	Program for the Develonment of Agricultural Technology, Programa de Desarrollo Tecnológico Agropecuario (MAG).
PVO	Private Voluntary Organization, Organización Privada Voluntaria.
REE	Research, Education and Extension, Investigación, Educación y Extensión.
RELU	Research-Extension Linkage Unit, Unidad para Vincular la Investigación-Extensión (FUNDAGRO).
RRA	Rapid Rural Appraisal, Investigación Rural Rápida.
RTTS	Rural Technology Transfer System, Sistema para la Transferencia de Tecnología Rural (USAID).
SCIA	Interamerican Cooperative Agricultural Service, Servicio Cooperativo Interamericano de Agricultura.
SEAN	National System of Agricultural Statistics, Sistema Estadístico Agropecuario Nacional (INEC).
SEDRI	Subsecretariat of Integrated Rural Development, Subsecretaría de Desarrollo Rural Integral (MBS).
TGC	Tribunal of Constitutional Guarantees, Tribunal de Garantías Constitucionales.
TSE	Supreme Electoral Tribunal, Tribunal Supremo Electoral.
UAPPY	Union of Cassava Producer and Processor Associations, Unión de Asociaciones de Productores y Procesadores de Yuca.

UCANO	Union of Small Farmers of the Northeast, Unión de Campesinos del Nororiente.
UNAE	Union of Natives of the Ecuadorian Amazon, Unión de Nativos de la Amazonía Ecuatoriana.
UNDP	U.N. Development Program, Programa de Desarrollo de las Naciones Unidas.
UNFPA	U.N. Fund for Population Activities, Fondo para las Actividades Poblacionales de las Naciones Unidas.
USAID	U.S. Agency for International Development, Agencia para el Desarrollo Internacional de los Estados Unidos.
USDA	U.S. Department of Agriculture, Departamento de Agricultura de los Estados Unidos.
WFP	World Food Program, Programa Mundial de Alimentos (U.N.).
WHO	World Health Organization, Organización Mundial de la Salud (U.N.).

THE ROLE OF AGRICULTURE IN ECUADOR'S ECONOMIC DEVELOPMENT:

EXECUTIVE SUMMARY

Overview

The principal conclusion of this study is that agriculture, a key sector of the economy, has been undervalued and depreciated by past policies as a basis for more rapid and equitable development. Economic growth has been internally-oriented, based largely on import-substitution industrialization with inherent constraints on the rate of progress. The macroeconomic policies associated with this development model have discriminated against agriculture, tradeable goods and rural people while subsidizing industry, home goods and urban dwellers. Substantial windfall gains from the petroleum boom and external credits to cover fiscal deficits were used to finance a too-large, unproductive public sector and a variety of other recurring subsidies to support internally-oriented growth. Subsidies are ubiquitous and tend to be captured mainly by various special interest groups of the non-poor although they are ostensibly to help the poor. All good and marginal agricultural land is in use and land and other natural resources are increasingly exploited and degraded. Agricultural productivity is relatively low even compared to other South American countries, reflecting completely inadequate investments in the human capital and science bases of the sector. The consequence has been a slow-growing economy during most of the 1980s, with real gross domestic product (GDP) per capita in 1989 at lower levels than at the beginning of the decade.

Main Findings

The most important findings of the assessment are as follows:

1. The Importance of Agriculture. Agriculture is the most important of any of the economic sectors on the basis of foreign exchange earned, contribution to GDP and share of employment;

2. Past Macroeconomic Policies and Incentives. The structure of incentives inherent in macroeconomic and sectoral policies associated with import-substitution industrialization has subsidized industry and urban dwellers and has discriminated against agriculture, especially against the small farm sector and rural people, for the last three decades;

3. Current Macroeconomic Policies. Macroeconomic and sectoral policies still subsidize industry and discriminate against agriculture, despite modest improvements throughout the 1980s and the commitments of the Borja administration to implement further reforms;

4. The Petroleum Boom. A large share (79 percent) of the proceeds of the oil boom were expended on salaries for a burgeoning public sector bureaucracy and subsidies for various special interest groups, which imposed a major, recurring fiscal burden on the economy;

5. Agricultural Growth. Agriculture grew very rapidly in the 1980s compared to slow growth in the 1970s, reflecting the responsiveness of Sierra and Costa farmers to a somewhat improved macroeconomic policy environment;

6. Industrial Stagnation. Industry and the rest of the economy were stagnant in the 1980s after rapid growth in the 1970s due primarily to the exhaustion of internal markets for import substitutes and subsequent very slow growth in demand;

7. The Agricultural Frontier. All the good and marginal agricultural land is now in production with major problems of soil erosion in the Sierra and expansion onto fragile soils of the Oriente and Northwest;

8. Natural Resources. While Ecuador was endowed with abundant natural resources, degradation is occurring at increasingly faster rates, with the strong likelihood that some of its most important natural resources will be destroyed or depleted within another 10-15 years;

9. Sources of Growth in Agricultural Production. Increases in yields have been modestly important in explaining changes in production of Coastal and Sierra crops, notwithstanding the relatively low levels of productivity and general reliance on natural resources for agricultural growth;

10. Agricultural Productivity. Productivity in agriculture is relatively low even in comparison with neighboring countries, despite the modest increases in yields noted above;

11. The Science Base and Human Capital. The research, extension and education system serving agriculture is seriously deficient, with especially limited human capital and very small and decreasing investments in agricultural research;

12. Agricultural Research. Improved technologies are very location-specific depending on soils, rainfall, temperature, pests, and diseases and require a strong research system linked to the international network of agricultural science;

13. Irrigation and Agriculture. Irrigation projects are highly subsidized and very inefficient with more than half of the subsidy being wasted and a large share of the modest benefits being captured by a few large landowners;

14. The Public Sector and Agriculture. Public expenditures on agricultural programs have always been relatively low and have declined substantially to only about 3 percent of the total since the peak reached during the oil boom;

15. Agricultural Subsidies. The greatest share of subsidies to agriculture are captured by well-to-do farmers with large holdings; the more affluent generally capture most of the subsidies throughout the economy;

16. Agricultural Trade. Agriculture has generated a relatively large trade surplus for decades that reached nearly one billion dollars per year in the late 1980s;

17. Food and Agriculture. Ecuadorian agriculture more than meets the country's food needs through a combination of domestic production and trade; the country

is completely self-reliant (as opposed to the notion of self-sufficiency);

18. Nutrition and the Diet. Apparent consumption per capita in 1985 was 117 percent of the minimum standard for energy (calories), and 125 percent for protein;

19. The Small Farm Sector and Subsistence Agriculture. Most farmers with small holdings sell the majority of their agricultural production commercially and are part-time farmers who earn most of their family income from off-farm and often urban sources;

20. Gender and Farming. Feminization of farming, especially of small farms in the Sierra and parts of the Costa, accelerated during the late 1970s and early 1980s as males increasingly worked off the farm;

21. Agricultural Credit. Savings and investments are constrained by subsidized, negative interest rates and loans are concentrated among the most influential borrowers who capture most of the subsidies;

22. Controlled Prices. Most of the benefits of controlled, low prices have been captured by influential consumer groups and intermediaries while production and productivity have been constrained;

23. Poverty and Agriculture. The incidence of poverty is greater in rural than in urban areas and output per worker is much lower in agriculture than the low-skill services or construction sectors;

24. Population Growth. Population is projected to grow at the relatively fast annual average rate of 2.6 percent between 1990 and 2000, even though the rate has declined from the very high 3.3 percent observed between 1962-74;

25. Migration Patterns. Migration patterns are very complex and census data reveal large migration from urban areas to other urban areas, from urban to rural areas and among rural areas, as well as the dominant trend of net rural to urban migration; and

26. Labor Markets. Labor markets linking agriculture and the other economic sectors are relatively efficient, moving large numbers of rural people out of agriculture and into higher paying employment in nonagricultural activities, largely in urban areas.

Foundations for Agricultural Growth

Several positive factors form the foundation for potentially more rapid agricultural growth and modernization:

1. Improved Macroeconomic Policies. The macroeconomic policy environment became somewhat more hospitable for agriculture in the 1980s, and was substantially improved by the Borja administration from the difficult situation it inherited in mid-1988. The economic plan announced in February 1990, if fully implemented, will further improve the macroeconomic policy climate and move toward a more open economy;

2. Strong Performance of Agriculture. Rapid growth of agriculture during the 1980s augurs well for the economic plan of the Borja administration. The sector clearly responded to improvements in the macroeconomic policy environment during the decade. The responsiveness of farmers to improved incentives after 1981 is an especially important index for predicting more rapid growth as additional macroeconomic policy reforms are implemented;

3. Commercialization of Agriculture. Agriculture shifted quickly from subsistence to commercial production during the 1970s and continuing into the 1980s. Farmers across the tenure spectrum demonstrated their willingness to mobilize and reallocate resources in response to changing economic conditions. Most farmers have participated in a market economy for a decade or more and have a good base of experience as commercial farmers;

4. Substantial Improvements to the Land. There have been substantial improvements to the land over the last two decades, especially through investments in irrigation and drainage, which provide a foundation for much more rapid growth. Most of the potential improvements in productivity have not been realized because of failure to make complementary investments in human capital and a science base for agriculture;

5. Increased Yields/Emergence of Science Tradition. Modest increases in yields suggest that some farmers already have experience in adopting improved technologies. Yield increases also demonstrate greater dependency on science as an input to agricultural production and the emergence of a science tradition. Low yields compared to the rest of South America implies Ecuador can increase productivity substantially at a relatively modest cost by adapting already proven technical knowledge; and

6. Good Natural Resource Base. Ecuador has a generally good endowment of natural resources which have been the principal basis for past agricultural development. They are being increasingly degraded, however, and continued reliance on them as the main input for agricultural development will eventually result in their destruction and eventual economic stagnation.

Principal Constraints

Three principal, interrelated problems are forcing Ecuador onto this dead-end road to economic stagnation and environmental crisis:

1. Discriminatory Macroeconomic Policies. The macroeconomic policy matrix continues to artificially depress the prices of agricultural products and tradeables relative to industrial and other home goods, although there is some movement towards more outward-oriented macroeconomic policies;

2. A Seriously Deficient Agricultural Science Base. Capacity to generate and extend new technical knowledge is extremely limited, with an especially weak research system; and

3. Limited Human Capital. The scarcity of human capital is the single most serious restriction to a more science-based, productive agriculture and is treated separately from the science base to emphasize and highlight its importance.

These three constraints are the most important identified in the assessment and combine to severely limit agricultural growth and intensify exploitation and degradation of natural resources. The deficient science base and limited human capital result in a general absence of new technical knowledge for agriculture. Discriminatory macroeconomic polices limit production or importation of modern, industrial inputs which incorporate or complement the new technical knowledge. The result is increasing pressure from agriculture on the natural resource base because of an extremely limited supply of substitute inputs to fuel agricultural production. In essence, agriculture has been largely dependent on natural resources for growth, but with some evidence of limited emergence of a science-based agriculture.

Other Important Problems

Four other important constraints also contribute to distorted and limited agricultural and economic growth. These constraints, while not judged to be the most important limiting factors, still are major impediments to more rapid and equitable development and deserve serious attention:

1. Rapid Population Growth. A relatively high rate of population growth erodes the benefits of the modest economic growth that is realized and the economy must produce relatively more just to maintain the standard of living;

2. Negative Sector Policies.

(a) Controlled Prices. Producer and consumer prices for a few key agricultural products are still controlled which limits producer incentives and results in subsides to the most influential consumers and middlemen; and

(b) Government Market Interventions. The government intervenes inefficiently in product and factor markets in direct competition with the private sector; such interventions require recurring subsidies and distort private incentives;

3. Degradation of Natural Resources. Natural resources from mangrove swamps to tropical forests to watersheds to topsoil are increasingly being degraded and destroyed which results in fewer inputs for agriculture; and

4. Inadequate Data Base and Analytical Capacity. Data for analyzing agriculture's role in the economy are out-dated and very inadequate while the capacity for policy analysis in agriculture is just as deficient, resulting in poorly founded, ineffective polices and programs.

Major Recommendations

1. An Outward-Oriented Macroeconomic Policy Matrix. Move quickly toward an outward-oriented set of macroeconomic polices in order to provide equal incentives for all economic sectors. Since past policies have discriminated against agriculture, outward-oriented policies will improve incentives for the sector and lead to increased investments in agriculture and tradeables generally, including industrial products and imported foodstuffs and feed grains. Such policies also will provide a healthy dose of competition which will lead to more efficient industry and access

to international markets. An improved macroeconomic policy matrix will thus contribute to higher rates of sustained agricultural and economic growth. Four changes are needed:

(a) Reduce Trade Barriers. Remove non-tariff barriers to trade and establish a relatively low, uniform tariff that is eventually eliminated;

(b) Reduce Public Sector Deficits and Inflation. Streamline government services by divesting of inefficient public businesses, reducing public sector employment and eliminating subsidies. Increase revenues by increasing prices of public goods such as energy to market levels, and improving the tax system;

(c) Unfetter Capital Markets. Allow market forces to establish interest rates for borrowers and savers; and

(d) Unify the Exchange Rate. Shift to a unified, floating exchange rate for all foreign trade transactions.

2. A Science Base for Agriculture. Strengthen, consolidate, expand and link research, education and extension programs into a viable science base for agriculture. This must be done mainly through government programs since the products of the science base are generally public goods. There are four specific recommendations:

(a) Make INIAP Autonomous and Increase Funding. Increase funding levels for research by eight-fold, make INIAP autonomous so it can pay competitive salaries for scientists and technicians, and mobilize a critical mass of senior scientists as quickly as possible;

(b) Consolidate Extension Services. Integrate and consolidate the disparate, uncoordinated extension programs into a single entity with a unifying philosophy;

(c) Consolidate and Strengthen Universities and Technical High Schools. Consolidate university and technical high school programs into fewer schools with increased emphasis on quality and practical experience. Research programs at selected universities should be greatly expanded with special concern for natural resources; and

(d) Link Components of the Science Base. Integrate research, extension and education programs into a cohesive, national system, enhance two-way communication between farmers and the science base, and strengthen ties to the international science network.

Establishment of a viable science base for agriculture is of equal importance to shifting to an outward-oriented macroeconomic policy set as twin foundations for rejuvenating the economy. These two major recommendations of this assessment are synergistic and more rapid, sustained agricultural and economic development is dependent on both being implemented. Establishment of the science base and greater investments in human capital result in the production of new technical knowledge. The outward-oriented macroeconomic policy matrix provides broad-based incentives for investing in agriculture, including the production or importation of modern, industrial inputs which complement and

incorporate new technical knowledge.

These two sets of inputs--modern, industrial inputs and new technical knowledge--are absolutely critical for more rapid, sustained agricultural and economic development and conservation of natural resources. They substitute directly for limited land and increasingly scarce and irreplaceable natural resources, thus saving and conserving them. They simultaneously release the constraints to agricultural and economic growth imposed by inelastic supplies of natural resources. They are the principal bases for raising the productivity of land and allowing abundant labor to be more productively employed. Thus, they also permit plentiful labor to be substituted for scarce natural resources and make Ecuador's products more competitive in the international marketplace.

One caveat needs to be raised about whether a science-based, high-input agriculture can be sustained. While a modern, industrial inputs can reduce pressure on natural resources and increase economic growth, important hidden costs emerge in the form of externalities such as pollution associated with their use. These externalities must be taken into account in policy formulation since they increase social costs and limit the degree to which resource conservation is enhanced by a science-based agriculture. In any case, a strong science base is the key to addressing the complex problems associated with developing a more productive and sustainable agriculture in Ecuador.

It is urgent that the recommendations for increasing funding and strengthening the research system and the science base be implemented as quickly as possible if ecologic and economic disaster are to be avoided. This strong recommendation rests on the three realities: (1) the research pipeline is nearly empty after continual funding cuts and loss of most of Ecuador's senior agricultural scientists since 1987; (2) it will take at least 2-3 years at a minimum to make the research system fully functional after the decision to do so; and (3) the long gestation period associated with agricultural research will require another 6-8 years for a meaningful flow of improved technologies to be produced.

The government has already begun to implement some of the recommendations made for shifting to an outward-oriented macroeconomic policy matrix. The economic plan announced in February 1990, if fully implemented, would address most of the recommendations of this assessment over the next three years. There are two concerns: the plan does not go far enough, especially on fiscal and trade issues and needs to implemented more quickly.

Other Recommendations

1. Slower Population Growth. Reduce the rate of population growth in order to amplify the effects of more rapid economic growth in the future from strengthening the science base and improving macroeconomic policies. It is important for the government to dedicate more resources and quiet leadership to reducing population growth via:

(a) More Specific Policies. Develop more specific government policies for reducing the rate of population growth; and

(b) Increased Support for Private Family Planning Services. Provide greater public financial support for private entities engaged in family planning services and related educational programs.

2. A Market-Based Private Agricultural Economy. Establish market pricing for agricultural products and a reduced and modified role for the state:

(a) Divest From Public Businesses. The government should divest itself of agencies that compete with the private agricultural sector or substantially modify their role. Prime candidates are BNF, ENPROVIT, ENAC, ENDES, FERTISA, AND PRONAMEC;

(b) Move to Market Prices. Remove all price controls at the consumer and producer levels except possibly for producer prices for rice, hard corn, oilseeds and sugar which should utilize a price band or reference price tied to the world market price; and

(c) Improve Government Market Services. Improve and update regulations for grades, standards, weights and measures; improve policing of market regulations; and expand market news services.

3. Better Management of Natural Resources The two most important recommendations for conserving natural resources already have been made. The recommendations to greatly strengthen the science base and human capital for agriculture and concomitantly to shift to an outward-oriented macroeconomic policy set also are the two key elements of a policy set to conserve natural resources. The two sets of inputs resulting from this policy--new technical knowledge and modern, industrial inputs--will substitute directly for scarce natural resources and reduce pressure on their exploitation. Other complementary recommendations include:

(a) Rationalize Property Rights. Modify private tenurial arrangements to public resources so that resource conservation is encouraged and grant private rights where resources are being exploited in common;

(b) Strengthen the Science Base for Natural Resources. Increase investments in science capacity to undergird improved management of Ecuador's renewable natural resources, with special emphasis on tropical forests and coastal resources, and in close coordination with selected universities and INIAP; and

(c) Improve Management Systems. Consolidate and improve the management of natural resources, with a more coordinated, integrated program, consistent with the recommendations made above.

4. Reliable Agricultural Data and Analytical Capacity. The data base serving agriculture must be substantially improved and updated, and analytical capacity enhanced as another fundamental basis for more rapid agricultural development:

(a) Take an Agricultural Census. Carry out an agricultural census on an urgent basis as the last one is nearly 20 years old;

(b) Improve Data Collection and Management. Continue and expand efforts to improve the collection, storage, utilization and publication of data on area, yields, production, marketing and prices; and

(c) Develop and Strengthen Analytical Capacity. Enhance the capacity of the Agricultural Policy Institute (IDEA) to do global policy analyses and link the public and private sectors in policy dialogue. Strengthen and institutionalize the capacity of MAG's Policy Analysis Unit (PAU) with emphasis on situation and outlook reports and microeconomic policy studies.

The Political Economy of Subsidies

Ecuador's economy can be divided into two basic sets of people; the poor and all others, referred to as the affluent for want of a better term. The poor are those with too little income to provide basic food, clothing and shelter; the affluent constitute the rest of society. Subsidies associated with import substitution and internally-oriented growth are usually justified politically to help the poor but, in fact, the affluent receive most of the benefits. For example, 90 percent of energy is consumed by the 10 percent of the population with the highest incomes. The poor generally wield little political influence but support the political interests of dominant affluent groups because they also benefit directly from subsidies. Subsidies both distort and limit economic development and leave the poor relatively worse off. Subsidies have contributed directly to the large fiscal deficits and inflation of the 1980s. Resources have been wrested away from the poor for years via an implicit inflation tax in order to provide subsidies which benefit mainly the affluent, special interest groups. Weaning special interest groups away from subsidies and toward a more productive economy is at the heart of true economic reform. The incentive is the prospect for substantially higher economic growth, more jobs and improved well-being. A safety net to protect those who suffer during the transition period likely will be a necessary part of a new development policy.

Ecuador Without Petroleum

The Ecuadorian economy is at a major crossroads with very little time to decide which way to turn. It will become a net petroleum importer in about 13 years. Agriculture is a major sector of the economy and will play an increasingly important, pivotal role as petroleum reserves are depleted. Production agriculture and related activities in other economic sectors are based largely on exploitation of natural resources and internal capital accumulations. The pressure on natural resources from agriculture will increase as petroleum is used up. Agricultural and economic development based on exploitation of natural resources will result in modest growth until natural resources are degraded and destroyed. At that point the economy will tend to stagnate.

Act Expeditiously

Time is of the essence. Prompt, courageous actions must be taken now if Ecuador is to get onto the high road to more rapid and equitable economic development. If petroleum reserves are depleted before the transition from a natural resource-based to a science-based agriculture is achieved, the results will be tragic both for the economy and Ecuador's natural resources. It is especially urgent that the agricultural research system become fully functional as soon as possible.

Implementing the recommendations presented in this assessment will require strong leadership, a clear vision of the future and political acumen. Achievement

of more rapid, equitable economic growth can only be realized through statesmanlike actions which subjugate short-term political agendas to the more fundamental longer-term needs of the people of Ecuador. Fortunately, a viable democratic system and enlightened and capable government leadership have already moved the economy in the direction of the recommended changes. Much more remains to be done, however, especially in reforming macroeconomic policies and in strengthening the agricultural science base.

CHAPTER

1

AGRICULTURE AND ECONOMIC GROWTH

MORRIS D. WHITAKER

I. Introduction

Economic growth and development in any modern society are concerned fundamentally and primarily with improving the well-being of people. One major objective is to increase the production of goods and services as rapidly as possible as the basis for improving the quality of life and standard of living. This goal reflects the economic behavior of *Homo sapiens* from a wide variety of political and cultural backgrounds around the world. While this concept is fundamentally materialistic, the collective aspirations of people, expressed through the political process, universally encompass a concern for adequate nutrition, housing, clothing, health care, education, arts, and other basic human needs. Concomitantly, there is a universal tendency to value expanded opportunities for the individual and freedom of choice in consumption and production activities. The standard measure used to compare economic progress among nations is the rate of growth in the value of goods and services produced in the economy, expressed in constant prices (real Gross Domestic Product or GDP). The rate of growth in real GDP is compared with the rate of growth of the population to determine if people are, on average, better off.

The second major objective of growth and development in today's world is to distribute production more equitably. Concentration of income and wealth among a small share of the population usually is not sustainable politically. Consequently, more egalitarian sharing of the fruits of economic progress is another important goal of development among countries of all ideological persuasions. This concern often is expressed by strong emphasis on increasing employment opportunities for the growing labor force, which usually is concentrated among lower-income masses, especially in developing countries. It also is expressed in progressive tax systems which redistribute income in favor of the poor and in social welfare programs which transfer resources to meet the basic human needs of poor people. While

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progressive tax systems and welfare programs tend to be the domain of the developed world, the developing nations are increasingly adopting these mechanisms. Thus, measures of the distribution of income and wealth are other important indices, along with per capita GDP, of achievement of the objectives of economic growth and development.

The role of agriculture in overall economic growth and development has not been well understood, until recently, either by economists, or by economic planners and policy-makers in developing countries. Agriculture was consigned to a secondary, poorly defined role in most of the formal models of economic development that have been in favor during the last few decades. Policy-makers compounded the errors inherent in these flawed models as they attempted to make inadequate economic premises fit with political expediency.

A substantial body of new theoretical and empirical knowledge about the role of agriculture in economic development has been produced by agricultural and developmental economists, especially during the last two decades. Policy makers in many developing countries have utilized this new knowledge, albeit with a lag of perhaps a decade or more, as a basis for modifying and improving economic development policies. These countries are in various stages of transition away from the development models of the past and toward more enlightened policy matrices for economic growth which recognize and exploit the potential contributions of agriculture. However, several Latin American countries, including Ecuador, still are following outmoded development models which discriminate against agriculture. As a consequence their economic growth is constrained well below the possible, and their distribution of income may be more unequal.

This chapter provides a conceptual foundation for the assessment of agriculture and its role in economic development presented in the following chapters. Section II reviews several general economic development models that were the basis for Ecuador's post World War II development strategy and discusses their failure to explain how agriculture is to produce a surplus to fuel the development process. Section III reviews the concept of the agricultural surplus while Section IV turns to a discussion of the body of more recent theoretical and empirical findings about the role of agriculture in economic development and the necessary conditions for producing the surplus. Section V provides a guide to the rest of the study.

II. Development Models of the Past[1]

Industrialization was proposed as the principal basis for economic development by development economists in the early 1950s. Such a position was rooted intellectually in the dual-sector models and growth-stage models of economic development. It also was based on the dependency theories of economic development advanced about the same time.

Dual-Sector and Growth-Stage Models

Dual-sector models emphasize the dichotomy between the traditional and modern sectors of the economy and suggest that economic growth must be based on development of a modern industrial sector. Dual-sector models can be classified as static or dynamic. The static model was first elaborated by Boeke. Dynamic models are based on the classic article by Lewis and include those developed by Ranis and Fei, and Jorgenson (1961, 1966).

Stage theories of economic growth suggest that the economy moves by steps

from a traditional agrarian structure characterized by low productivity to an industrialized state with commercialized agriculture and high productivity. Growth-stage theories can be divided into two schools of thought, structural transformation and leading sectors. The structural transformation school stressed the shift from primary to secondary and tertiary activities as development occurred (Clark). The "leading sectors" school developed later and is credited mainly to Rostow.

The Rostow, Ranis and Fei and Jorgenson models emphasize development of a modern industrial sector in a closed economy. All identify the generation of a surplus as an explicit and initial role for agriculture in promoting general economic development. Both Ranis and Fei and Jorgenson clearly recognize that increases in agricultural productivity will be necessary in order to produce a sustained surplus to drive modernization of the industrial sector.

None of the models adequately explains how the agricultural surplus is to be generated. Indeed, they devote only limited attention to the agricultural surplus, although it is critical to their central thesis. Both Ranis and Fei and Jorgenson argue that agricultural productivity can be increased sufficiently to produce a sustained agricultural surplus through land improvements and other labor-intensive capital formation. In fact, it is now well known that a sustained process of technical change in agriculture requires substantial investments, especially in human capital, and a relatively long gestation period (Hayami and Ruttan 1985, Chapters 5 and 6).

A second shortcoming of the models is the assumption that all the agricultural surplus is available for development of the industrial sector. In fact, demand for a whole series of marketing services such as transportation, storage, wholesaling and retailing increases substantially as resources flow from the agricultural to the emerging industrial sector. This occurs because the income elasticity of demand for such services tends to be relatively high. Thus, a substantial portion of the agricultural surplus is, in reality, drawn off to support development of the services sector which is ignored in the dual-sector and growth-stage models.

A third weakness, explicit in the modern dual-sector models and implicit in the growth-stage models, is the assumption that the industrial sector will generate sufficient new, higher-paying jobs to accommodate labor released from the rural sector. The capital-intensive nature of industrialization generally has limited creation of jobs. Also, industry generally demands skilled labor, and rural labor largely is unskilled. Consequently, many migrants are forced to seek employment in the informal service sector.

Dependency Models

The structuralist model of economic development has been the principal conceptual basis for Ecuador's economic development policy since the late 1950s (see Chapter 2). The model was formulated almost simultaneously but independently by Hans Singer and Raul Prebisch (1950). Prebisch (1959, 1963) and his colleagues at the U.N. Economic Commission for Latin America (CEPAL) developed the theory most completely. Their model focuses on a dependency relationship between developing and developed countries. They argued that there is a tendency for the external terms of trade to turn against developing countries that export primary goods, relative to developed countries that export manufactured goods. This occurs because of low income elasticities of demand in the developed countries for primary goods, and high income elasticities for industrial products in the peripheral countries. They also argued that primary products had to compete in competitive markets while industrial products were sold in monopolistic markets. Finally, they

suggested that productivity growth is much slower in production of primary goods in the periphery than for industrial goods in the center. They concluded that the potential for rapid and sustained economic growth from exports of agricultural products was nil. Their principal policy prescription was for developing countries to promote domestic production of imported industrial products as a much more viable development model.

The Prebisch-CEPAL structuralist model of development attracted considerable attention, especially in Latin America, where it has been followed almost dogmatically. Prebisch (1981) has since modified his views about import substitution.

Other dependency models also are relevant to Ecuador because they tend to be identified with and reinforce the policy implications of the structuralist model. The neo-Marxian dependency model, developed about the same time as the structuralist model, also focuses on the economic relationship between the developed center and the underdeveloped periphery (Baran).[3] It argues that the developed center extracts resources from developing countries of the periphery as they become integrated into the world economy. In this view, exportation of advanced technologies from the center results in the development of a coalition in the periphery of newer industrial-commercial interests with the traditional, landed class. This new power group controls the economic and political system, and the majority of rural and urban workers are isolated and oppressed.

DeJanvry (1975, 1981) has proposed a dependency model of generalized rural poverty and agricultural development in Latin America along the general lines of the neo-Marxian dependency model. He conceptualizes three levels of exploitation that result in marginalization of the rural poor: (a) the center exploits the periphery through trade of industrial goods for raw materials, à la the structuralist model; (b) the emerging industrial-commercial sector of the periphery exploits the subsistence sector and laborers in agriculture; and (c) landlords exploit subsistence farmers and laborers. He argues that farmers are increasingly marginalized by the process of modernization and incorporation in the market economy. He also argues that a coalition of industrial interests and landlords control the political and economic power and conspire to exploit the rural poor.

The DeJanvry model has been criticized on several grounds (Schuh 1984): there is serious doubt that the terms of trade has deteriorated[4]; the labor theory of value, which DeJanvry implicitly assumes, has been generally and widely discredited; trade has evolved principally between the center countries, not between the center and the periphery, which pattern raises serious questions about the predictive power of the model; the substantial political power of urban wage groups throughout Latin America vis-à-vis DeJanvry's industrial-agricultural elite is ignored; the large masses of rural workers are unskilled and have little value to the industrial sector, which requires highly skilled workers; the foreign exchange constraint was not imposed from abroad but was internally generated by a policy matrix that subsidized import-substitution industrialization and neglected the traditional export sector during a period when world trade was growing rapidly; the lag in technological development of the periphery was largely self-imposed and not the result of collusion among the center countries which have had a high degree of competition in research and development; labor services can be made more inexpensive by increasing labor productivity which would have been in the interest of DeJanvry's supposed industrial-agricultural coalition; and high rates of population growth, which explain much of the lag in per capita income of the periphery, are treated superficially. Perhaps the most serious weakness of the DeJanvry model is its failure to clearly specify policies for modernizing agriculture

and integrating marginalized rural people into the economy.

The principal conclusion of the dependency models is that rapid and sustained economic growth is possible only by constraining commerce with the center, and focusing on development of a modern industrial sector based on internal markets.

Notwithstanding the serious weaknesses of the various models discussed above they have contributed to a better understanding of the development process. Dependency theories focus on trade as one of the important sources of economic growth and development. They also clarify that social and institutional structures are important determinants of the distribution of the gains from trade and of overall social welfare occasioned by trade. These are important factors which the dual sector and growth stage models ignored. The dual sector models provide substantial insight into the interrelationships between the traditional and modern sectors of the economy and especially intersector labor markets. They also correctly identify the critical role of the agricultural surplus in fomenting overall economic development. The dependency models failed to address these important elements of the development process. While the various theoretical constructs discussed above each have enhanced understanding they failed individually and collectively to identify appropriate policies for more rapid and sustained agricultural and economic growth. This failure is due mainly to their simplistic natures and the lack of empirical foundation for many of their questionable assumptions.

Ensuing Strategies and Results

The synthesis of the structuralist and neo-marxian models of dependency and the growth-stage and dual-sector models has provided a foundation for broad-based political support for autonomous, internally-focused growth strategies throughout Latin America and much of the developing world for most of the period since World War II. The principal feature of such strategies has been the development of a highly protected, modern industrial sector to produce previously imported consumer durables for the internal market. A second feature has been the isolation of the economy from international economic forces with reliance on growth from expansion of internal markets. A third generalized feature has been the socialist orientation of ambitious welfare and labor legislation that attempts to assure the well-being of poor and disadvantaged groups. Such strategies generally have ignored and depreciated the role of agriculture and tradeables as a basis for more rapid growth because of the weaknesses and shortcomings of the intellectual abstractions underlying these strategies.

Several Latin American countries which adopted import-substitution industrialization in the 1950s had experienced disappointing results from this development model by the mid-1960s (Hirschman). Stagnation occurred as import-substitution opportunities were exhausted and internal markets saturated. Employment generation also was much lower than expected despite initial rapid growth.[5] Subsequently, these countries modified their development policies and have moved toward externally-oriented growth strategies with much greater reliance on agriculture.

Ecuador has followed this general pattern but has lagged well behind other Latin American countries in introducing necessary policy reforms. Macroeconomic policies improved during the 1980s and significant reforms were proposed in early 1990 for implementation during 1990-1993. However, the country still employs an inward-oriented development strategy based on import-substitution

industrialization as its primary development model at the beginning of the 1990s, with significant political opposition to the proposed reforms. As a consequence, Ecuador's agricultural development and economic growth continue to be constrained, as agriculture still is taxed to subsidize the industrialization process and urban people (see Chapter 2).

Ecuador's agricultural sector could have and can yet play a much greater role in more rapid, sustained and equitable economic growth and development. The next section briefly reviews the role of agriculture in the development process and the nature of the agricultural surplus. Then the necessary and sufficient conditions for producing a sustained surplus are set forth in the light of new conceptual and empirical knowledge about agriculture's role in economic development.

III. The Agricultural Surplus

Development of a modern agricultural sector capable of contributing to overall economic growth is a dynamic process whereby the efficiency with which food and fiber products are produced and marketed is increased. Public investment is essential to increase the productive capacity of the sector, to improve efficiency in product and factor markets, and to provide basic social services--especially effective education--if the sector is to be modernized. Provision of these public services induces increased private investments in production and marketing and in the host of service sector activities associated with them. As a consequence of such investments, the productivity of the agricultural sector increases and the intersector flows of products and factors is facilitated.

Sustained increases in productivity in the agricultural sector result in what economists have referred to as a "surplus" to facilitate development of the modern sector (Ranis and Fei; Jorgenson 1961, 1966; Nicholls). Increases in productivity cause the supply of agricultural commodities to increase faster than demand. Prices of food and fiber fall and the internal terms of trade (the price of agricultural products relative to nonfarm products) shifts against the agricultural sector.[6] The falling prices of agricultural products put pressure on owners of resources to shift them out of the sector, and cause the real incomes of consumers to increase.

The agricultural surplus consists of two main components: (a) redundant resources in agriculture; and (b) increased real incomes. Both components are fundamental to the development process because they provide a source for shifting resources to the nonagricultural sector in support of general economic development, without reducing agricultural output.[7] However, if transfers of resources are to have maximum impact in the nonfarm sector, careful attention must be paid to rural people.[8] Labor is the most important factor of production in agriculture in developing countries, but many rural people are illiterate and unskilled. If such people are to find more remunerative employment outside agriculture and the informal sector in urban areas they must be provided with marketable skills. Also, careful attention must be given to improving the efficiency of intersector labor markets.

Redundant resources result from decreasing prices of agricultural goods and tend to become relatively more valuable in the nonfarm sector than in agriculture. Owners of such resources must seek alternative employment outside agriculture if they are to earn the same return as before the sustained technical changes began. Subsequent resource transfers facilitated by public investments (such as education) lead to increased levels of production in the economy. The surplus

derived from redundant resources may be viewed as the increase in product value that can be obtained if labor and other resources are utilized in their best alternative outside agriculture.

Increases in real income, the second component of the agricultural surplus, tend to be realized in both urban and rural areas. In urban areas, increases in real income result from decreases in the price of agricultural products. Since the demand for these products tends to be price inelastic, expenditures decrease as prices fall. The savings occasioned by reduced agricultural prices also may be viewed as an increase in the real income of urban consumers. Since agricultural products are the most important wage good for the majority of urban consumers in a developing country, the increase in the real income of the average consumer can be substantial.[7] This increased income is available for purchase of wage and investment goods produced in the nonfarm sector, and more desireable agricultural products. The result is an increase in demand and investment in those sectors with increased markets and more rapid development.

In rural areas, decreases in the price of food and increases in productivity both affect real incomes. Just as in urban areas, decreases in the price of food tend to reduce the expenditures for food in rural areas and increase the real income of the rural consumer. Since rural consumers are almost always producers, however, their incomes are simultaneously being reduced by decreasing prices (induced by technical change). Thus, increases in income from decreased food costs tend to be offset by decreases in farm revenues. Technical changes, however, will cause costs of production to fall faster than farm revenues, especially for early innovators. The combined effect will result in increased real incomes for rural producers who adopt the cost-saving technologies. Others will be under some pressure to seek alternative employment for their resources as falling revenues are likely to swamp the lower food costs.

Increased incomes in the rural sector also can be invested or used to purchase consumption goods. The impact of such increases in real incomes can be significant in view of the large proportion of the population concentrated in the agricultural sectors of most developing countries. When combined with the increases in urban incomes, the increase in demand from falling food prices due to technical innovations in agriculture can be substantial. Rising real incomes in both rural and urban areas leads to broader and deeper national markets and contributes to the development of the services and industrial sectors.

The production of an agricultural surplus has three other implications for economic development. First, price decreases tend to shift the distribution of income in favor of the low-income masses, who normally constitute a majority of the population. This happens because low-income people spend a larger proportion of their income on food than the more well-to-do. Second, the nutrition of the population tends to improve as consumers gain access to foods with needed nutrients that were previously too expensive. The improved health of the population can lead to further increases in productivity and production. Third, products of the agricultural sector become more competitive in the world market with subsequent increases in exports, domestic production of previously imported products, and increased foreign exchange earnings.

Most developing countries are characterized by a relatively large agricultural sector with low levels of productivity. The conclusion drawn here is that modernization of agriculture and production of a surplus in such countries can contribute substantially to an improved rate of economic growth, and a more equitable distribution of income. As noted above, past development models and associated strategies generally have recognized the importance of agriculture and

the agricultural surplus. They have failed, however, to explain how such surpluses are generated.

What are the conditions for producing sustained increases in agricultural productivity, and an agricultural surplus? The next section considers a body of new theoretical and empirical knowledge about agricultural development that addresses this question.

IV. Generating a Sustained Surplus: Modern Perspectives

A substantial body of new theoretical and empirical knowledge about agricultural growth and overall economic development has been developed during the last two decades.[10] This body of knowledge provides much better understanding of the nature of agricultural development and of the policy variables which affect modernization of the sector. It also contains a much clearer explanation of the importance of agriculture in fostering economic development. Increases in agricultural productivity and market incentives are identified as critical elements for generating an optimum rate of economic growth. Concurrent development of the various sectors of the economy, rather than dependence on a leading sector, also is recognized as necessary for rapid and sustained economic growth by most development scholars.

This section briefly reviews three major, interrelated elements of this new set of knowledge, including: (a) a theory of induced agricultural development proposed and refined by Hayami and Ruttan (1971, 1985) which focuses on technical and institutional change; (b) the effects of macroeconomic and sectoral policies on agriculture based on a substantial number of theoretical and empirical studies principally by South American economists (Valdés) and the World Bank (Krueger, Schiff and Valdés 1988); and (c) the implications of the emergence of an international economy for developed and developing countries (Schuh 1987, 1986, 1976 and 1974). These new theoretical constructs and empirical findings provide the principal conceptual bases for the analysis which follows in the rest of this assessment.

Induced Innovation in Agriculture

Yujiro Hayami and Vernon W. Ruttan (1971, 1985) have proposed a general theory of induced agricultural development, which builds on and extends the seminal work of Schultz. Their model of agricultural development is widely accepted and their book is considered a classic by agricultural economists (Johnson). Schultz, in what has come to be known as the "high-payoff input model" (Hayami and Ruttan 1985, pp. 59-62) hypothesized that poor farmers in developing countries allocate their meager resources efficiently and are constrained by traditional technologies and poverty. Consequently, little or no gains are to be had from reorganizing traditional factors of production. He further argued that agricultural technologies generally are highly location specific and cannot be readily transferred among countries. Schultz suggested that rapid increases in agricultural output can be obtained primarily from technical changes, and utilization of more modern factors of production, which form part of the package of inputs necessary to adopt the improved technology.

The policy implications for agricultural development of the high-payoff input model are threefold: (a) development of a publicly supported science base for agriculture which can produce and extend flows of new technology; (b) production

of modern inputs which incorporate and complement the new technical knowledge; and (c) education of farmers so that the new technical knowledge can be adopted and utilized. The various hypotheses of the high-payoff input model have been exhaustively tested and generally supported by a large number of empirical studies. Returns to investments in agricultural research, extension and education have been shown to be uniformly high in both developed and developing countries for a variety of individual crops and in aggregate (Evenson, Waggoner and Ruttan; Lockhead, Jamison and Lau; Huffman). Farmers of all economic classes around the world generally have been found to be efficient allocators of factors of production.[11] A significant literature about principles of organization and management of agricultural research, both nationally and internationally, has evolved (Arndt, Dalrymple and Ruttan; Pinstrup-Andersen; Ruttan). This latter body of knowledge strongly supports Schultze's intuitive premise that agricultural technologies are location specific, and not easily transferred.

The high-payoff input model clearly has had a substantial impact on agricultural development strategies in many developing and developed countries around the world. The principal contribution of the model is the identification of specific investment targets for increasing agricultural productivity. The model, however, treats technical changes as exogenous, and fails to explain how technical changes are induced, especially in the public sector. The Hayami-Ruttan model of induced innovation in agriculture incorporates all the elements of the high-payoff input model, but treats technical changes as endogenous to the sector. In their conceptualization, innovations occur in the public as well as the private sector in response to price signals from the product and factor markets. Furthermore, interactions occur between technical changes and institutions, with induced institutional innovations allowing individuals or groups to internalize returns from technical progress. Finally, in dynamic sequences of technical change and economic growth, technical progress that resolves one critical constraint often leads to another kind of bottleneck with a resultant induced innovation to resolve that bottleneck.[12]

The principal challenge of successful agricultural growth in the Hayami-Ruttan model is to attain an efficient path of technological change which saves the relatively scarce factor of production. In their model, technical changes permit substitution of abundant resources for those in scarce supply. If labor is the limiting resource in the development process then an efficient path of technical change must be labor-saving. Innovations are generally mechanical in this case, and permit machines and capital to substitute for labor thus increasing the use of land and raising the productivity of labor. In essence mechanical innovations permit abundant land to be substituted for scarce labor. If land is relatively limited and labor is in abundant supply, then innovations must save the scarce land. Chemical-biological innovations will permit various technical inputs (such as improved seeds and fertilizers) to substitute for the scarce land, thus increasing its productivity and the use of relatively abundant labor. Thus, chemical-biological innovations permit abundant labor to be substituted for scarce land.

In the induced innovation model of agricultural development, an efficient path of technical change reflects the original endowment of res ces, and changing relative prices of products and factors. Farmers seek technologies which save the scarce (expensive) factor and reduce their costs. They turn to both public research agencies for improved technologies and to the commercial-industrial sector for modern inputs which can substitute for the limiting factor. Public sector researchers are induced to work on the technological constraints, and the private commercial-industrial sector to produce modern technical inputs which incorporate

and complement new technical knowledge. This process results in what Hayami and Ruttan (1985 pp. 133-37) conceptualize as a meta-production function which permits the continuous and sustained substitution of new technical knowledge and inputs for the scarce factor of production.

The induced innovation model provides several new insights about agricultural growth and overall economic development. Perhaps most important is that transition from a natural resource-based to a science-based agriculture is the sine qua non of both agricultural and overall economic development. There are several policy implications associated with this finding: (a) substantial resources will be required to develop a viable system capable of producing, extending and adopting continuous flows of new technical knowledge because it is a very capital intensive process; (b) human capital at scientific, technical and general levels must comprise a significant part of the investment in the agricultural science base; (c) the public sector will have to undertake most of the investments in research because the efficient path of technical change for most developing countries is chemical-biological in nature, and private investors generally cannot internalize the gains from such research; and (d) organization and management of the public science base for agriculture will be a major challenge and of critical importance to achieving more rapid growth, given the alternative, multiple paths of possible technical innovation.

The induced innovation model also confirms the now generally held view among development economists that transfers of the agricultural surplus to the nonfarm sector are essential for high rates of economic development. An equally important but seldom discussed implication is that the use of the agricultural surplus to develop the nonfarm sector has a major, direct effect on the rate of economic growth. In the words of Hayami and Ruttan (1985 pp. 440-41):

> In many developing countries, the income streams generated in the agricultural sector have been used to purchase a nonviable industrial sector or a nonproductive military and administrative bureaucracy....The experience of the last several decades indicates that although it may be easy for poor countries to acquire an industrial sector that produces manufactured products that were formerly imported, it is much more difficult to purchase an industrial sector that is capable of making a sustained contribution to income streams comparable to those generated by the agricultural sector.
>
> If the intersector income transfers resulting from technical change in agriculture are to result in a cumulative contribution to economic growth, the new sectors purchased by these transfers...must be capable of producing the new industrial materials needed to sustain the process of agricultural development.

The policy implication is clear: economic development policies must recognize the interdependencies of the various productive sectors and exploit the comparative advantages of each, if the rate of economic growth is to be maximized.

The third key finding of the induced innovation model is the important role of market forces in inducing both technical and institutional change. Price distortions in product and factor markets resulting from government policies and interventions have limited the prospects for more rapid and sustained agricultural and general economic growth. These distortions have constrained opportunities in the public and private sector for technical change and in many countries have constrained the possibility of moving onto an efficient path of technical change. The pricing system must reflect the actual scarcity of products and factors in

allocation decisions of public and private sector officials if an efficient path of technical change is to be attained. The policy implications are clear: a more modern system of factor and product markets must be developed with government support for improved information and communication, grades and standards, and transportation and storage within and among principal economic sectors; and distortions and subsidies inherent in misguided public policies must be removed by adopting a more rational macroeconomic and sectoral policy matrix.

While the induced innovation model of agricultural development does recognize the negative effect on agriculture of overvalued exchange rates, and price and interest rate controls, the effect of macroeconomic and sectoral policies is not formally incorporated into the model.

Macroeconomic and Sectoral Policies

There is a large and growing body of evidence that the macroeconomic and agricultural sector policy matrix utilized by many developing countries during the last few decades significantly constrained public and private investments in agriculture. These countries almost uniformly adopted policy matrices to promote import-substitution industrialization and self-reliant growth. Principal macroeconomic policies included: overvalued exchange rates; protection of domestic industry through tariff and non-tariff barriers to trade; direct subsides to industry and commerce including tax exonerations and subsidized credit; and highly subsidized importations of capital equipment and intermediate goods.[13] Such countries simultaneously maintained a set of negative sectoral policies for agriculture including: price ceilings for most food and fiber products, which translated into low producer prices; taxes on exports of primary agricultural products; export prohibitions; state interventions in product and factor markets; and taxes on imports of agricultural inputs in some cases. Finally, such countries also attempted to help agriculture by subsidizing credit and other inputs and through investments in irrigation, storage and transportation infrastructure; land reform and titling; and research, education and extension.

The World Bank has recently completed an exhaustive review of the effect of macroeconomic and sectoral policies on agriculture in 18 countries around the world for the period 1975-84 (Krueger, Schiff and Valdés 1988). Included are Argentina, Brazil, Chile, Colombia, the Ivory Coast, Dominican Republic, Egypt, Ghana, Republic of Korea, Malaysia, Morocco, Pakistan, the Philippines, Portugal, Sri Lanka, Thailand, Turkey and Zambia. These countries represent a wide range of development and all the principal low-income regions of the world. Each country was studied independently by different researchers who utilized a common methodology to provide comparability.[14] Each study empirically measured the effect of direct sector-specific policies (both negative and positive), and of indirect, economy-wide macroeconomic policies on agricultural incentives for principal exportable and importable agricultural products. The impact is measured relative to what prices would have been with a free-trade regime and no direct sector interventions (either positive or negative). The reference price is the border price for all tradeables, appropriately adjusted for various marketing costs.

The results indicate clearly that sectoral and macroeconomic policies have discriminated substantially against agriculture in almost all the countries studied. The net effect of direct, positive and negative sectoral policies was equivalent to a tax on exportables (-11 percent on average) and to a subsidy to importables of 20 percent. Thus, direct sector policies favor importable agricultural commodities while depressing incentives for exportables. The indirect effect of macroeconomic

policies taxes both exportables and importables at about the same magnitude (-29 and -27 percent, respectively). The indirect effects are relatively large and dominated the direct effects. Moreover, the total effect, on average for the 18 countries, taxed both exportables (-40 percent) and importables (-6 percent). Thus, the average price of exportables is only about 60 percent and of importables is 95 percent of what would have existed under a free-trade macroeconomic policy matrix and no direct sector interventions.

These results conclusively demonstrate the pervasive and dominant effect of indirect, macroeconomic policies over sector policies for both exportable and importable agricultural commodities throughout a large number and wide variety of developing countries. Producers of agricultural exports have suffered significant reductions in incentives, both from direct sector interventions and especially from macroeconomic policies. Producers of importable agricultural commodities have been the recipients of relatively large subsidies from direct policies, only to have these eroded and swamped by indirect policies.

These results illustrate a puzzling anomaly, raised by Krueger, Schiff and Valdés (1988 p. 264): "...agricultural producers often have larger interests in macroeconomic policies than they do in agricultural pricing policies, yet their representatives usually concentrate on the latter." They suggest a partial answer is in the search by consumers of importables and by producers of exportables for internal price stability. However, the magnitude of the disincentives from indirect policies is so great that farmers surely would be greatly concerned if they clearly understood the negative impacts of such policies. The knowledge base about the effect of indirect and direct policies on agriculture is quite new. It is very likely that many farmers do not understand the effect of such policies. Moreover, the urban-commercial-industrial elite, who benefit from directly from the subsidies inherent in such policies, are a strong political coalition which likely would vigorously resist attempts to change the status quo.

There are two other important studies which strongly support the conclusions of the World Bank studies. Valdés provides a summary of the effects of commercial and macroeconomic policies on agricultural growth for South America. He sets forth a valuable methodological contribution by focusing on the real exchange rate, and provides results for Argentina, Brazil, Chile Columbia, and Peru from several empirical studies.[15] He concludes that agriculture throughout South America has been constrained by inappropriate macroeconomic and commercial policies. He suggests that diversification and expansion of exports may be the most important structural adjustment facing South America. Valdés argues that taking advantage of the opportunities for growth in the international economy, especially for agriculture, will require an alignment of the real exchange rate to stop taxing the sector.

Finally, there is evidence from eight South American countries that agriculture responded positively to post-1982 adjustments in their macroeconomic policy matrices (IICA). These policies were changed in a series of structural adjustments that became necessary after the onset of the international debt crisis in mid-1982, and because of low growth rates and stagnation. These adjustments corrected distortions and reduced or eliminated disincentives associated with import-substitution industrialization and internally-oriented growth strategies. While the response of each of the eight countries has been somewhat different, all tended to experience increases in agricultural growth. One principal conclusion of the study is that the macroeconomic policy matrix should continue to be modified in order to eliminate the anti-agricultural policy bias that has existed for decades. The study (IICA p. 13) recognizes the: "...high supply-response capacity of the

agricultural sector to favorable macroeconomic policies, basically an increase in the real effective exchange rate and free market internal prices." (Translation by author.)

Sector policies will become much more important once macroeconomic policies have been rationalized. Improvements in macroeconomic policies will provide the greatest increase in incentives to agriculture and of about equal magnitude to exportables and importables according to the results of the World Bank studies. Substantial increases in incentives then can be realized through appropriate positive sectoral policies since their effect will not be dampened and swamped by discriminatory macroeconomic policies or negative sector policies. The net effect of past positive and negative sectoral policies in the 18 countries studied by the World Bank was to modestly tax exportables and to heavily subsidize importables. These data suggest policymakers will need to be especially careful to introduce more neutral positive sector policies as macroeconomic policies are rationalized and negative sector policies are eliminated.

Extracting resources from agriculture through macroeconomic and negative sectoral policies when no surplus is being produced contributes to an increase in the real internal terms of trade in favor of agriculture (that is, an increase in the shadow price of agricultural commodities relative to non-agricultural products). In this situation there would be pressure for resources to flow into agriculture, if markets were allowed freely to perform their allocation function. Government policies which extract resources from agriculture in such a situation lead to an even more inefficient allocation of resources. The main criticism noted here is that such a policy matrix is not extracting surpluses nor can it stimulate surplus production. While it does extract resources, the real internal terms of trade are turned increasingly in favor of agriculture. The existence of discriminatory macroeconomic and sectoral policies implies that agricultural surpluses do not exist, and that agriculture is bearing an unduly heavy tax to support the nonfarm sector. In the long run, such a policy matrix reduces the well-being of all consumers.

An Emerging World Economy

A truly international, global economy began to emerge after World War II, and now is growing vigorously. The world economy is substantially different than it was even in the early 1960s, with increasingly interdependent economic relationships and greater specialization among nations. The reality of the new international economic order, and the high probability that it will continue to grow and develop, has significant implications for both developed and developing countries. Macroeconomic and sectoral policies must be consistent with the realities of the international economy if national economies are to maximize their rate of economic growth and development.

A key factor which appears to underlie the emergence and growth of the international economy is continuing technological innovation in information. Rapid scientific advances in communications and computers have substantially reduced the costs of producing, analyzing and transmitting information. This has resulted in the development of a global communications network in which people in every nation are regularly informed of events around the world.

There have been significant changes in the international economy during the past few decades. These changes have impinged directly on almost every country of the world and especially those with relatively open economies. Schuh (1987, 1986, 1976, 1974) has identified several major changes and analyzed their impact on the U.S. economy.[16] The rest of this section summarizes four of Schuh's main

findings and their implications for developing countries in their quest for more rapid and equitable economic growth.

First, there has been a substantial increase in international trade throughout the world, with especially significant increases between the developed countries. Dependency on imported foreign goods increased in most countries throughout the period. Concomitantly, exports increased rapidly, especially in countries that exploited economic growth potentials inherent in the emerging international marketplace. Several countries that were underdeveloped in the early 1960s have graduated into the status of newly-developed countries by exploiting their comparative advantages in the rapidly growing international economy. Others have experienced much slower development as they have followed internally-oriented growth strategies. Almost all countries, however, are much more open than they were twenty-five years ago, and some have experienced quite remarkable changes from basically closed to highly open economies. The expectation is that international trade will continue to grow, and that major opportunities for economic growth for both developing and developed will lie in the international market place.

A second major change is the emergence of a pervasive, well-developed international capital market based, at least in part, on advances in communications technology. The size of the market is phenomenal, at U.S.$42 trillion in 1984 compared to U.S.$2 trillion in international trade (Schuh 1987, p. 2). This market has grown very rapidly and still appears to be expanding. It essentially functions in an international environment, unconstrained by national boundaries. It provides access to the huge pool of international savings for investors in those countries which are willing to recognize and abide by the market forces which allocate capital in the global marketplace. But countries which have erected barriers to the free functioning of this market have found themselves penalized in terms of capital flight, reduced access to international lending and lower credit-worthiness.[11]

Third, there have been major and dramatic changes in comparative advantage of nations and regions. Moreover, changes in comparative advantage are continuing and apparently at a faster pace. Reference has already been made to the emergence of the newly developed countries, primarily of the Far East. Major industries from steel to automobiles to textiles have moved from the older industrialized countries of Europe and especially the U.S. to Japan, and thence to the Republic of Korea, Taiwan, and then to Brazil and Mexico. One can predict that such industries, which depend on cheap labor, and utilize technologies that are not location specific, will continue to be on the move.

Significant resources are being invested in research and development activities oriented to develop comparative advantages vis-à-vis the international marketplace in a large number of forward-looking developing and developed countries. For example, institutional innovations in agricultural research have resulted in the rapid development of thirteen truly international agricultural research centers, focused on assisting developing countries. These centers have developed improved technologies for tropical food crops, which tend to be location specific. Several developing countries simultaneously have strengthened their own capacity for agricultural research. The end result of all of these efforts, in agriculture, manufactures and services, will be continuing shifts in comparative advantage that will result in significant reallocation of resources among countries, and changes in the mix of products and factors within countries. In short, competition in the international economy will become more and more intense, and economic integration greater and greater in the years ahead. Those countries which adopt policies to exploit what appears to be a secular change in international specialization will experience substantially greater growth rates and economic

progress than those which adopt inward-oriented policies.

A fourth major change documented by Schuh has been the abandonment of the system of fixed exchange rates in 1973. A system of floating exchange rates for the major currencies of the world has been adopted, with other currencies tied to the major currencies. Many people in both the developing and developed world pay little attention to the value of their currency in foreign exchange markets. However, as trade has expanded, and the size of the capital market has burgeoned, the exchange rate has become one of the most important prices in the economy. When this price is modified by overt government policy, the distortions introduced will result in misallocation of significant resources relative to opportunities in the international market. The result, again, will be constrained rates of growth and failure to exploit comparative advantages in the growing international market.

The new international world economy developed quite rapidly during the last 25 years, and the rate at which it is growing and maturing appears to be accelerating. The future obviously can not be predicted with much precision, especially in the longer term. The recent, rapid changes in the international economic order presage, however, continuing integration of national economies into the emerging international economy. The end result of a continuing integration would be eventually a world-wide economy, with fully integrated markets. The rate a which such integration will take place probably will quicken, although the process likely will be characterized by spurts and lapses rather than a smooth continuum. The technological changes which have driven the substantial integration on the last twenty-five years can be expected to continue. Certainly the extent of technical innovation and resultant international economic integration to date would have been difficult to predict in the early 1950s, when most nations existed quite independently.

One of the most important lessons from recent changes in the international economy is that domestic economic policies are increasingly unable to modify the effects of international market forces with impunity. In short, policy makers are becoming subject to economic forces largely beyond their control as world markets emerge. Those nations which attempt to insulate their economies from these pervasive and growing international economic forces will pay a high price in terms of foregone growth and development. Such attempts will consign them to a low-growth path and may cause them to fall permanently behind competitor nations in the race for greater productivity and market shares. Other more enlightened countries which develop policies to exploit significant investment opportunities inherent in the increasingly rapid integration of the world economy will experience much greater rates of growth. Some can be expected to emulate the recent experience of the newly developed countries.

This is not to suggest that policymakers should not be concerned with moderating the impacts of adjustments as a country moves toward an increasingly open economy. It may be economically rational to implement policies which help to stabilize price fluctuations while recognizing that domestic policy can have little effect on secular price levels determined in the world market place. Commodity price policy is a case in point. While recognizing the advantages of trade at international prices Mellor and Ahmed (Chapter 4) recommend a domestic price stabilization policy for developing countries with commodity prices set in reference to the world price.

V. The Rest of the Assessment

The new empirical and conceptual knowledge set forth above--the induced

innovation model of agricultural development; the effect of macroeconomic and sectoral policies on agricultural growth; and the emergence of a new global economic order--comprise the principal conceptual foundation for the analyses that follow in the rest of this assessment. The next two chapters provide a perspective on agriculture in overall economic development. Chapter 2 presents a review and analysis of Ecuador's macroeconomic and sectoral policies, and provides additional evidence on the negative effects of such policies on agriculture. Chapter 3 provides information on economic and agricultural growth, and assesses how well agriculture has performed in contributing to overall economic growth.

The main body of the sector assessment comprises Chapters 3 through 12, and focuses on analyses of various aspects of agriculture. Chapter 4 treats the role of natural resources in agriculture, analyzes the extent of the agricultural frontier, and presents some new approaches to natural resources policy. Chapter 5 focuses on the demographic characteristics of the population, the nature of the intersector labor market, and rural income and poverty. The production milieu, including production trends and factor use for principal commodities is treated in Chapter 6, while Chapter 7 turns to an analysis of the effectiveness and economic viability of present and future public irrigation and related multipurpose projects. Chapter 8 reviews the agricultural marketing system with special emphasis on government interventions, and Chapter 9 focuses on the market for agricultural credit. Chapter 10 analyzes the role of social institutions in agricultural development, with emphasis on the family and the role of women, and special concern for age and gender issues. Chapter 11 considers the mandates and functions of various public sector institutions serving agriculture, and supporting programs of donor agencies. Chapter 12 turns to an analysis of the human capital and science base serving agriculture, including education, research and extension programs.

The findings of the sector assessment are presented in Chapters 13 and 14. Chapter 13 summarizes the principal constraints which must be addressed through new and revised policies, and the accomplishments which serve as a basis for expected success of modified policies. Chapter 14 presents recommendations for modernizing agriculture and enhancing overall economic growth and development.

NOTES

1. This section considers only those general economic development models that heavily stress industrialization and self-reliant development, the dominant policy thrust of Ecuador during the last three decades. For a more comprehensive review of literature on economic development policy, especially as it relates to agriculture see Hayami and Ruttan (1985 Chapter 1); Eicher and Staatz (Chapter 1); Johnston and Kilby, Johnston, and Mellor. This section draws especially on the insights of Hayami and Ruttan (1985 Chapter 1) and Eicher and Staatz (Chapter 1).

2. Rostow's approach led to the development of several growth-stage models in agriculture. See especially Johnston and Mellor.

3. See Hayami and Ruttan (1985 pp. 33-39) for a more detailed analysis of dependency models.

4. Spraos concludes that there is no evidence of a clear decline in the terms of trade between primary and industrial goods during 1900-1970. He found a declining trend between 1870 and 1930, however.

5. See Whitaker and Schuh for an analysis of the effects of import-substitution industrialization on labor absorption in Brazil.

6. The dual-sector models of both Ranis and Fei, and Jorgenson (1961, 1966) define the agricultural surplus as a shift in the internal terms of trade against agriculture, which indicates that a process of sustained economic growth is underway.

7. This intersectoral transfer has been referred to as a production squeeze on agriculture (Owen).

8. Such intersectoral transfers can be realized either through the market or via public policy instruments. An important question for policy makers concerns the effects of transfers made through alternative public actions on the development process each relative to the pattern induced by market forces. While this is an important issue, it will not be considered here. Rather, the focus will remain on the nature of the agricultural surplus and its importance in the development of the non-farm sector.

9. The degree to which real income of consumers is increased due to decreasing prices of agricultural products depends on two factors. First, the more inelastic the demand for food and fiber, the greater will be the reduction in expenditures as prices fall. Second, the greater the share of the budget of the average consumer spent on agricultural products, the greater the proportional increase in real income from price decreases.

10. Hayami and Ruttan (1985 Part I) and Eicher and Staatz (Parts I and II) each present a substantial review of literature of the role of agriculture in economic development and of models and theories of agricultural development, as they have emerged and evolved in the post-World War II period. These two reference are highly recommended reading for those who wish to gain a better understanding of modern economic thought on agricultural development.

11. See Hopper for a classic example from Asia.

12. For example, original models of grain reapers saved critical harvest labor but led to shortages of labor for raking and binding. This induced invention of self-raking reapers and binders (Hayami and Ruttan 1985, pp. 92-93).

13. The subsidies came both from access to foreign exchange at the overvalued rate, and from exonerations from tariffs or prohibitions for importation of capital and intermediate goods.

14. The country study teams met together in Washington, D.C. during February 1988 to compare and evaluate their analyses. A list of the individual country studies and their authors is presented in Krueger, Schiff and Valdés (1988 Footnote 1, p. 257). A summary of the studies is made in Krueger, Schiff and Valdés (Forthcoming).

15. The studies for Argentina, Chile and Colombia cited by Valdés are by the same authors as for the World Bank country studies, and are precursors of them.

16. Schuh (1987, 1986, 1976, 1974) has provided incisive analyses of the effects of changing international economic conditions on the U.S. economy and particularly agriculture in these four related studies. Most of his findings have equal applicability to any nation facing the challenge of adapting domestic economic policies to the reality of the emerging world economy.

17. Conventional wisdom in South America, and certainly in Ecuador, views the United States and U.S. private banks as the dominant force in this market, à la the neo-Marxian dependency thesis. In fact, the center of gravity has shifted from the U.S. and Europe to the Pacific Rim countries. Japan now has the five largest banks in the world and their combined assets are over three times greater than the five largest U.S. banks. Citicorp, the largest U.S. bank, has only about 60 percent of the assets of Japan's fifth largest bank (Economist, The p. 6).

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CHAPTER

2

DEVELOPMENT POLICY AND AGRICULTURE: AN HISTORICAL PERSPECTIVE

MORRIS D. WHITAKER AND DUTY GREENE

I. Introduction

The process of economic development in Ecuador in this century can be divided into two periods each reflecting substantially different economic development models and their associated macroeconomic and agricultural sector policy regimens: (a) the traditional export period from 1900 to the late 1950s; and (b) the import-substitution industrialization period from the late 1950s to the present.[1] Economic growth in the first period was founded on the export of primary commodities, mainly agricultural products from the *Costa* region.[2] The second period saw economic growth based on industrial development through domestic production of import substitutes.

The import-substitution industrialization period has been heavily affected by two other major economic events: (a) the petroleum boom of 1972-81; and (b) the period of austerity and structural adjustment following the international financial crisis and falling petroleum prices since 1982. The petroleum boom is extremely important in understanding Ecuador's economic and agricultural development. The rapid increase in revenues from petroleum production provided large windfall gains which made it possible to continue subsidies inherent in import-substitution industrialization. The post-1982 period of austerity and adjustment became necessary because of burgeoning public and private expenditures, decreased fiscal revenues and sharply curtailed international credits. More fundamentally, adjustment and austerity became necessary because industrial growth stagnated as internal markets became saturated and import-substitution opportunities were exhausted.

Agricultural growth and economic development have been constrained during the entire 20th century by macroeconomic and sectoral policies which have taxed the agricultural sector. Direct taxes have been levied on agricultural exports

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during most of Ecuador's republican period and were a main source of government revenues until the onset of the petroleum boom in 1972. Macroeconomic and sectoral policies have discriminated against agriculture and tradeables and have subsidized industrial and other home goods. Such policies caused significant distortions in relative prices especially during the import-substitution industrialization era. As a result, the internal terms of trade moved increasingly against agriculture as resources were extracted by government policy from this sector and transferred into the highly protected industrial sector.

Principal macroeconomic policy distortions which have taxed the agricultural sector over the last three decades include: an overvalued exchange rate; a set of tariff and non-tariff barriers that highly protected domestic industry; and subsidized credit and tax exonerations for industry. Principal direct sector policies which have discriminated against agriculture include: taxes on agricultural exports, consumer price ceilings and state interventions in marketing. Other direct policies which have helped agriculture include: subsidized interest rates on agricultural loans; subsidies on fertilizers, rental of farm machinery and irrigation water; construction of roads, irrigation works, storage facilities and other infrastructure; effective price supports for a few crops; and provision of research, extension and education services. The net effect of positive and negative direct sectoral policies and the macroeconomic policy matrix has been to reduce incentives in agriculture in Ecuador (Scobie and Jardine 1988a).

Reduction of many of these policy distortions, starting in mid-1982, has contributed to a modest rejuvenation of agriculture and the highest sustained agricultural growth rates in Ecuador's history (see Chapter 3). The macroeconomic policy matrix and the setting of price ceilings on many food commodities continue, however, to discriminate against agriculture and to favor urban consumers and industrial development. In fact, import-substitution industrialization and inward-oriented growth still are principal elements of Ecuador's economic development model. This approach continues to have many advocates and was proposed as recently as April 1989 to be the basis for reactivating the economy (Martes Económico p. 3).

This chapter reviews the evolution of the principal economic policies of Ecuador during this century and assesses their impact on agriculture. The traditional exports period of 1900 to the late 1950s is described in Section II. Section III focuses on the import-substitution industrialization period from the late 1950s to the present while the petroleum boom of 1972-81 is treated in Section IV. Section V then reviews the subsequent period of austerity and structural reforms from 1982 to the present. The effects of macroeconomic policies on agriculture during the last three decades are discussed in Section VI based on the findings of several key studies. Section VII contains a brief summary.

II. The Traditional Exports Period: 1900 to the Late 1950s[3]

Ecuador's development engine from colonial times to the late 1950s was the exportation of minerals and agricultural commodities, with very limited processing. During the 15th century mining and exportation of gold and silver to Spain were the principal economic activities, although they never achieved the degree of importance as in some other Spanish colonies. Exports of textiles also were important in the early colonial period. Such exports were based on wool with some 750,000 head of sheep reported in the fertile intermountain valleys of Northern Ecuador in 1585. The colonial economy underwent a transition from primarily

mining in the 15th century to agriculture and livestock during the 16th and 17th centuries. Agriculture dominated the economy by the 18th century. Principal crops included cereals and tubers in the *Sierra* region and tobacco, cacao, coffee, sugarcane and lumber from the tropical Guayas River basin near the port city of Guayaquil. Cacao and tobacco became important exports during the last few decades of the 19th century (Hurtado pp. 6-9).

Cacao, coffee and bananas dominated Ecuador's exports during most of this century. Cacao was the principal export crop from the 1860s through about 1920. Production was seriously affected by disease during the latter part of this period which restricted exports. Cacao production recovered after World War II with the introduction of improved varieties and again in the 1970s in response to increasing world prices. Exports of cacao (beans and processed products) increased rapidly during the late 1970s and was the most important agricultural export in 1980.[4] Coffee exports first became important in the late 1920s and represented 17 percent of all exports during the early 1930s, although coffee has been produced since colonial times (Hurtado p. 81). The area planted to coffee expanded rapidly in the late 1960s and the 1970s in response to increased demand and high prices. Coffee emerged as one of the leading earners of foreign exchange during the late 1970s. Banana exports grew rapidly in the early 1950s as weather and disease eroded Central America's near monopoly position in world markets. By the mid-1950s Ecuador was the leading exporter of bananas, a position which it has retained to the present, with the exception of one year of bad weather.

The development model of Ecuador during the 1900s to the late 1950s was production and exportation of primary commodities, principally agricultural. Government programs focused on agriculture, minerals, commerce and industry, with emphasis on technical education, infrastructure and foreign investment. The first 20 years of the century saw continued growth of agricultural exports led by cacao. During this period exports generally exceeded imports and there were large positive balances on the trade account. The advent of serious diseases, declining demand for cacao and trade barriers in the 1910s and 1920s seriously reduced export earnings. Some diversification of exports occurred in the late 1920s and early 1930s, led by coffee but exports did not recover to the levels of the early 1900s until the 1950s. As a result, the economy entered into a period of prolonged recession in the early 1920s which continued until the rapid increase in banana exports in the late 1940s. During the 1920-1950 period the trade balance was rarely positive putting substantial strain on economic development and social programs (Hurtado pp. 70-85).

Macroeconomic and commercial policies tended to discriminate against agricultural and other tradeables throughout the period 1900 to the late 1950s. Fiscal policies, such as taxing agricultural exports, reduced the profitability of investments in agriculture relative to other sectors. Customs duties also were levied on imports; the imports in turn depended on foreign exchange earnings generated by agricultural exports. Such export taxes and customs duties provided the primary sources of tax revenues for financing government programs.

These fiscal policies led to government deficits which were inflationary. Government budgets were in deficit from the late 1800s through the 1920s, despite the relatively large income from export taxes and customs duties, as expenditures exceeded tax revenues. The government deficit is estimated to have been S/.25.0 millions in 1925 and averaged as much as 80 percent of government expenditures in 1914 (Hurtado p. 323, note 42). Deficits were financed by borrowing from private banks which were largely uncontrolled and could issue their own currency and thus increase the money supply. The result was increasing inflation which became

very pronounced after the decline in export earnings in the late 1920s and the early 1930s.

The Sucre was created in 1878 and set at a par with the U.S. dollar and the Ecuadorian peso of 91.67 percent pure gold weighing 1.58 grams (BCE 1986, Part 1, p. 182). The exchange rate remained at par until the mid 1910s when disease decimated cacao exports and foreign exchange reserves were eroded. The Sucre became increasingly overvalued and had to be successively devalued to maintain the competitiveness of the country's exports. The Sucre had fallen to 2.15 per dollar by 1913 when the effects of the cacao disease began to be felt. The exchange rate appreciated to 2.25 in 1920, 5.00 in 1926, 10.80 in 1934, 13.50 in 1949 and 15.00 in 1951 (Hurtado p. 82; BCE 1977, p. 44).

Agricultural exports were taxed and imports were subsidized implicitly with the overvaluation of the Sucre. As the Sucre became increasingly overvalued the prices of Ecuadorian tradeables fell relative to those of home goods. The incentives to produce tradeables were increasingly reduced because of decreased Sucre earnings from exports and relatively lower prices for imported products vis-à-vis locally produced substitutes. The loss of part of Ecuador's share of the world cacao market to other competitors during this period may have been as much the fault of exchange rate policy as the effect of diseases.

The world prices of coffee, bananas and cacao and other primary goods fell toward the end of the 1950s due to rapidly increasing suppiles relative to demand (Rosero de Cevallos pp. 1-3). The result was a reduction of both foreign exchange earnings and government revenues which were derived mainly from export taxes and customs duties. Concomitantly, demand for imported industrial goods and scarce foreign exchange was growing in both the public and private sectors. The decrease in foreign exchange earnings coupled with increased demand for imports led to a growing trade deficit which resulted in an increasingly overvalued Sucre at the fixed exchange rate that had prevailed since 1950 (S/.15/US$1). The fiscal situation also worsened which put greater inflationary pressure on the Sucre. In 1960, Ecuador devalued its currency from S/.15 to S/.18 to the U.S. dollar in an attempt to increase its export earnings and to reduce imports.

As the prices of primary goods fell the prices of imported industrial goods, produced mainly in developed countries, were increasing. Thus, the external terms of trade between Ecuador and the developed world deteriorated in the late 1950s, just as it did for many developing countries which were exporters of primary goods.

III. Import-Substitution Industrialization: Late 1950s to the Present[5]

The shift in the external terms of trade against Ecuador's primary exports, with the resulting overvaluation of the Sucre and loss of government revenues, precipitated a major and significant change in development policy by the government. A strategy of promoting growth of the industrial sector as the primary basis for rapid and equitable economic progress was adopted in 1957 (Rosero de Cevallos p. 3). This strategy focused on growth of domestic industry and internal markets by protecting selected products and firms from international competition with trade barriers and by cheap food policies.[6] Import-substitution industrialization and internally-oriented growth have been the principal elements of Ecuador's economic development model since the late 1950s to the present. Economic growth was especially rapid during the mid-1960s through 1981, a period that corresponded closely to the petroleum boom. Even though growth has been

very slow since 1982, the underlying development model has not been fundamentally altered.

In 1957, Ecuador adopted the Law of Industrial Incentives (World Bank 1987, p.13; Rosero de Cevallos p. 3) which formed the initial basis for a heavy thrust into import-substitution industrialization. The incentives introduced in this law were reinforced and extended in the Industrial Development Law of 1962, and further refined in 1971 (Rosero de Cevallos pp. 1-12) and in 1985 (World Bank 1987, p. 13). Tariff and non-tariff barriers were established to protect the domestic production of consumer goods. Relatively low tariffs or exonerations were provided for raw materials, intermediate and capital goods imported for use in protected industries. Relief from income and other taxes also was given to protected industries. Finally, subsidized credits also were made available to import-substituting industries.

A dual exchange rate has been maintained throughout most of the 1950-90 period. From 1960 through 1970 all foreign trade was pegged at the official rate of S/.18/US$1. A somewhat higher free market rate was in effect for all other transactions. The official exchange rate became increasingly overvalued during the 1960s and was devalued to S/.25/US$1 in 1970. The same pattern occurred in the 1970s and the official rate was again devalued in 1982 to S/.33.15/US$1. The exchange rate policy resulted in underpricing of tradeables (both exports and import substitutes) and clearly discriminated against agricultural producers. It also provided additional subsidies to imports and especially favored imports of industrial inputs which were generally free of tariffs and other non-tariff trade restrictions.

Incentives in agriculture also were reduced by several negative direct sectoral policies during the late 1950s through 1982. Taxes on exports of agricultural products were maintained throughout most of this period, even after the advent of the petroleum boom in 1973, as agricultural exports were seen as a primary source of taxable income. Consumer price ceilings were in effect for many agricultural products during much of the period as part of a cheap food policy. And the government intervened in agricultural product and factor markets, especially after the petroleum boom began, in an effort to reduce marketing costs.

The government did provide some limited direct assistance to the agricultural sector during the import-substitution era, which tended to improve incentives. This took the form of investments in irrigation, transportation and some marketing infrastructure; provision of research, education and extension services; subsidized credit and other inputs such as fertilizers and machinery; price supports for a few crops; and a modest land reform program. In the 1960s, direct government policies and programs focused mainly on diversification into the production of food crops and livestock products instead of traditional export crops as their prices fell in world markets. This strategy was reversed in the 1970s as prices for principal export crops increased rapidly. The government responded by increasing public expenditures to support production of export crops. For example, publicly supported research and extension efforts, with primary focus on introduction of higher-yielding varieties and disease and insect control, resulted in increased competitiveness and capacity in coffee, cacao and bananas (Ruff).

Overall, the net effect of the set of macro-economic and sectoral policies in Ecuador was to turn the internal terms of trade against agriculture and other tradeables and towards non-traded, protected industrial products and other home goods (Vos p. 1123; Scobie and Jardine 1988a, 1988b). These policies extracted resources from relatively backward rural areas for development of the rapidly modernizing urban-industrial centers, especially Quito and Guayaquil.

What is often ignored by apologists for import-substitution industrialization

in Ecuador is that the small-farm sector, comprising the largest single group of poor people at the time, bore much of the onerous burden of this policy approach. The *campesino* sector, along with other more prosperous farmers, transferred substantial labor and capital to the more well-to-do urban centers. The dominant development model concentrated growth in income and wealth in urban areas, which tended to worsen the distribution of income between rural and urban people and leave rural areas more impoverished (Vos pp. 1130-31).

IV. The Petroleum Boom: 1972-1981[7]

The petroleum boom was an exogenous event that made it possible to sustain rapid economic growth via the import-substitution industrialization model during the 1970s and early 1980s. The effect of the petroleum boom on economic growth and agricultural development, in particular, was significant and pervasive. The period of most rapid industrial growth and greatest agricultural stagnation coincided with the oil boom during the 1972-81 period even though import-substitution industrialization had been adopted nearly 15 years before as the primary development model. Thus, import-substitution industrialization began to flourish in Ecuador just as it was diminishing in many other Latin American countries. Windfall gains from the oil boom were the primary reason that rapid growth from import-substitution industrialization was sustained in Ecuador well beyond the time period in other countries.

Petroleum was first discovered in Ecuador in the Santa Elena area of the Guayas Province and was commercialized in the 1920s. In the mid-1960s significant discoveries were made in Ecuador's *Oriente* region (see Chapter 4). Total crude production increased by 54 times between 1970 and 1973, from 1.4 to 76.2 million barrels. At the same time the world price more than quadrupled in 1973 (World Bank 1984, 1987). Thus, Ecuador was the beneficiary of sudden and very large export earnings which were sustained through 1981 and were largely appropriated by the government (Nelson; CORDES; UNDP/World Bank).[8]

The large and unexpected windfall gains from petroleum exports provided the basis for deepening and strengthening import-substitution industrialization. Very ambitious government investments in infrastructure were mounted including upgrading and construction of paved and secondary roads, seaports, national and international airports, power generation and distribution, irrigation, drainage and flood control projects, schools and universities, hospitals, and sports and other community facilities. Significant resources were also devoted to upgrading the armed forces and providing modern equipment. These investments directly complemented the industrialization process and encouraged expansion of manufacturing industry to meet increased demand from oil revenues.

The programs of the government, oriented toward production and consumption of home goods, resulted in greatly increased public sector employment. One estimate indicates that 79 percent of the petroleum revenues between 1972 and 1985 were spent on public sector salaries (CEA 1988). Private sector employment also expanded rapidly during this period as the huge petroleum revenues facilitated industrial development and rapid growth in wholesale and retail trade, transportation, construction, utilities and services.

The ambitious government investment programs and the rapid increase in real per capita incomes, especially in urban areas, resulted in greatly increased demand in both the public and private sectors. The windfall gains from petroleum exports precipitated a buying binge of unprecedented proportions for domestic and imported capital and consumption goods that far exceeded revenue sources. The

consequences were deficits on current account, public sector deficits, increasing inflation and an increasingly overvalued official exchange rate. The deficits were financed by external borrowing by both the public and private sectors from international banks on the basis of expected increases in petroleum revenues. Domestic savings apparently fell and capital flight increased because of relatively low, fixed domestic interest rates. The limited domestic credit that was available was channeled to selected industries at highly subsidized rates. The overvalued official exchange rate, used for all trade transactions, served implicitly to subsidize imports and especially imports of industrial inputs, while imports of consumer goods were either highly protected or prohibited.

The rapid increases in income substantially altered the structure of demand for food and fiber with greatly increased demand for animal proteins, fruits, vegetables and seafood especially in urban areas (see Chapter 6). The changing structure of demand induced substantial changes in agriculture toward the production of those foods with higher income elasticities of demand and away from traditional cereals and tubers. This was accompanied by a rapid commercialization of agriculture both in the small-farm subsistence sector and among traditional haciendas. Also, there was a substantial outmigration of rural labor to urban areas where higher-paying jobs were available in construction and services.

The petroleum boom adversely affected agriculture in at least four fundamental ways. First, increasing inflation led to the imposition and enforcement of official retail price ceilings for a large number of basic food commodities in an attempt to mollify the increasingly powerful urban consumers. Second, imported wheat and powdered milk were subsidized directly by the government through importation at the official exchange rate and sale at lower prices than the purchase price. Consumers quickly substituted the consumption of now cheaper bread and noodles from imported wheat for traditional foods. These subsidies (along with the shift in the structure of demand) thus constrained domestic production of wheat, barley, soft corn, tubers and legumes and increased the public sector deficit. Third, agricultural exports continued to be taxed. While the government started to reduce and eliminate taxes on bananas and sugar in 1973-74, the inadequacy of petroleum revenues to finance rapidly increasing government expenditures resulted in the taxes on cacao and coffee being retained and raised. Taxes were continued through 1977 for bananas and cacao and until 1981 for coffee (Keeler, Scobie and Greene p. 53). Fourth, the increasingly overvalued exchange rate meant that agricultural exports were being increasingly taxed and the prices of import substitutes were being depressed.

Negative direct sectoral policies (fixed prices, imported food subsidies and export taxes) and macroeconomic policies (overvalued exchange rates, protection of the industrial sector and direct subsidies to industry) all greatly reduced incentives to invest in agriculture during the petroleum boom. They extracted resources from agriculture to support the import-substitution industrialization process and urban development. Ironically, the enormous windfall gains from the petroleum boom were not only expended mainly to subsidize the production of industrial and other home goods and benefit urban people; they exacerbated the discrimination against agriculture inherent in the underlying development model. They did this by providing the funding to increase the level and breadth of subsidization to industry and shift the internal terms of trade even further against agriculture.

The government attempted to promote agricultural development directly in several ways during the 1970s. Mention already has been made of investments to rejuvenate production of export crops. The government also promoted food self-

sufficiency during the 1970s. An earlier producer price support system that had been largely ineffective was modified in 1972 and applied to crops produced for domestic consumption. The National Agricultural Storage and Marketing Company (ENAC) was established to buy crops at guaranteed minimum prices and store and sell crops when prices improved. The program has focused almost exclusively on rice, hard corn and soybeans with very limited success in inducing increased production and has been very costly in terms of government subsidies. ENAC generally has been unable to sustain floor prices because of limited funding for purchases, especially in periods of excess supply. In 1971 the government also established the National Enterprise for Basic Products (ENPROVIT) to bypass middlemen and purchase directly from the producer for sale to the consumer, with the objective of reducing marketing costs and food prices for low-income consumers. Expenditures on ENPROVIT have contributed to the public sector deficit as ENPROVIT also has experienced large operating deficits.

The government invested heavily in development of additional irrigation infrastructure during the 1970s. The primary emphasis was on feasibility studies, arranging loans and developing pilot projects. Projects in Babahoyo and Milagro were completed by 1981 and other major projects were planned for completion in the 1980s. Public irrigation only had limited impact on agriculture during 1972-1981 because the extent of publicly irrigated land was quite small at the beginning of the period and most new projects were not finished until late in the period. Public investments in irrigation generally have been socially unprofitable, highly subsidized and a significant drain on the public sector budget (see Chapter 7).

Substantial amounts of subsidized credit were directed to agriculture through the National Development Bank (BNF). Most credit lines were directed to import-substitute crops especially in the Costa region. The level of subsidization has been very high resulting in decapitalization of the BNF. Moreover, most of the benefits have been captured by relatively large farmers (see Chapter 9).

Finally, the government made modest investments in research, extension, and related programs through the Ministry of Agriculture (MAG) and the National Institute of Agricultural Research (INIAP) in an attempt to improve productivity in the sector. A major share of the expenditures appear to have been in inadequately trained professionals at low salaries with little evidence of increased productivity from these investments (see Chapter 12).

Attempts to enhance agricultural growth in the 1970s through direct sector policies and programs were swamped by the disincentives inherent in the macroeconomic policy matrix and the negative sector policies (Scobie and Jardine 1988b). The petroleum boom amplified the disincentives to agricultural growth inherent in the broad set of macroeconomic and negative sectoral policies which favored import-substitution industrialization and urban people. Direct sectoral policies generally had only a limited effect on agricultural production and productivity during the period of the petroleum boom and were a substantial drain on the treasury. In addition, the internal market for domestic industrial products became saturated toward the end of the oil boom period. Opportunities for domestic production of additional import-substituting products virtually were exhausted by the early 1980s (World Bank 1987, p. 13; 1988, p. 48). Consequently, industrial production stagnated between 1982 and 1990 which is one of the fundamental causes of the sustained period of economic crisis since 1982.

V. Austerity and Structural Adjustment: 1982 to Present[10]

A financial crisis ensued in mid-1982 when foreign banks found that the credit-worthiness of Latin America generally and of Ecuador, specifically, was questionable. Ecuador's foreign debt had increased from US$350 million in 1973 to US$5.8 billion in 1981 largely from pubic sector borrowing, which accounted for 74 percent of the 1981 debt. In 1971 the public sector had a surplus of 3.1 percent of GDP; by 1981 there was a deficit of 5.8 percent of GDP, which increased to 7.5 percent in 1982 at the same time that international interest rates increased. Foreign banks were unwilling to lend further in such an environment (World Bank 1987, pp. 2-5).

The Roldós-Hurtado Government (1979-1984)

The Roldós-Hurtado government continued during 1979-1981 with the inward-oriented macroeconomic and sectoral policies that had been in effect since the late 1950s. The government also continued to make large investments in social programs primarily on the expectation of future oil revenues and external credits.

In early 1982 the government suddenly and somewhat unexpectedly was challenged with the most serious economic crisis in Ecuador's modern history. Foreign credit dried up and the government faced the formidable task of internally financing its burgeoning fiscal deficit. More fundamentally, it had to address the structural problems inherent in nearly three decades of heavily subsidizing industry and urban consumers at the expense of agriculture and rural people. The policy response was the beginning of a continuing period of austerity and structural adjustment throughout the 1980s which reduced somewhat the degree of subsidy to industry and moderately improved investment opportunities in agriculture.

The economic crisis was complicated by the accidental death of President Jaime Roldós on May 24, 1981. The young Vice-President, Oswaldo Hurtado, suddenly was left alone to respond to the formidable problems associated with the emerging economic crisis while he simultaneously had to develop and restructure the political support necessary to govern the country.

The immediate response to the 1982 crisis was to expand credit and the money supply which culminated in the loss of foreign exchange reserves of nearly one-half billion dollars and rapid overvaluation of the Sucre at the official exchange rate. This led to a devaluation of the Sucre in March 1982 from S/.25/US$1 to S/.30/US$1.

The government then appears to have implemented a more integrated and outward-oriented response to the economic crisis. First, the policy of maintaining a fixed and increasingly overvalued exchange rate system was abandoned. The Sucre was devalued to S/.33/US$1 in May 1982 and a system of daily "mini-devaluations" was implemented. The dual exchange markets were maintained which resulted in an overvalued official exchange rate that still subsidized industry and home goods at the expense of agriculture and tradeables. The system of mini-devaluations continued throughout the Hurtado administration; in addition the Sucre suffered two macro-devaluations and was at S/.72/US$1 in mid-1984. Second, strict import controls and restrictions were established in 1982. As a result, the large deficit in the current account balance was reduced substantially in 1983. Third, the Hurtado government entered into an austerity program with restrictions on government spending that sharply curtailed the ambitious social programs of the

first two years of the Roldós-Hurtado administration. These measures effectively eliminated the public sector deficit in 1983 and removed some of the inflationary pressure from the economy. The success of these measures permitted an expansion of the credit available for the private sector and the government raised interest rates although they still were less than the rate of inflation. Also, the government rescheduled its debt, assuming that of the private sector with the "Sucretization" program of October 1983 (Nickelsburg). It also negotiated a standby agreement with the International Monetary Fund (IMF).

The austerity measures compounded by bad weather precipitated a recession in 1983 and GDP fell by 2.8 percent. Disastrous weather referred to as the "El Niño" phenomenon was a major factor in the economic downturn. Unprecedented rainfall caused flooding and loss of roads, railroads, communication infrastructure and bridges, and destroyed crops and livestock. Agricultural production fell by 13.9 percent. In 1984 the economy recovered somewhat and the public sector budget had a surplus for the first time in years.

The Febres Cordero Government (1984-1988)

The Febres Cordero government took office in August 1984 and refined and expanded substantially the policy initiatives of the Roldós-Hurtado administration. One major adjustment was to move gradually toward a unified exchange rate and away from the dual system which tended to be overvalued and favored industry and home goods at the expense of agriculture (World Bank 1987, pp. 4-8; 1988, pp. 9-13). Initial steps in late 1984 involved shifting some foreign exchange transactions from the official rate of S/.66.5/US$1 to the intervention rate of S/.96.5/US$1. Then in September 1985 all international trade was unified at the intervention rate which was devalued to S/.108.5/US$1 in January 1986. Finally, in August 1986 the Sucre was floated, with a single market-determined rate for all foreign exchange transactions. The unified rate that was established initially in the free market of S/.145/US$1 represented a devaluation of the Sucre of 25 percent compared to the intervention rate of S/.108.5/US$1.[11] The unified rate remained relatively constant for several months and then began to appreciate. By August 1987 it was at S/.200/US$1, a devaluation of 28 percent compared to the free-market rate of a year earlier. The rapid devaluation of the Sucre after August 1986 made agricultural products much more competitive in world markets (World Bank 1987, pp. 10-11).

A second major policy reform was to free interest rates on all savings and loans except those on subsidized loans from the Central Bank to specific sectors. The Febres Cordero government also undertook measures to raise public sector revenues and helped generate the 1984 budget surplus and sustain it in 1985. The government also was able to obtain another stand-by agreement from the IMF and to reschedule its external debt with private banks (World Bank 1987, p.7).

The Febres Cordero government also implemented several new policies which attempted to reverse the excesses of import-substitution industrialization and to improve incentives for agriculture (World Bank 1987, pp. 8, 11). First, the government eliminated almost all consumer price ceilings in 1985. In addition, the number of products subject to minimum price supports through ENAC buying and selling operations were limited to rice, corn, soybeans and cotton. Second, the operations of ENAC were curtailed by selling some of its storage facilities and a system of issuing negotiable certificates for ENAC-stored commodities was implemented. Third, an agricultural commodities exchange market (Bolsa de Productos) was established in 1986 to facilitate marketing of agricultural products.

Fourth, the government eliminated all export taxes on agricultural products except for a very small tax to finance customs services.

The government simultaneously embarked on an ambitious program to reduce and eliminate restrictions and prohibitions on the importation of industrial goods that have been at the heart of Ecuador's economic development model of import-substitution industrialization for nearly three decades. Restrictions were removed for a significant number of imports, primarily final consumer goods, in April 1985 and January 1986. Tariffs were reduced for many items and the average tariff, including surcharges, for all items on the import list fell from 51 to 38 percent (World Bank 1987, pp. 13-15). While this was a significant reduction, tariffs remain at very high levels. Finally, the government eliminated its monopoly in fertilizer imports and sales and permitted the free importation of fertilizers and other agricultural inputs.

Exogenous events in 1986 and 1987 severely constrained attempts to diversify the economy and move toward a more efficient path of sustained economic growth. First, the price of petroleum fell precipitously in 1986 to about US$12 per barrel from an average of US$25 in 1985. This sharply reduced government revenues and led to a budget deficit of 5.1 percent of GDP in 1986 (World Bank 1988, p. 11). At the same time imports had to be sharply curtailed as foreign exchange reserves were reduced by about US$1.0 billion. Second, there was a major earthquake on March 5, 1987 which destroyed a section of the trans-Andean pipeline and essentially eliminated most of Ecuador's petroleum exports for nearly six months. This event caused the postponement of approximately another US$1.0 billion of foreign exchange earnings. The combined effect of these exogenous events was the reduction in public sector revenues from 28 percent of GDP in 1985 to only 22 percent in 1987. The Febres Cordero government was concomitantly engaged in a very expansionary fiscal policy that saw public sector expenditures increase from 26 percent to 31 percent of GDP during the same period. As a result the public sector deficit increased substantially to 10.5 percent of GDP in 1987 and the foreign exchange position worsened. In late 1987 and early 1988, the Sierra experienced a drought during most of the prime growing season and the production of food crops declined in 1988.

These exogenous shocks created a major economic crisis in late 1987 and early 1988. The rate of inflation, the public sector deficit and the Sucre/U.S.Dollar exchange rate all increased rapidly. The government subsequently reversed some of its innovative policy reforms. In February 1988 price ceilings for primary consumption products, principally agricultural, were reinstated. In early March 1988 a multiple exchange rate system was reestablished. All government transactions were set at S/.250/US$1, and all private imports and exports were required to be transacted at a "controlled free-market" rate of up to S/.275/US$1. The free market rate for all other transactions was at nearly S/.400/US$1, so the fixed rates were highly overvalued, which led to massive imports and a disincentive to export through the official market. The free market exchange rate surged to S/.560/US$1 by July 1988.

This reversal of price and exchange rate policy was a major step backward in the effort to free market prices and to promote a more outward-oriented economy. This policy change, instituted only a few months before the Febres Cordero government left office, also provided a mechanism to transfer significant resources to those who received import licenses and subsequent access to foreign exchange at highly subsidized rates. In any case, the free-market policies of the Febres Cordero government were ended primarily because of the exogenous shocks combined with expansionary fiscal policy mentioned above and the desire to control

the ensuing rapid devaluation of the Sucre and increasing inflation.

The Borja Government (1988-Present)

The Borja government inherited a rapidly deteriorating economic situation when it assumed power on August 10, 1988. The fiscal deficit was estimated to be at 13.8 percent of GDP, inflation was increasing rapidly and foreign exchange reserves were exhausted (Monetary Board, Ministry of Finance and Central Bank of Ecuador 1990a, p. 6A). As a consequence, an emergency economic plan was announced on August 30, 1988 for the first year of the government. It focused on economic stabilization and control of inflation as highest priorities along with several social welfare programs to repay the "social debt," (U.S. Embassy/Quito; MAG/PAU).

The highly overvalued Sucre at the intervention rate was devalued to about 80 percent of the free market level (S/.390/US$1) and a weekly mini-devaluation of S/.2.50 was implemented with the announcement of the emergency economic plan. As a result, the exchange rate policy became more favorable to the production of agricultural goods and tradeables than it was at the end of the Febres Cordero administration. However, the multiple exchange rate structure established near the end of the Febres Cordero government was maintained as was industrial protection through trade restrictions and tariffs.

The Borja administration also imposed a very tight monetary policy and limited the growth of the money supply to about 60 percent of the inflation rate. Imports were restricted for most capital and some consumer goods unless financed abroad. Prices of domestic petroleum products and electricity were raised significantly, regular monthly price increases were established and a substantial subsidy on imported wheat was eliminated. Petroleum export prices strengthened, averaging over US$16/barrel during 1989. Consequently, international monetary reserves increased by US$533 million between August 1988 and December 1989 with a positive balance of US$203 million at the end of the period while the deficit on the current account balance fell from 7.0 percent to 4.4 percent of GDP. The fiscal deficit, which had reached a projected high of 13.8 percent of GDP in August 1988, was reduced to 5.1 percent of GDP in 1988 and to 2.2 percent in 1989 (Monetary Board, Ministry of Finance and Central Bank of Ecuador 1990a, p. 6A). The intervention exchange rates, which tended to become increasingly overvalued, were adjusted to market levels through the weekly mini-devaluations and several macro-devaluations in the base rate since August 1988.

Inflation was gradually reduced during 1989. The annual rate, which had been increasing since July 1988, approached 100 percent in March 1989. Food prices surged in early 1989, especially rice and sugar and the government was forced to import both these items during 1989. Inflationary pressures abated during late 1989 to an annual rate of about 50 percent and monthly rates during the last quarter that averaged about 40 percent on an annual basis. It has been very difficult to reduce the inflation rate below this level as the perennial fiscal deficit has continued to push aggregate demand in the economy.

The monthly inflation rates increased modestly during the first quarter of 1990 relative to the last quarter of 1989 suggesting a possible increasing trend (BCE 1990, p. 50). Several interrelated factors suggest that inflation will increase during 1990. The 1990 winter crop was severely affected by a prolonged drought in both the Sierra and the Costa regions which contributed to increasing food prices during April and May 1990. Petroleum prices fell substantially during the second quarter of 1990 as they dropped below US$13 per barrel and are expected

to be weak for the rest of the year. Coffee prices have been severely depressed since July 1989, shrimp and cacao exports are down, the economy is growing very slowly and the foreign debt renegotiation was not progressing well as of May 1990. The decrease in foreign exchange earnings and government revenues could be further aggravated by external events such as a continued fall in the price of petroleum, or disruptions in its supply. Inefficiency in the public sector and wasteful public spending on subsidies to various special interest groups are structural aspects of fiscal deficits and inflation which continue to be major constraints to economic stabilization. The Borja administration has not yet articulated an adequate fiscal policy to control and limit expenditures and, although it has improved its taxation policy, revenues and foreign exchange earnings are falling because of declining petroleum prices and other exogenous events beyond the government's control. This pessimistic scenario suggests a strong tendency to growing fiscal deficits and inflation during 1990. A stagnant economy during the Borja administration has led to increasing demands from the private sector to relax monetary policy in order to stimulate investment and economic growth, which could further contribute to inflationary pressure.

The foreign debt is another major problem facing the Borja administration. It was US$12.4 billion in April 1990, including an accumulated arrearage of US$1.2 billion with US$5.6 billion being owed to international private banks (CEA 1990). The proposed Brady plan may serve to reduce some of the debt burden although renegotiation of the debt will not be possible on the highly favorable terms sought by the government. The debt service is very large relative to Ecuador's capacity to pay. Payment of the debt will tend to limit growth and could contribute to inflation.

Reactivation of the economy is the second major priority of the Borja government. There is great concern that focusing on inflation for too long and exclusively may result in a major recession. CONADE made a preliminary estimate of economic growth in GDP for 1989 of .5 percent with agricultural GDP falling by 1.8 percent (Cifra p. 9). However, reliable sources indicate that soon-to-be released national account data will show that GDP fell by 1-2 percent while agricultural GDP increased by 2-4 percent. The Borja administration has set the goal of 3.5 percent growth in GDP in 1990 which seems highly unlikely. The actual rate will probably be much lower given the country-wide drought during the principal agricultural season, low and falling export prices, sharp decreases in shrimp production, increasing inflation and the relatively inhospitable investment climate. In essence, the economy is stagnant with a tendency to uncontrollable inflation.

CONADE announced its economic development plan in mid-1989 (CONADE 1989a). The primary economic theme and development model of the CONADE plan was continued emphasis on producing for the internal market, which incorporates import-substitution industrialization and self-sufficiency. For example, the proposed CONADE plan for agricultural development was focused on cooperative production for the internal market and simultaneous achievement of social and equity objectives, with little emphasis given to programs to increase productivity (CONADE 1989b, pp. 5-10). This was fully consistent with the governing political party's position on economic development during the campaign (Izquierda Democratica pp. 19-22). A "new" industrial development strategy to activate the economy also was proposed (Martes Económico p. 3). This scheme suggested import-substitution industrialization based on production of food, clothing and housing for the internal market as the primary strategy for economic growth. The CONADE plan and the "new" industrial development strategy are seriously flawed and have been largely ignored by the press and economic policymakers in the government.

The Ministry of Finance, the Central Bank and the Monetary Board have been moving cautiously but consistently toward a more outward-oriented set of macroeconomic policies since the beginning of the Borja administration, in contrast to CONADE's inward-oriented plan. They also have been increasingly involved in setting economic development policies. These three government agencies jointly announced a new economic action plan in early 1990 in letters to the World Bank and to the International Monetary Fund (Monetary Board, Ministry of Finance and Central Bank of Ecuador 1990a, pp. 6-7A; 1990b, pp. A6-7). This action plan is based on opening the economy, reducing and eliminating trade barriers, reducing government deficits and liberalizing prices and interest rates. These official communications signaled a shift in power within the government in the formulation of economic policy from CONADE to the Ministry of Finance, the Central Bank and the Monetary Board. They also implied a shift in policy from import-substitution industrialization toward an outward-oriented economy (Hoy p. 3A).

The emerging development plan of the Borja administration appears likely to substantially alter past policy of inward-oriented and establish an outward-oriented growth strategy for the 1990s. If all of the elements of the letters to the World Bank and the IMF were to be fully implemented Ecuador's economic development model would be substantially altered and lead to a more dynamic, competitive economy.

The plan, however, has its limitations. There is no integrated policy for agricultural development and improvement in the production of tradeable commodities. For example, the plan fails to free agricultural trade with substantial barriers on both exports and imports based on the outmoded and inefficient notion of self-sufficiency in food production. It fails completely to address the fundamental need for greater productivity as the primary basis for competitiveness in the international marketplace both for agriculture and the rest of the economy. It is seriously deficient in addressing the fiscal deficit and especially the oversized, inefficient public sector and the large, recurring subsidies in the economy. Finally, the time-frame for implementation appears to be too long with a piecemeal approach, which may lead to economic crisis before more rapid growth is realized. Nevertheless, the economic action plan of the Borja administration is a substantial improvement over past inward-oriented policies.

VI. Effects of Macroeconomic Policies on Agriculture

There is a growing body of literature which analyzes the effect of macroeconomic and commercial trade policies on agriculture in Ecuador and other developing countries. These studies generally conclude that agricultural production and exports have been constrained by such policies relative to a more neutral set of policies.

Keeler, Scobie and Greene examined the effects of macroeconomic and commercial policies on the structure and performance of Ecuador's agricultural sector during 1960-1985. This study calculated effective exchange rates to take into account the variations in exchange rates, and inflation rates of Ecuador's major trading partners. It also calculated equivalent exchange rates to account for the effects of taxation and subsidization policies on exports and imports. The effective and equivalent exchange rates were aggregated into the effective equivalent exchange rate to determine how competitive Ecuadorian importers and exporters were in the international market.

The Keeler, Scobie and Greene study found that a steady appreciation of the

effective exchange rate between 1961 and 1982 made conditions steadily worse for Ecuadorian exporters, and made importable goods less expensive, ceteris paribus. The effects of subsidies and taxes on imports and exports, as accounted for in the equivalent exchange rate, further discriminated against agricultural exports, and especially against the traditional exports of bananas, cacao and coffee which comprise the majority of agricultural exports. These trade policies generally had the effect of encouraging import-competing activities and of discriminating against export production. While the equivalent exchange rate for the aggregate of all imports was generally higher than that for exports, the study notes that imports of raw materials and capital goods for industry faced a much lower equivalent exchange rate than for imports of highly protected final goods.[12]

The Kreler, Scobie and Greene study, unfortunately, did not disaggregate the equivalent exchange rate for industrial raw materials and capital goods relative to final goods. The study documents, however, a series of tariff reductions and exonerations and exemptions from other non-tariff barriers to import raw materials and capital goods, especially for industry. It is likely that the equivalent exchange rate for the importation of such goods was lower than any of the equivalent rates for exports, suggesting a significant subsidy to such imports. The study's general conclusion is that commercial policies made the production and export of agricultural commodities steadily less attractive, especially during the period 1970-82. The study also concluded that: (a) protection to industry was maintained at relatively high levels in the first half of the 1980s, even though policy changes after 1982 increased incentives to agriculture; and (b) commercial and macroeconomic policies favored production of home goods (generally industrial) at the expense of tradeable goods (generally agricultural).

Scobie and Jardine (1988a) reviewed the performance of the agricultural economy of Ecuador in the context of macroeconomic policies applied to the general economy during the 1970-1987 period. They argue that the secular performance of agriculture was relatively poor, and that sustained stagnation was a function of both sectoral and macroeconomic policies. They demonstrate that most of the products of agriculture are tradeable and that, therefore, prices of most agricultural products are subject to international market forces. They argue that because the agricultural economy is so open, that the incentives in the sector are influenced by macroeconomic policies which change the competitiveness of Ecuadorian agriculture relative to the rest of the world.

A key variable in their analysis is the real exchange rate, defined as the price ratio of tradeables to non-tradeables (or home goods). They demonstrate that this rate turned increasingly against tradeables (mainly comprised of agricultural products) during 1960-1981, and especially during the years of the oil boom (1973-1981), and in favor of home goods (an important share of which was comprised of industrial products and public services). The study suggests that this occurred in spite of increased, direct public sector investments and policies supporting agricultural development (such as infrastructure, research and extension and price supports). In essence, macroeconomic policies (especially the overvalued exchange rate and industrial protection), and negative sector policies (such as taxes on traditional agricultural exports) overwhelmed the effects of positive sectoral policies.

The Scobie and Jardine study (1988a) concluded that changes in the macroeconomic policy matrix implemented in 1981 as part of the readjustment program of the Roldós and Hurtado administrations, and enhanced during the Febres Cordero administration from 1984 through 1987, improved the internal terms of trade in favor of tradeables, with a generally more favorable set of incentives

for agriculture. They argued that the recovery of the agricultural sector during 1984-86 was a direct response to the more favorable incentives induced by the policy changes. The study also concluded that any implementation of the macroeconomic and trade policies of the 1970s which taxed agriculture so heavily will constrain growth and reduce welfare.

Scobie and Jardine (1988b) also tested the effects of different macroeconomic policies on the performance of the agricultural sector with an empirically estimated econometric model. Because Ecuadorian agriculture is so open to international economic forces, the price of tradeables is hypothesized to be very sensitive to changes in macroeconomic policies which modify the relative profitability of tradeables and home goods. The real exchange rate (the ratio of the prices of tradeable to home goods) is hypothesized to be a function of macroeconomic policies, and affected directly by changes in them. The real exchange rate first was estimated as a function of fiscal, monetary, exchange rate, and commercial policies. The second equation of this recursive model then estimated the relationship between the real exchange rate and the relative output of tradeables (agricultural goods) and home goods (non-agricultural). The estimated coefficients of this model indicate that much of the decline in the relative output of agriculture that occurred in the 1970s can be explained by appreciation of the real exchange rate, caused by macroeconomic policies.

The Scobie and Jardine (1988b) study found, utilizing the econometric results and simulation models, that agriculture could have grown at over 5 percent in real terms between 1970 and 1986 with a more appropriate set of macroeconomic policies. Real agricultural output (GDP) in 1986 would have been more than three times what was actually produced. Trade policies, with high protection to industry for domestic production of import substitutes, an overvalued exchange rate and taxes on tradeables were found to be major constraints to increased agricultural production.

The Scobie and Jardine (1988b) study simulated the level of protection to imports that would have been necessary in order to maintain the relative output of agriculture at average levels of the 1960s. They found that protection would have to have been negative (i.e., subsidies to imports) just for agriculture to have remained even. This suggests that protectionist policies for industry severely taxed agriculture and reduced potential economic growth. Results of the study also suggest, very strongly, that agriculture had resources extracted from it to subsidize the industrialization process. This study also suggests that macroeconomic policies offset attempts to stimulate agriculture through direct investments in the sector, such as irrigation, roads, and research.

The inescapable conclusion of the recent studies of the effects of macroeconomic policies on agriculture in Ecuador is that the agricultural sector was heavily taxed to support an inefficient import-substitution industrialization process and the production of home goods. It is an anomaly that Ecuador continues to cling to a development model that clearly is very costly in terms of foregone growth and economic development.

These conclusions are consistent with similar findings for many other developing countries around the world. There is a growing body of evidence that the macroeconomic policy matrix associated with import-substitution industrialization reduced public and private investments in agriculture in many Latin American countries (Valdés). There also is evidence from 18 countries in Asia, Africa, Europe, and Latin America that the negative effects on agriculture of discriminatory macroeconomic policies and negative sectoral policies were much greater than the positive effects of direct policies intended to help the sector

(Krueger, Schiff and Valdés). Finally, there is evidence from eight South American countries that agriculture responded positively to post-1982 adjustments in their macroeconomic policy matrices which corrected distortions and reduced or eliminated disincentives associated with import-substitution industrialization (IICA).

The lesson for Ecuador, from the specific studies from Ecuador and from studies of other developing countries, is consistent and clear. Ecuador must continue to move toward a more outward-oriented set of macroeconomic and trade policies, and then sustain this policy set if it is to achieve a more rapid rate of economic growth. This modified policy matrix clearly should incorporate movement away from protection of industry with its production primarily for the internal market, toward production for competitive external markets. The World Bank (1988) presents projections of economic growth in Ecuador which indicate that movement to an outward-oriented strategy will result in much more rapid rates of growth, albeit with the poor bearing a disproportionate share of the adjustment costs in the short run.

The World Bank (1988) report also recommended removal of protection and an export-oriented strategy to revitalize industry. The stagnation of the industrial sector is a result largely of inward-oriented macroeconomic and trade policies. The internal market for most of the products of industry is relatively small and is growing very slowly. The market is generally saturated, and opportunities for additional import-substitution are nil. Moreover, subsidies to imports of capital equipment for industry have tended to constrain utilization of labor and reduce employment over what it might have been under a more appropriate set of macroeconomic and trade policies (Lal and Rajapatirana; World Bank 1986; World Bank 1987, p. 13). There is evidence however, that some parts of industry (e.g., milling and bakery products, fish, cigarettes, weaving, sawmill products, furniture, soaps, perfumes and cosmetics, tires, cement, and electric home appliances) are relatively efficient (World Bank 1988, Annex C). Movement toward a more outward-oriented macroeconomic and commercial policy matrix will improve incentives for both agriculture and industry, although inefficient firms in both sectors will be subject to competition and possible reallocation of resources. In the longer term, the net effect will be more rapid economic growth and development than is possible under protectionist policies of the past.

VII. Conclusions

Economic growth in Ecuador for the first sixty years of this century relied primarily on the exports of three primary agricultural commodities: cacao, bananas, and coffee. Taxes on exports of these commodities provided the major source of government revenues during this period. Export taxes and an overvalued real exchange rate discriminated against the production of agricultural and tradeable goods. Growth in demand for industrial goods and increased supply of primary commodities after World War II resulted in falling relative prices of primary products on the world market and a deterioration in the external terms of trade for most developing countries. As a result there were increasing incentives and pressures to move toward a model of import-substitution industrialization in Ecuador, as in most of the developing world.

Ecuador adopted import-substitution industrialization as its model of economic development in the late 1950s and has continued with it to the present although the country edged toward a more outward-oriented economy during the 1980s. The industrial sector was seen as the basis for rapid economic growth while the role of agriculture was depreciated. Industry was protected from foreign competition

through a variety of tariff and non-tariff barriers to trade that resulted in a rapid expansion of the sector. The Sucre was overvalued during most of the last three decades which reduced the price of exports and imports on average. Imports of final goods that competed with domestic industry were heavily taxed, while imports of raw materials and capital equipment for industry were either exempt from import taxes and restrictions or taxed at very low rates. In essence, the industrial sector has had access to foreign exchange at subsidized rates for imports of raw materials and capital goods during the last three decades. Industry also has enjoyed subsidized lines of credit and exemption from, or reduction or deferment of various taxes. In contrast, agriculture generally has been taxed, directly and indirectly, through a variety of policy instruments to provide government revenues and to subsidize import-substitution industrialization. The policy reforms of the 1980s induced by the economic crisis of 1981 were more of degree than of fundamental change in development strategy. The dominant policy thrust throughout the 1980s has been import-substitution industrialization, with a brief flirtation and some experimentation with a more outward-oriented, free-market approach especially during the Febres Cordero administration. Even though there was relative improvement in macroeconomic policies in favor of agriculture during the 1980s, post-1982 macroeconomic and sectoral policies continued to subsidize industry and urban areas while taxing agriculture and rural people. While the Borja administration has announced its plan to move toward an outward-oriented economy, the industrial sector and urban dwellers still remain highly protected and subsidized at the beginning of the 1990s.

NOTES

1. The present refers to May 1990 when this Chapter was finalized.

2. Continental Ecuador comprises three principal geographic regions: the *Costa*, the *Sierra* and the *Oriente*. These three regions are referred to throughout the sector assessment by their Spanish names since they are the formal names of Ecuador's main geographic regions. The Costa is a strip of tropical lowlands along the Pacific coast from the Colombian border on the north to Peru on the south and inland about 200 km at its widest point to the western foothills of the Andes Mountains. The Sierra is a zone of mountains and intermontane valleys of the Andes east of the Costa region and includes a wide range of elevations and climates from cold to temperate to subtropical. The Oriente region is a vast area of tropical lowlands east of the Sierra region covered mainly with native rain forests. The Sierra and the Oriente regions also border Colombia and Peru. Ecuador's fourth princial region, the Galápagos Islands in the Pacific Ocean west of continental Ecuador, is not included in this assessment since it has almost no agricultural activity. See Chapter 4 for a description of Ecuador's three principal geographic regions and eight major agro-ecological zones.

3. This section draws on Hurtado. While Hurtado's work focuses on the rise of Ecuador's political parties it contains a brief but excellent analysis of Ecuador's economic history from the colonial period until 1950. It is highly recommended reading for students of Ecuador's economic development.

4. See Chapter 3 for a detailed analysis of agricultural trade during 1965-1987.

5. All exchange rates reported in the rest of this chapter are taken from BCE (1990, 1988, 1978, 1977) unless otherwise noted.

6. The policy stance adopted by Ecuador was heavily influenced by the dependency, dual-sector and growth stage theories of economic development discussed in Chapter 1.

7. This section draws on data and analyses by the World Bank (1987, 1988); Pachano (1986, 1987); and by Scobie and Jardine (1988a, 1988b).

8. See also Brogan and Gibson for more information on the role of petroleum in Ecuador's economy.

9. See Chapter 8 for more information about the agricultural marketing system.

10. The discussion of adjustments by the Roldós-Hurtado and Febres Cordero governments in this Section is based partially on studies by the World Bank (1987, 1988).

11. The free-floating, unified rate initially depreciated to S/.145/US$1 compared to the free market rate of S/.164.5/US$1 that existed in the dual market in July 1986, immediately prior to the float. The free market rate of July 1986 pertained to only a small segment of the total foreign exchange market, while the lower intervention rate covered the largest share of the market. When these two segmented markets were unified after August 1986 the free-floating rate averaged

somewhat less than the July free market rate for several months but was substantially more than the intervention rate.

12. The overvalued nominal exchange rate had the general effect of subsidizing imports and therefore discouraging domestic production of import-competing goods. In addition, imports of capital equipment and raw materials for producing import-competing products had access to foreign exchange at the overvalued rates and low average import tariffs, compared to final goods whose importation was either prohibited, or imported at a very high average tariff.

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CHAPTER

3

THE PERFORMANCE OF AGRICULTURE

MORRIS D. WHITAKER AND JAIME ALZAMORA

I. Introduction

More efficient and productive agriculture generally is necessary in order to achieve faster, sustained economic growth in developing countries. The agricultural sector of most such countries is relatively large and, in many cases, is the primary economic basis from which overall growth and development must proceed. Agriculture produces much of the principal wage and subsistence goods in these economies--food and fiber. With appropriate policies and public sector investments it can: release labor and generate savings and capital for investment in the production of nonagricultural goods and services; generate increased foreign exchange earnings to pay for imports of capital and consumer goods, including food; and provide a nutritious diet at decreasing real prices.

Chapter 2 argued that achievement of more rapid and sustained economic growth in Ecuador in the post-World War II period was seriously constrained by macroeconomic policies which discriminated against agriculture while subsidizing industry. It concluded that the policy environment and incentives facing agriculture improved somewhat in the post-1982 austerity period, but that subsidization of industry at the expense of agriculture continued. How well has agriculture done in this restrictive environment?

This chapter analyzes the performance of agriculture and it's contribution to general economic development. Growth rates and the changing importance of the principal sectors of the economy first are analyzed and compared in Section II for main period of import-substitution industrialization (corresponding closely to the petroleum boom) and the post-1982 austerity periods. Section III reviews growth in agriculture's subsectors and their changing relative importance for the same periods. Agricultural trade and agriculture's contribution to foreign exchange

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earnings is treated in Section IV. Section V considers the role of agriculture in meeting the nutritional needs of the population, while Section VI analyzes the interrelated issue of the cost of the diet and economic access to food by the poor. The role of agriculture in employment generation is treated in Chapter 5.

II. Development of the Principal Sectors

National account data from the Central Bank of Ecuador (BCE) provide the basis for analyzing the relative performance of the principal sectors of the economy during 1965-1988 (BCE 1989, 1988a, 1982a, 1982b). This section compares sectoral growth and structure within and between the main part of the import-substitution industrialization period (1965-1981) and the following austerity period (1982-1988).

Growth during the Main Import-Substitution Period (1965-1981)

Economic development proceeded at a historically high rate during the heart of the import-substitution industrialization period. Gross Domestic Product (GDP, or value added) grew in real terms at an average rate of 8.2 percent from 1965-1981 which is high by any standard (Table 3.1, Appendix Table 3.1). Growth in

Table 3.1 Rates of Growth in Gross Domestic Product by Sector for Selected Periods[a] (%) (Calculated from GDP in constant 1975 prices)

Sector	Import Substitution Period (1965-81)	Austerity Period (1982-88)	Austerity Period (1984-88)	Total Period (1965-88)
Agriculture	3.4	6.2	8.1	3.2
Petroleum and Mining[b]	6.1	2.1	-3.5	4.6
Industry	9.3	0.2	1.3	7.0
Utilities	9.5	15.6	14.2	10.0
Construction	5.8	-1.1	-0.4	3.6
Wholesale/Retail Trade	7.6	1.2	2.5	5.6
Transportation/Communications	10.7	4.3	5.0	8.5
Total Services	7.7	0.9	1.2	6.3
Financial Services	7.9	-0.2	0.9	6.1
Household Services	6.0	2.7	2.6	6.0
Government Services	6.7	0.9	0.6	6.6
Total GDP (at market prices)	8.2	2.3	2.5	6.2

Source: Appendix Table 3.1.

[a] The annual average (continuous) growth rate as calculated by fitting a curvelinear (exponential) trend line to the data. The formula utilized is $y = ae^{bt}$ where $a>0$, and $y>0$.

[b] Data for petroleum between 1965 and 1971 are negative, due to an accounting procedure in the national accounts. All growth rates are calculated with 1972 and later data.

this period was led by the petroleum sector which expanded by 54 times between 1970 and 1973 (World Bank 1987, p. 1).[2] Not only did production and exports increase rapidly but world prices rose by more than four times in 1973, swelling foreign exchange reserves and providing the economic basis for rapid growth in industry and related sectors for the rest of the decade (World Bank 1984, p. i). The transportation and communications sector grew at an annual average rate of 10.7 percent, followed closely by utilities and industry at 9.5 and 9.3 percent, respectively. Services grew at 7.7 percent led by a very rapid increase in government services. Construction, the slowest growing sector except for agriculture, still grew at nearly six percent per year.

In contrast, agriculture grew relatively slowly at only 3.4 percent during 1965-1981, barely faster than the rapid population growth experienced in this period. Thus, the other sectors of the economy each grew approximately two to three times faster than agriculture which was relatively stagnant. This general pattern reflects the petroleum boom and the subsidization of industry, transportation and communications, utilities and urban areas at the expense of agriculture and rural people via macroeconomic and sectoral policies (see Chapter 2). It also resulted from strong linkages between industry and the other sectors of the nonagricultural and predominantly urban-based economy.

Reversal of Sectoral Growth Pattern and Stagnation During Austerity Period (1982-1988)

There was a major reversal of the sectoral growth pattern of 1965-1981 during the austerity period of 1982-1988 and economic growth stagnated. Growth in GDP was only 2.3 percent reflecting the effects of the financial crisis and subsequent recession of 1982, the devastating El Niño rains and floods of 1983, destruction of part of the transandean petroleum pipeline in a 1987 earthquake and modest changes in macroeconomic policies in favor of agriculture throughout the period.

Agriculture responded to the improved incentives and was one of the leading sectors of the economy during the austerity period. It experienced an average annual growth rate of 6.2 percent between 1982-1988, almost three times as fast as the overall economy and about twice the rate of the 1965-1981 period.[3]

In contrast, most of the rest of the economy grew very slowly. GDP in the important industrial sector was stagnant, growing at only .2 percent per year during the austerity period. The industrial sector, which was heavily protected since 1957, was relatively inefficient. Even though only gradually and partially exposed to market forces since 1982 by changes macroeconomic and sectoral policies it was unable to compete. Moreover, the import-substitution industrialization process had about run its course, with a relatively saturated and constrained domestic market, which also dampened growth.

The recession of 1982 and stagnation in industry had a chilling effect throughout the rest of the nonagricultural economy. GDP in construction fell by an average of 1.1 percent per year during 1982-1988. Services grew by only .9 percent and wholesale and retail trade grew only slightly faster at 1.2 percent. GDP in transportation and communications grew at 4.3 percent, about two times slower than in the earlier period, while the small utilities sector grew at 15.6 percent. The relatively rapid growth of transportation and communications and utilities during the austerity period reflects continued large government subsidies. These sectors continued to receive waivers of import controls and tariffs and heavily subsidized prices for petroleum derivatives (gasoline, diesel fuel, etc.). The

petroleum sector grew at only 2.1 percent on average during 1982-1988 primarily because of the ruptured pipeline in 1987. When 1987 data is removed from the calculation petroleum and mining output grew at 10.3 percent. Depressed petroleum prices have nullified the potential benefits of increased production however.

The dichotomy in the pattern of sectoral growth between the import-substitution industrialization era and the austerity period is even more pronounced when data for 1984-1988 are compared with the 1965-1981 period. During 1984-1988 GDP in agriculture grew at an annual average rate of 8.1 percent while the overall economy grew at 2.5 percent. The large annual increases in agricultural production in 1984, 1985, 1986, 1987 and 1988 reflect primarily responses to the set of improved incentives inherent in the modified policy environment relative to disincentives and slow growth during 1965-1981. Part of the relatively large increase in agricultural production in 1984 and to some extent in 1985 also reflected recovery from the El Niño floods and rains of 1983. In contrast, the rest of the economy continued to be relatively stagnant, although there is evidence of very limited recovery from the 1982 recession during 1984-1988 especially in wholesale and retail trade and household services.

Sectoral Shares of GDP

The structure of the economy changed substantially during the main period of import-substitution industrialization (Table 3.2). Agriculture, which accounted for 25.6 percent of GDP during 1965-1967 (at the beginning of the period) produced only 14.5 percent of GDP by 1979-1981 (the end of the period) as the sector grew much more slowly than total GDP. The petroleum sector increased its share from nearly zero to 10.8 percent of total GDP during 1965-1981, while industry, and transportation and communications modestly increased their shares of GDP. These latter two sectors benefitted heavily from the subsidies provided in the import-substitution industrialization strategy and grew somewhat faster than overall GDP. The contribution to GDP declined slightly for wholesale and retail trades, construction, and services which each benefitted less directly from the import-substitution strategy and grew more slowly than GDP.

The policies implemented during the austerity period reversed the changes in the structure of the economy that had taken place during the import-substitution industrialization period. The share of agriculture, which had fallen further to 14.0 percent during 1982-1984 primarily because of the effect of the El Niño weather phenomenon, increased to 16.6 percent of GDP on average during 1986-1988 and stood at 16.8 percent in 1988. In contrast, the share of industry, which had been increasing, fell from 18.9 to 17.2 percent during the austerity period and was down to 16.8 percent in 1988, only slightly more than at the beginning of the import-substitution industrialization period. The shares of transportation and communication, and utilities increased slightly, maintaining the trend of the past, in response to continued subsidies during the austerity period. All other sectors of the economy declined in relative importance, although the decline in petroleum's share was due mainly to the destruction of the transandean pipeline in the March 1987 earthquake. Petroleum accounted for 12.3 percent of GDP on average for 1986-1988 and 14.8 percent in 1988, shares somewhat higher than at the end of the import-substitution period.

III. Agriculture's Subsectors

The national accounts divide agriculture into five subsectors: (a) bananas,

Table 3.2 Sectoral Structure of Gross Domestic Product for Selected Periods, 1965-1988 (%)

Sector	Import Substitution Period		Austerity Period		
	1965-67	1979-81	1982-84	1986-88	1988
Agriculture	25.6	14.5	14.0	16.6	16.5
Petroleum and Mining[a]	-1.6	10.8	12.4	12.3	14.8
Industry	15.6	18.5	18.9	17.2	16.6
Utilities	0.6	0.7	1.0	1.5	1.7
Construction	6.3	4.8	4.4	4.0	3.5
Wholesale/Retail Trade	17.1	16.5	15.4	15.0	14.5
Transportation/Communications	4.7	6.8	6.9	7.6	7.3
Total Services	26.7	26.4	27.6	26.1	24.5
Financial Services	11.6	11.6	11.9	10.8	11.4
Household Services	6.9	5.6	6.3	6.4	6.5
Government Services	8.2	9.1	9.4	8.8	8.4
Others[b]	5.0	1.2	-0.7	-0.2	-0.2
Total GDP (at marketprices)	100.0	100.0	100.0	100.0	100.0

Source: Appendix Table 3.1.

[a] Data for petroleum between 1965 and 1971 are negative, due to an accounting procedure in the national accounts; consequently the share for 1965-1967 is negative.

[b] Includes net customs taxes and imputed bank services.

coffee and cacao (export crops); (b) other traditional crops (includes rice, hard corn, soybeans, soft corn, potatoes, barley, wheat, legumes, and other minor crops); (c) livestock (includes beef, dairy, poultry, hogs, sheep and minor animals); (d) forestry; and (e) hunting and fishing (which includes shrimp farming). Performance among the subsectors of agriculture has been highly variable over the last two decades and the structure of the sector has changed considerably (Table 3.3, Appendix Table 3.2).

Growth Rates

Growth in the both the export and traditional crops subsectors was relatively low on average during the import-substitution industrialization era. Export crops grew by only 1.2 percent during 1965-1981 and traditional crops fared only slightly better at 2 percent. In contrast, forestry, and hunting and fishing grew at relatively rapid rates of 9.6 and 11.7 percent, respectively, while livestock performed reasonably well at 4.6 percent. Rapid growth in hunting and fishing is partially explained by growth in demand for shrimp and fish in the export market. The high rates of growth in livestock production, and forestry are at least partially explained by the strong backward linkages from protected domestic industries to

Table 3.3 Structure and Growth Rates of Gross Domestic Product in Agriculture and its Subsectors for Various Periods, 1965-1988 (Calculated from GDP in constant 1975 prices)

	Bananas Coffee & Cacao	Other Traditional Crops	Livestock Production	Forestry	Hunting & Fishing	Total
Growth Rates[a] (%)						
1965-81	1.2	2.0	4.6	9.6	11.7	3.4
1982-88	2.4	8.1	3.8	1.8	16.7	6.2
1984-88	4.4	10.4	4.5	3.1	20.3	8.1
1965-88	0.2	1.7	4.3	7.6	12.5	3.2
Structure[b] (%)						
1965-67	26.4	38.8	29.2	3.3	2.3	100.0
1970-74	22.2	39.4	30.3	4.4	3.7	100.0
1979-81	19.4	32.3	34.0	7.1	7.1	100.0
1982-84	15.4	29.7	37.6	7.9	9.5	100.0
1986-88	13.7	32.2	33.5	6.7	14.0	100.0

Source: Appendix Table 3.2.

[a] The annual average (continuous) growth rate as calculated by fitting a curvelinear (exponential) trend line to the data. The formula utilized is $y = ae^{bx}$ where $a>0$, and $y>0$.

[b] The share of the subsector in total agricultural GDP.

these two sectors which produced raw materials for the rapidly expanding internal market.

The pattern of growth changed substantially during the austerity period 1982-1988. The rates of growth in livestock production and forestry both fell as domestic industry stagnated following the recession of 1982. The growth rates in the other subsectors increased substantially as the new policy matrix provided increased incentives to tradables. These policies induced greater production of export crops which grew at 2.4 percent during 1982-1988 and other traditional crops which grew at 8.1 percent. It also further stimulated shrimp farming, so that hunting and fishing grew at 16.7 percent during the austerity period.

This pattern is even more pronounced during 1984-1988 after recovery from the 1982 recession and the 1983 El Niño floods. The two export subsectors (bananas, coffee and cacao and hunting and fishing) had even higher average rates of growth during 1984-1988. GDP in other crops increased at a very fast 10.4 percent per year on average with the fastest sustained rates of growth in this subsector in the last two decades. Growth in livestock production, and in forestry had recovered from the 1982 recession to relatively high rates of growth but still less than in the import-substitution industrialization period.

Changes in Structure

These variable rates of growth caused the structure of the agricultural sector to change considerably. Export crops (bananas, coffee and cacao) fell continually from an average of 26.4 percent of GDP during 1965-1967 to 13.7 percent in 1986-1988, while other traditional crops fell from 38.8 to 29.7 percent between 1965-1967 and 1982-1984. Other traditional crops recovered somewhat due to its very high recent growth rate and accounted for 32.2 percent of agriculture's GDP during 1986-1988. Hunting and fishing registered the largest increase from 2.3 to 14.0 percent of GDP between 1965-1967 and 1986-1988. Forestry more than doubled its share, and livestock production increased from 29.2 to 37.6 percent between 1965-1967 and 1982-1984 before falling back to 33.5 percent at the end of the austerity period (1986-1988). The large decline in the share of traditional exports was offset by a similar increase in the share of fish and shrimp exports under the rubric of hunting and fishing. The decrease in the share of other traditional crops was offset by modest increases in the share of GDP in livestock production and in forestry. It is important to note, however, that other traditional crops (foodcrops and feedgrains) and livestock still accounted for 65.7 percent of agricultural GDP (average in 1986-1988) down only slightly from 68.0 percent early in the import-substitution industrialization period (1965-1969). When bananas, coffee and cacao are added to this, traditional agriculture continues to constitute the major share of sectoral GDP at 79.4 percent.

IV. Agriculture and Trade[5]

Agricultural exports long have been an important element of the Ecuadorian economy. The relative importance of such exports, however, decreased dramatically and substantially with the advent of the petroleum boom in 1973. The petroleum sector has since received much of the attention from economic analysts and government planners, even though agricultural exports continued to be a major component of foreign trade and their relative importance has increased substantially in recent years. This section analyzes the extent and nature of the contribution that agriculture has made to the foreign exchange earnings of Ecuador between 1965 and 1987. This is done by comparing agricultural exports and imports and calculating the agricultural trade balance from trade data published by the BCE (1988b, 1978). The potential for improving the commercial balance through expanded agricultural exports also is explored.

Exports

Agricultural exports are defined to include products from the five principal sectors of agriculture in the National Accounts: (a) export crops (bananas, coffee, and cacao); (b) other traditional crops; (c) livestock; (d) forestry; and (e) fishing and hunting. They also are defined to include processed or manufactured products from these same five groups that are included in the manufacturing sector of the national accounts. For example, agricultural exports include cacao as beans and processed cacao products such as cocoa. This definition is utilized to account for exports of all products of agricultural origin, whether they are exported directly from agriculture as primary products or as processed industrial products.

Agricultural exports are a very important component of total exports (Figure 3.1, Appendix Table 3.3). Before the advent of the petroleum boom in 1973

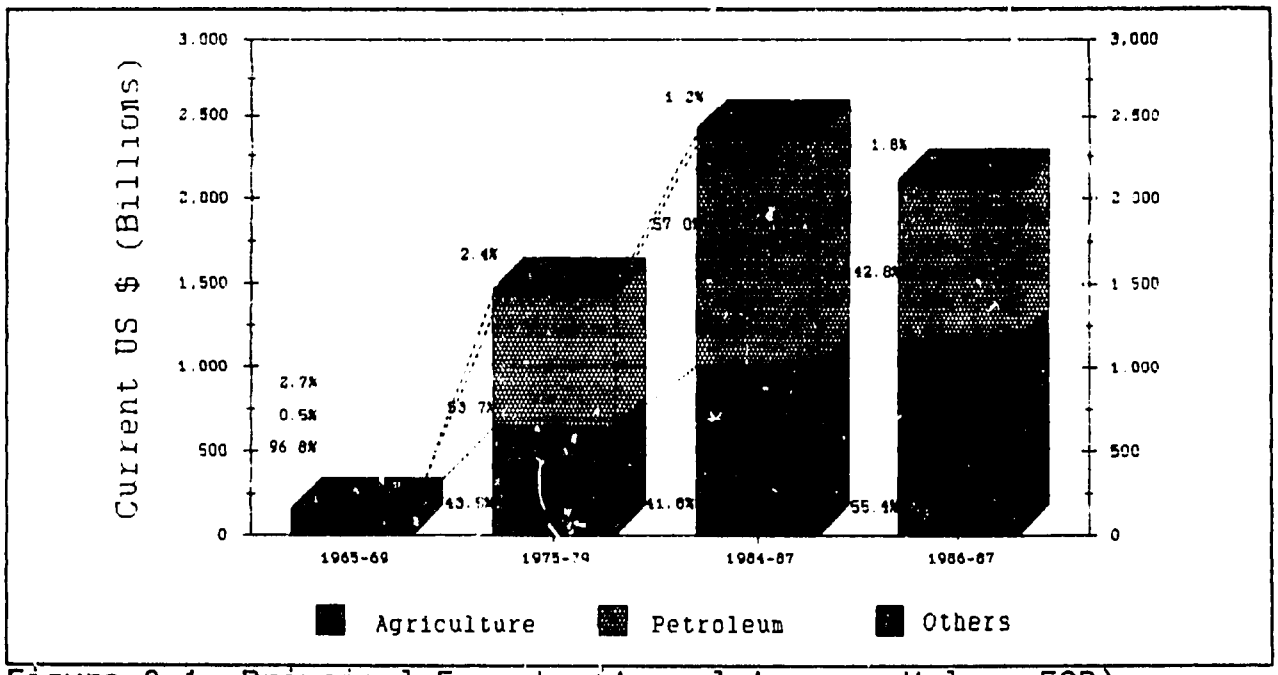

Figure 3.1 Principal Exports (Annual Average Value, FOB)
Source: Appendix Table 3.3.

agricultural exports accounted for almost all exports (e.g., 96.8 percent during 1965-1969). With the very large increase in petroleum production and prices in 1973 the value of petroleum exports exceeded those of agriculture for the first time and the share of agriculture fell to 43.9 percent during 1975-1979 and to 41.8 percent during 1984-1987.

The relative importance of agricultural exports recovered substantially in 1986 and 1987 primarily because of exogenous shocks to the petroleum sector. In 1986 the world price of petroleum fell precipitately and the value of Ecuador's petroleum exports fell by nearly one billion dollars. This was followed by the destruction of the transandean pipeline in March 1987 as a direct result of a severe earthquake which cut petroleum exports for about six months, causing postponement of another approximately one billion dollars in export earnings in 1987. As a result of these two exogenous shocks agricultural exports exceeded petroleum exports in both 1986 and 1987 and averaged 55.4 percent of total exports during 1986-1987. Agricultural exports likely will be more important than petroleum exports in the face of what appears to be much lower petroleum prices compared to the boom years of the 1970s and early 1980s and declining petroleum production. This suggests that the Ecuadorian government and the foreign donor community should assist agriculture to maintain its competitiveness in foreign markets in its principal export lines and to diversify to other agricultural exports.

Ecuador long has been dependent on the export of traditional, primary agricultural products as principal earners of foreign exchange, with cacao, coffee and bananas being the most important during the last two decades (Figure 3.2, Appendix Table 3.4). Exports of coffee and cacao beans and fresh bananas together accounted for 52.5 percent of total agricultural exports on average during 1984-1987, down from 83.5 percent during 1965-1969.

Exports of fresh (chilled and frozen) shrimp, lobster and fish increased rapidly during the last decade. This class averaged 26.4 percent of total

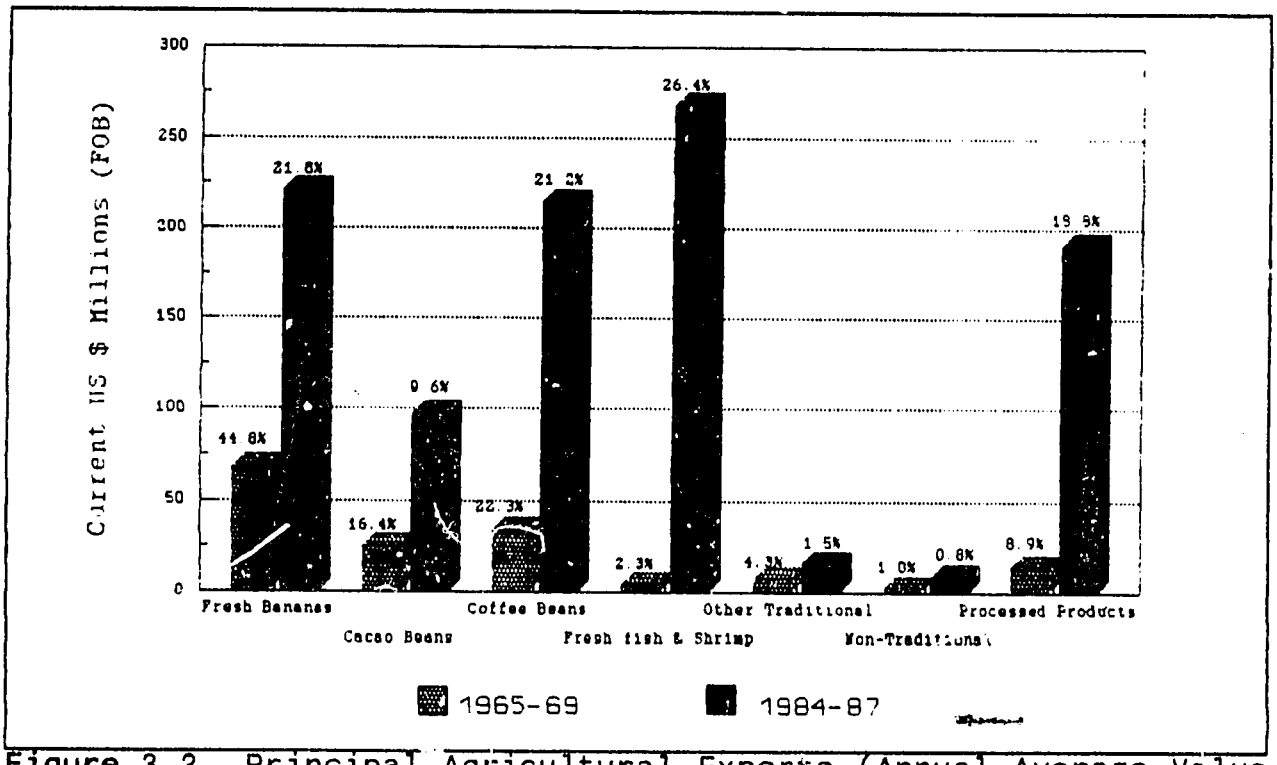

Figure 3.2 Principal Agricultural Exports (Annual Average Value and Share)
Source: Appendix Table 3.4.

agricultural exports during 1984-1987 with shrimp exports being dominant. This was up from only 2.3 percent in 1965-1969. Fresh shrimp, which primarily are raised in ponds, became the single most important agricultural export in 1987, accounting for 33.1 percent of the total, well ahead of bananas or coffee. This could signal the beginning of an era in which shrimp and fresh seafood exports lead agricultural exports, given the broad-based growth of shrimp and seafood production and strong international markets.

Non-traditional agricultural exports have received considerable attention in the popular press, with recurring articles about exports of cut flowers, strawberries, asparagus, and other fresh fruits and vegetables. During 1984-1987, however, all these products combined accounted for only 0.8 percent of agricultural exports and the share of this class declined slightly between 1965-1969 and 1984-1987. The products in this class appear to offer limited potential for substantial improvements in agriculture's commercial balance compared to other major crops (see below).

Four primary product groups now dominate agricultural exports instead of three, with fresh bananas, cacao beans, coffee beans, and fresh seafood (mainly shrimp) accounting for 79.0 percent of all agricultural exports during 1984-1987. This share, however, is down somewhat from 1965-1969, when these four products were 85.8 percent of total agricultural exports.

The decline in the share of exports of primary agricultural products reflects increased exports of processed agricultural products, especially cacao, coffee and fish and shrimp. Exports of processed agricultural products increased as a direct result of government incentives and taxes on the export of primary (unprocessed)

agricultural products. Processed agricultural products were 18.8 percent of total agricultural exports during 1984-1987 up from only 8.9 percent during 1965-1969. The elimination or reduction of export taxes on primary products in the early 1980s reduced incentives to invest in processing but exports of processed coffee, cacao and seafoods continued at relatively high levels compared to the late 1960s.

When exports of processed coffee, cacao, bananas, and shrimp and seafood are added to primary exports of these four major export products, their combined importance as foreign exchange earners increases from 79.0 to 95.3 percent of all agricultural exports during 1984-1987 (Table 3.4, Appendix Table 3.5). Exports of all other minor primary and processed agricultural products are relatively small amounting to less than 5 percent of total agricultural exports during 1984-1987, down from 12 percent during 1965-1969. The decrease in the importance of minor

Table 3.4 Exports of Primary and Processed Agricultural Products, Annual Averages, 1965-1969 and 1984-1987

Years	Bananas	Cacao	Coffee	Fish & Shrimp	Subtotal	Others	Total
Value (US$ 1,000)							
1965-69							
Total	67,391	26,202	33,606	4,747	131,947	18,531	150,478
Primary	67,388	24,614	33,605	3,481	129,088	8,050	137,138
Processed	3	1,588	2	1,266	2,859	10,481	13,340
1984-87							
Total	224,800	162,926	236,107	340,916	964,749	48,105	1,012,853
Primary	220,777	97,058	214,184	267,805	799,824	22,917	822,740
Processed	4,024	65,868	21,923	73,111	164,925	25,188	190,113
Shares (%)							
1965-69							
Total	44.8	17.4	22.3	3.2	87.7	12.3	100.0
Primary	44.8	16.4	22.3	2.3	85.8	5.3	91.1
Processed	0.0	1.1	0.0	0.8	1.9	7.0	8.9
1984-87							
Total	22.2	16.1	23.3	33.7	95.3	4.7	100.0
Primary	21.8	9.6	21.1	26.4	79.0	2.3	81.2
Processed	0.4	6.5	2.2	7.2	16.3	2.5	18.8

Source: Appendix Table 3.5.

agricultural exports means Ecuador's export portfolio now is less diversified than it was twenty years ago, notwithstanding the emergence of shrimp and seafood as a fourth major agricultural export.

Imports

Agricultural imports are defined to include: (a) agricultural consumer goods for direct consumption (foodstuffs, tobacco and alcoholic and other beverages); (b) inputs for agriculture (animal feeds, fertilizers, chemicals and other factors of production); (c) capital goods for agriculture (machinery and implements, tractors and transportation equipment and other agricultural equipment); and (d) raw materials of agricultural origin for industrial processing (unprocessed or semiprocessed foods, fibers and hides).[b] The category "raw materials of agricultural origin for industrial processing" is included to permit the calculation of a commercial balance of agricultural trade and highlight its relative importance.

Agricultural imports are a relatively small proportion of total imports accounting only for 18.4 percent in 1984-1987, down from 26.8 percent during 1965-1969 (Table 3.5, Appendix Table 3.6). In contrast, imports of nonagricultural raw

Table 3.5 Principal Imports, Annual Averages, 1965-1969, 1975-1979 and 1984-1987

Years	Agriculture[a]	Industrial Consumer Goods[b]	Raw Materials & Capital for Industry[c]	Constuction[d]	Transport, Fuel & Misc.[e]	Total Imports
Value (US$ 1,000,000)						
1965-69	56.3	27.7	74.5	14.1	37.6	210.2
1975-79	218.0	125.4	601.5	72.3	231.0	1,248.1
1984-87	334.3	150.0	916.6	57.7	356.3	1,814.8
Share (%)						
1965-69	26.8	13.2	35.5	6.7	17.9	100.0
1975-79	17.5	10.0	48.2	5.8	18.5	100.0
1984-87	18.4	8.3	50.5	3.2	19.6	100.0

Source: Appendix Table 3.6.

[a] Foods, beverages, tobacco, agricultural inputs and capital goods, and raw food products and fibers for industrial processing.

[b] Pharmaceuticals, clothing, other nondurables and consumer durables.

[c] Minerals, chemicals, other nonagricultural raw materials and capital goods for industry.

[d] Construction materials.

[e] Transportation equipment, fuels and lubricants and miscellaneous.

materials and capital goods for industry have increased in relative importance throughout the last two decades from 35.5 percent of total imports in 1965-1968 to 50.5 percent of total imports during 1984-1987. When imports of raw materials of agricultural origin for industrial processing (which are defined as part of agricultural imports in this analysis) are counted as part of industrial imports, industry's share of total imports increases from 50.5 to 62.4 percent for 1984-1987 and agriculture's share falls from 18.4 to only 6.6 percent. Thus, the industrial sector is by far the largest demander of foreign exchange for imports. The transportation sector (which is defined to include transportation equipment, fuels and lubricants and miscellaneous imports) is the second most important demander of foreign exchange with 19.6 percent of all imports on average during 1984-1987. Thus, the industrial and transportation and communication sectors dominate imports. Industrial consumer goods accounted for 8.3 percent of total imports and construction materials were 3.2 percent.[6]

The most important class of agricultural imports is raw materials of agricultural origin for industrial processing at 64.4 percent of the total during 1984-1987, down from 71.0 percent in 1965-1969 (Table 3.6, Appendix Table 3.7). The

Table 3.6 Principal Agricultural Imports, Annual Averages, 1965-1969, 1975-1979 and 1984-1987

Year	Agricultural Consumer Goods[a]	Fertilizer & Other Inputs[b]	Capital Goods[c]	Agricultural Raw Materials for Industry[d]	Total
Value (US$ 1,000 CIF)					
1965-69	6,387	4,649	5,297	39,925	56,258
1975-79	34,464	32,375	35,693	115,416	217,951
1984-87	27,705	63,074	25,096	215,395	334,271
Share (%)					
1965-69	11.4	8.3	9.4	71.0	100.0
1975-79	15.8	14.9	16.4	53.0	100.0
1984-87	8.3	18.9	8.4	64.4	100.0

Source: Appendix Table 3.7.

a Foods, beverages and tobacco.

b Fertilizer, animal feeds, pesticides and other inputs.

c Machines and implements, tractors and transportation equipment, and other agricultural equipment.

d Cereal grains, unrefined vegetable oils, powered milk and other unprocessed foods, natural fibers, and hides.

most important imports in this class are wheat, barley, unrefined vegetable oils, powdered milk, cotton, wool, hides and other food products for processing. Agricultural consumer goods for direct consumption (food, beverages, and tobacco) were 8.3 percent of agricultural imports during 1984-1987, down from 11.4 percent in 1965-1969.[9] Operating and capital inputs for agriculture accounted for 27.3 percent of agricultural imports on average during the 1984-1987 period, up from 17.7 percent two decades ago (see Chapter 6 for more information on agricultural inputs).

In summary, agricultural imports are a relatively small part of total imports even when raw materials of agricultural origin for industrial processing are included. The industrial and transportation sectors dominate imports and are the largest demanders of foreign exchange.

An Agricultural Trade Surplus

Agricultural exports have exceeded agricultural imports by a substantial margin during the last two decades (Figure 3.3, Appendix Table 3.8). The trade surplus ranged from US$80 million in 1965 to US$866 million in 1986 a ten fold

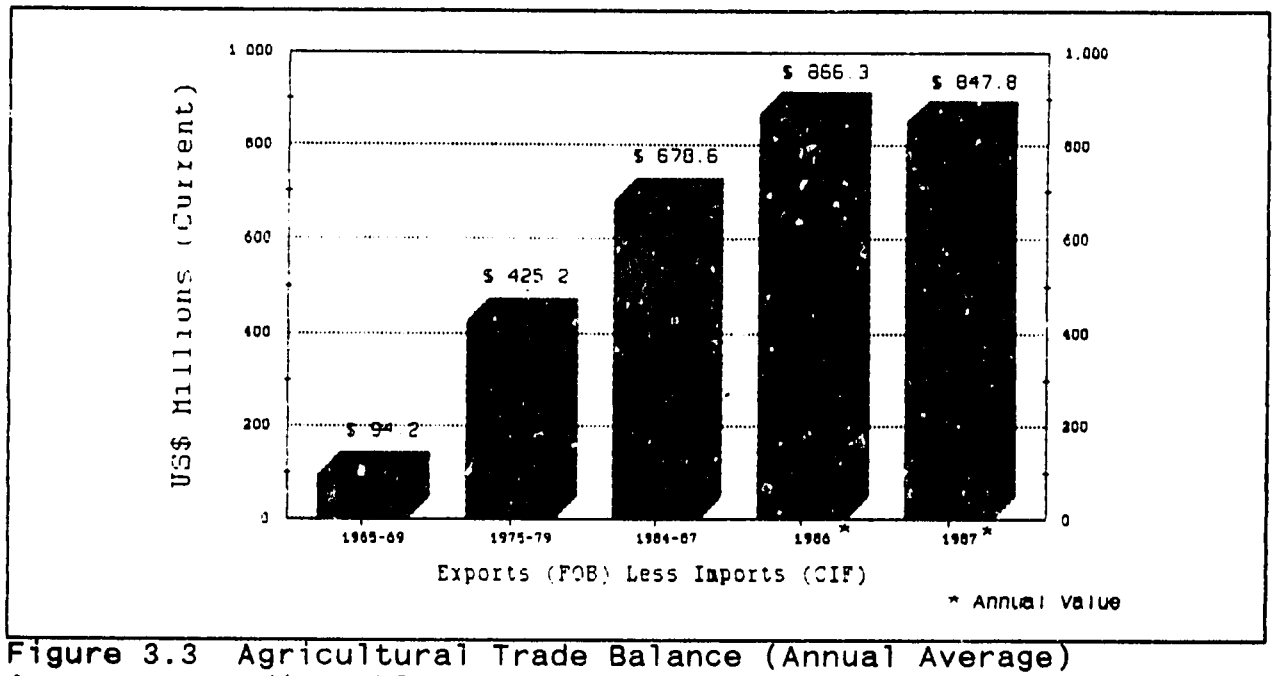

Figure 3.3 Agricultural Trade Balance (Annual Average)
Source: Appendix Table 3.8.

increase (measured in current dollars). The surplus averaged US$94 million per year during 1965-1969, US$425 million during 1975-1979 and US$679 million during 1984-1987. The surplus has approached the US$1 billion level during 1986 and 1987.

Agricultural exports have been sufficient to pay for all imports of: (a) food, beverages and tobacco for direct human consumption; (b) inputs and capital goods for agriculture; (c) raw materials of agricultural origin for industrial processing (primarily food products, wool, cotton and hides); and (d) all costs associated with these imports, including customs charges, insurance and freight, with relatively

large surpluses left over. These surpluses have contributed significantly to the foreign exchange earnings of Ecuador. The agricultural trade surplus exceeded petroleum exports in both 1986 and 1987 and averaged over 55 percent of petroleum exports since 1965. The agricultural trade surpluses have been utilized, in large part, to subsidize and sustain the import-substitution industrialization approach to economic development during the last three decades.

The agricultural trade surplus has been sufficiently large to pay for all or most of industry's imports of other raw materials (besides those of agricultural origin) and capital goods depending on the period under consideration (Table 3.7).

Table 3.7 Agricultural Trade Balance, 1965-1987 (US$ 1,000,000)

Years	Agricultural Exports (FOB)	Agricultural Imports (CIF)	Trade Balance	Raw Materials & Capital for Industry	Trade Balance as Share of Industrial (%)
1986	1,174.5	308.2	866.3	944.4	91.7
1987	1,157.9	310.1	847.8	1,097.8	77.2
Average					
1965-69	150.5	56.3	94.2	74.5	126.4
1975-79	643.5	218.0	425.2	601.5	70.7
1984-87	1,012.9	334.3	678.6	916.6	74.0

Source: Appendix Table 3.8.

During 1965-1969 agricultural trade surpluses were 126.4 percent of industrial imports; agricultural exports covered 74.0 percent of the much larger industrial imports during 1984-1987.

Agriculture has made and continues to make a major contribution to economic growth and development through the generation of very large surpluses of foreign exchange. This is a remarkable accomplishment when the disincentives to invest in agriculture inherent in the macroeconomic policy matrix and the general neglect of the sector are considered (see Chapter 2).

Opportunities for Improving the Agricultural Trade Balance

Agricultural exports are very important earners of foreign exchange but Ecuador's continued reliance primarily upon five principal exports should be a cause for serious concern. Producers in Ecuador face generally elastic world prices for their exports and are unlikely to be able to influence prices in the next few years. Prices for these products are determined by constantly changing market conditions outside Ecuador. One reality of world markets is the volatility of prices in response to changes in international supply and demand, so that Ecuador's foreign exchange earnings always are subject to substantial variations which are beyond the influence of domestic policies. The devastating consequences of the precipitate fall in petroleum prices in 1986 and coffee prices in 1989 are grim

reminders of the painful adjustments such price swings can impose on a small, open economy such as Ecuador.

Changes in world market conditions also can result in erosion or loss of Ecuador's market shares to international competitors as has happened with cacao (Ghana and Brazil), bananas (Colombia) and is happening with shrimp. There are many countries in Asia and Central America that will strongly challenge Ecuador's share of the fresh shrimp market in the next few years, as their productive capacity develops. The recent incursion into the market by China is a case in point. Technological improvements in both production and marketing processes will determine which countries are able to consolidate their shrimp industries and remain as significant suppliers in the highly competitive North American and European markets.

A potential exists for increasing the domestic agricultural production for export and for domestic production of several of the food and fiber items now imported for direct consumption or industrial processing. Ecuador probably could supply close to one third of its wheat and all of its vegetable oils, milk, hides, and wool, and possibly have surpluses for export. There also is potential for exports of rice and vegetable oils to Andean neighbors which import large amounts of these items. Ecuador has perhaps the best agricultural base of any of the Andean countries for producing rice and vegetable oils with evidence of comparative advantage in their production (IDEA; Stewart and Cuesta). Domestic production of fertilizers based on natural deposits of phosphates and abundant natural gas also is a possibility although the economies of scale required for production of nitrogen fertilizer are large (Hammond and Hill). Again, however, there may well be opportunities for export of any surplus fertilizer production to Andean neighbors.

The value of potential exports or of savings from production of import substitutes in agriculture is an estimated US$100 million (Whitaker and Alzamora 1988b, pp. 23-27). The export crops with the greatest potential are rice and cacao. Palm oil also has export potential but in the near future is more likely to be an important import-substitute. Other important import substitutes are milk, wheat, cotton and rubber.

V. Nutritional Status and Agriculture

Agriculture in Ecuador contributes to the availability of food in two fundamental ways. First, it produces a wide variety of crops and livestock products primarily for domestic consumption. Second, it generates a substantial foreign exchange surplus after paying for all imports of food and fiber and inputs and capital for agriculture. Thus, it can be argued that the agricultural sector of Ecuador has provided all of the available food, both domestic and imported, and has generated significant additional foreign exchange for development of the rest of the economy.

The adequacy of the available food supply in meeting the needs of Ecuador has two principal dimensions. The first is the nutritional requirements of the population which is treated in this section. This dimension is concerned with whether there is enough food and of sufficient quality to provide, on average, the minimum level of nutrition necessary for a healthy and productive life for each member of society. The second is the cost of food which is considered in the following section.

Conventional Wisdom and Data

It is commonly believed in Ecuador that there is not enough food available, on average, to meet the minimum nutritional needs of the population. This viewpoint has been a continuing theme of the popular press and of some institutions and observers over the last two decades (see, e.g. Freire and Polanco 1984). This school of thought has criticized the large imports of food and the shift of lands out of Sierra cereals, tubers and legumes and into pastures and production of animal proteins (see Chapter 6). It has called for increased production of traditional Sierra crops and argues for self-sufficiency in meeting the nutritional needs of the population. It has not recognized the critical role of agricultural exports in paying for food imports nor of past GOE policies which subsidized imports of food to the detriment of domestic production.

Data for measuring the nutritional status of the Ecuadorian population are limited and confined almost exclusively to small case studies or to estimates of apparent consumption from secondary data. There have been only two national nutrition surveys and neither was representative of the total population. The first was carried out in 1959 by the Ecuadorian military, the Ecuadorian National Institute of Nutrition (INNE) and the Interdepartmental Committee on Nutrition for National Defense (ICNND) of the U.S. Departments of State and Defense (see ICNND). The second was a national survey of children through five years of age carried out by the National Development Council (CONADE) in 1986 which relied on anthropometric measurements (Freire).

Past Analyses of Apparent Consumption

Several analyses of food balances for various years between 1961 and 1980 comprise the principal sources for inferring that there has not been enough food to meet minimum nutritional requirements of the population. Estimates of apparent consumption were made by Freire and Polanco, the United Nations Food and Agriculture Organization (FAO) 1980 and 1977, the United Nations Economic Commission for Latin America (CEPAL) and FAO, and Ribadeneira Baca. The general approach of each of these studies was to calculate the apparent consumption of food by adjusting production for imports, exports, stocks, losses in marketing, animal feeds, seeds, industrial processing losses and food preparation losses. The edible balance was converted to nutrient content (energy, protein, vitamins, etc.) by use of standard factors to determine the amount of nutrients available per capita per day. Minimum daily requirements, as recommended by various national and international agencies, were adapted to the body-weight regime and the age and sex distribution of the population to determine weighted average per capita requirements. The comparison of average daily per capita availability with weighted average per capita daily requirements (or standards) indicated whether the particular nutrient was surplus or deficit.[10]

The results of these analyses vary considerably for both energy and protein (Table 3.8). The studies found deficiencies in energy, as measured by kilocalories, for various years between 1961 and 1980 ranging from 77 to 92 percent of the standard utilized. The CEPAL-FAO and FAO studies each revealed a trend of increasing levels of energy consumption from about 80 percent of the standard in 1961 to over 90 percent by 1974. The Freire and Polanco and Ribadeneira Baca studies found much lower levels of energy consumption in 1968 than did the CEPAL-FAO and FAO studies for 1968 and 1969-71, respectively. The Freire and Polanco study showed the same increasing trend as CEPAL-FAO and FAO between

Table 3.8 Daily Availability of Energy and Protein per Capita in Ecuador, Based on Calculation of Apparent Consumption from Various Studies, 1961-1980

Year	Study	Apparent Consumption		Standard Utilized[a]		Apparent as a Share of Standard	
		Energy (k calories)	Protein (grams)	Energy (k calories)	Protein (grams)	Energy (%)	Protein (%)
1961	CEPAL-FAO	1,885	46	2,300	45	0.82	1.02
1961-63	FAO (1977)	1,845	46	2,290	--	0.81	--
1968	CEPAL-FAO	2,023	45	2,300	45	0.88	1.07
1968	Freire-Polanco	1,748	41	2,300	62	0.76	0.66
1968	Ribadeneira-Baca	1,618	42	2,100	57	0.77	0.74
1969-71	FAO (1977)	2,062	--	2,290	--	0.90	--
1972-74	FAO (1977)	2,087	47	2,290	--	0.91	--
1974	CEPAL-FAO	2,109	48	2,300	45	0.92	1.07
1974	Freire-Polanco	1,985	37	2,300	62	0.86	0.60
1975-77	FAO (1980)	2,109	50	--	--	--	--
1980	Freire-Polanco	1,755	44	2,300	62	0.76	0.71

Source: See references to this chapter for the detailed citation of each study.

[a] The standards utilized vary according to the study. They generally are weighted-average per capita requirements, but for a weight regime of a typical developed country taken from FAO-WHO. An exception is the 62 grams of protein from Freire which is the FAO-WHO "safe level" at a score of 60 percent for a moderately active adult male weighing 65 kilos. Freire incorrectly compares this to percapita consumption, rather than to consumption per adult male equivalent. See text.

1968 and 1974, then a decrease by 1980 to 1968 levels.

The CEPAL-FAO study found per capita protein consumption, measured by grams, exceeded the standard in 1961, 1968 and 1974, with a slight increase between 1961 and 1968 and then maintenance of this level in 1974. Freire and Polanco and Ribadeneira Baca found substantially lower levels of protein consumption in 1968 than CEPAL-FAO at only 66 and 74 percent of the standard, respectively. Moreover, Freire and Polanco's results indicated a strong decrease in per capita protein consumption by 1974 to only 60 percent of the standard and then an increase by 1980 to 71 percent, back to near the 1968 level.

Great care must be exercised in interpreting the results of these studies because they all contain errors. They tend to overestimate the protein and energy standards and hence conclude that deficits are greater and surpluses are less than they actually are.

First, all the studies appear to use standards based on average body-weights more representative of a developed than a developing country. These standards are based on recommendations of FAO and the United Nations World Health Organization (WHO) but appear to have been erroneously adapted from those for FAO-WHO's typical developed country rather than its typical developing country. For example, Freire and Polanco (p. 30) describe their reference or standard man

as that for "...developing countries, being a man of 29-39 years of age, with a weight of 65 kilograms, healthy and able to work 8 hours per day in moderate activities." (Translation by author.) However, 65 kilograms is the weight of the reference man for FAO-WHO's typical developed country; that for a typical developing country is only 53 kilograms (FAO-WHO p. 82). They also are based on recommendations of the National Institute of Nutritional and Social-Medical Research (ININMS) which uses a body-weight regime that is nearly identical to FAO-WHO's typical developed country and was adapted from data for Central America (Oleas p. 5; INCAP). Thus, the body-weight regime utilized in these studies is not even based on studies of body-weight in Ecuador which has people of relatively small stature. To the extent the body-weight regime utilized is heavier than that of the Ecuadorian population, the protein and energy standards are too high and protein and energy deficits are overestimated (or surpluses are underestimated).

Second, the Freire and Polanco study also substantially overestimated the magnitude of the protein deficit because it compared the protein requirement for a standard or reference man with the per capita availability for the population. The study should have compared the weighted average requirement for protein for the population (adjusted for body-weight and weighted by the age and sex distribution of the population) with the per capita availability. Such comparisons would have revealed much smaller protein deficits, or even surpluses and would have been more consistent with CEPAL-FAO and FAO results.

Third, the protein standard in Freire and Polanco is further overestimated because of an unduly pessimistic assumption about the quality of protein in the Ecuadorian diet. The ININMS's standards assume that only 60 percent of the protein is high quality, equivalent to milk or eggs, with all the essential aminoacids (Oleas). FAO-WHO (p. 73) indicates that poor countries like Ecuador have a protein quality that averages 70 percent and that an average quality of 60 percent is typical of only the very poorest developing countries where "...70-80 percent of the diet comes from such foods as cassava and maize and virtually none from animal foods..." The CEPAL-FAO study corrected its protein standard to a score of 65 percent in recognition of this deficiency (Szretter 1982, p. 207).

Apparent Consumption: 1985

Apparent consumption was calculated for 1985 utilizing the same general methodology employed in the studies cited above. Domestic production was adjusted for imports and exports, stocks (when available), animal feed, seeds, and processing, marketing and food preparation losses. The remaining edible portion was converted to energy and protein equivalents utilizing factors published by INN, the predecessor agency of ININMS. This analysis indicated daily, per capita consumption in 1985 of 2,354 calories of energy and 46.6 grams of protein (Table 3.9, Appendix Table 3.9). Not included in this total are an estimated 207 calories consumed in the form of sugarcane-based alcohol and home made brown sugar (*panela*).

The per capita requirements for energy and protein consumption were calculated for the Ecuadorian population in 1985, based on the published recommendations and average body-weights of ININMS (Oleas) and projections of the population for 1985 by the National Institute of Statistics and Census (INEC), CONADE and the Latin American Demographic Center (CELADE). The average requirements for energy and protein for each age and sex class of given body-weight, and for lactating and pregnant females were weighted by the share of the population in each age and sex group. The resulting per capita requirement was

Table 3.9 Food Balance Sheet for Ecuador, 1985

Food Source	Production	Imports	Exports	Seeds	Ani.feed	Losses & Wastage	Apparent consump	Availab. per/cap.	Daily per capita Energy[a] (k calories)	Daily per capita Protein (grams)
	(metric tons)							(kgs/yr)		
Total	9,594,128	573,820	2,045,658	116,603	257,841	3,444,304	4,303,544	458.90	2,353.27	46.55
I. Grains (e)	660,104	265,531	10,984	55,096	204,708	36,276	612,571	65.32	576.54	14.73
II. Legumes & Nuts	122,253	1,456	0	10,347	0	40,740	72,622	7.74	60.49	3.52
III. Tubers	669,759	0	10	48,999	0	30,840	589,910	62.90	188.91	3.05
IV. Oils and Fats	546,962	267,649	5,458	2,161	53,133	584,974	168,885	18.01	426.26	0.00
V. Vegetables	215,659	0	0	0	0	23,528	192,131	20.49	20.07	0.67
VI. Fruits	3,563,071	1,627	1,649,173	0	0	412,461	1,503,064	160.28	451.37	4.46
VII. Animal	871,117	37,557	62,944	0	0	27,700	818,030	87.23	225.35	17.81
VIII. Other	2,945,203	0	311,089	0	0	2,287,784	346,330	36.93	395.27	2.31

Source: Appendix Table 3.9.

[a] An additional 207 calories per capita of energy are consumed in the form of alcohol and home-made brown sugar, produced from sugar cane. This amount is not included in the total because most of these calories are believed to be consumed mainly as alcohol (definitive data are lacking).

2,285 calories of energy and 49.2 grams of protein (Appendix Tables 3.10 and 3.11).

Comparison of per capita availability with the ININMS based standards indicates that there was enough energy to meet the requirements of the population, on average at 103.0 percent of the standard (Table 3.10) not including that from alcohol from sugarcane. Protein availability was only 94.7 percent of the minimum standard.

The ININMS per capita energy and protein requirements for 1985 were corrected to account for too low a protein score and for body-weights that appear to be too heavy for Ecuador. The protein score was assumed to be 70 instead of 60 percent per FAO-WHO findings (p. 73) which reduced the weighted average protein requirement from 49.2 to 42.2 grams. The modified protein requirement and the energy requirement also were adjusted downward to reflect the body-weight regime of FAO-WHO's typical developing country (p. 82).[13] When this correction is made the protein requirement falls further to 37.3 grams and the energy requirement falls from 2,285 to 2,020 calories.

Utilizing these corrected and more realistic standards indicates apparent consumption of energy and protein in 1985 were 116.5 percent and 124.9 percent, respectively, of the average requirements for Ecuador in 1985. Moreover, the protein availability per capita as calculated in all the apparent consumption studies cited above is greater than the corrected standard excepting in the Freire and Polanco results for 1974. The level of apparent consumption of energy per capita is very close to the corrected energy requirement in six of the eleven previous studies of apparent consumption and estimated deficits are much smaller than with the higher standards utilized in the studies.

Quality of the Diet

The quality of the average diet also was analyzed in relation to a suggested

Table 3.10 Daily per Capita Apparent Consumption of Energy and Protein Compared to ININMS Standards and to Corrected Standards for Ecuador, 1985

Class	Energy (k calories)	Protein (grams)
1. Apparent Consumption[a]	2,354	46.6
2. ININMS's Standards[b]	2,255	49.2
3. Corrected Standards[c]	2,020	37.3
4. Available as Share of Standards		
(a) ININMS	103.0%	94.7%
(b) Corrected	116.5%	124.9%

Source : Appendix Tables 3.9, 3.10, and 3.11.

[a] Not including 207 grams from sugarcane-based alcohol, and panela (home-made brown sugar).

[b] Weighted by Ecuador's age and sex distribution in 1985.

[c] Protein score of 70 percent instead of 60 percent, and body-weight regime similar to that of a developing, instead of a developed country.

ININMS standard for sources of energy and found to be reasonably good (Table 3.11). The apparent consumption of various foods was converted to calories derived from protein, fat and carbohydrate sources by utilizing average conversion factors (White, Handler and Smith). The calculated percentage distribution of calories from

Table 3.11 Quality of the Diet in Terms of Energy Sources

Food Class	Source of Energy (k calories)			Total
	Protein	Fat	Carbohydrates	
Grains	61.5	30.0	494.2	586.0
Legumes & Nuts	14.8	15.4	33.3	63.5
Tubers	12.4	1.2	172.1	185.6
Oils and Fats	0.0	458.4	0.2	458.6
Vegetables	2.8	1.8	23.1	27.7
Fruits	19.2	19.7	474.5	513.4
Animal Foods	73.0	116.2	40.9	230.1
Other	9.5	46.1	377.6	433.2
Total	193.5	688.5	1,615.8	2,498.2
Percent of total	7.75%	27.57%	64.68%	100.00%
Recommended Diet (ININMS)	9-11%	30-35%	54-61%	

Source: Whitaker and Alzamora 1988a, Appendix Table 4.

each of the three energy sources was compared to the ININMS standard to measure the quality of the diet. The comparison indicated that too little of the average diet came from proteins and from fats and that too much came from carbohydrates. The deviations from the ideal were not large, however, suggesting that the quality of the average diet is reasonably good. No attempt was made to adjust this analysis for the corrected energy and protein standards but the implication is that the quality of the diet is somewhat better than indicated.

Average versus Minimum (Marginal) Requirements

It is important to recognize that the earlier studies of apparent consumption and the 1985 analysis in this study measured per capita food availability in relation to the average requirements for the population. Surpluses or deficits defined in this way can be misleading because it is tempting to interpret them as absolute indicators of the availability or shortage of adequate food supplies. The more important issue is how many people fall below the margin not whether the minimum requirement is satisfied on average.

A surplus of food on average does not imply either: (a) that all people are consuming the minimum nutritional requirement; or (b) that excess food supplies exist which can be allocated to those consuming below the minimum requirement. In fact, the term "surplus" is a misnomer because all the available food supply is consumed with higher-income groups consuming more than the minimum requirements and the lowest-income groups consuming less than the minimum. The supply of food would have to be increased to raise consumption up to the minimum standard for all those consuming below it. Thus, even with a "surplus" compared to average requirements a food deficit may exist when compared to meeting all nutritional requirements at the margin.

Ecuador has a highly unequal distribution of income. This suggests a significant number of people have limited economic access to food relative to the situation that would exist with a more equitable distribution of income. The more optimistic findings of the 1985 analysis of apparent consumption relative to the earlier studies are ones only of degree; as will be shown below there is a significant proportion of the population who do not have economic access to a minimally nutritious diet suggesting a food deficit relative to total nutritional needs.

Nutritional Deficiencies

While the above analyses suggest there has been enough, or close to enough food, on average, to meet the minimum nutritional requirements of the population in the years studied between 1961 and 1985, there are serious nutritional deficiencies among various subgroups of the population. These have been documented in a number of case studies and in the national surveys referenced above.

Thomason found that energy consumption in 1953 and 1954 among lower income groups in the rural and urban Sierra was deficient. The national level ICNND survey of civilian and military populations found inadequate consumption of riboflavin, thiamin, niacin and calcium among both groups. Civilians had a high incidence (40 percent) of goiter (iodine deficiency) in the Sierra and anemia (iron deficiency) in the Costa, with inadequate energy intake, especially in the rural Sierra (ICNND). The endemic level of goiter appeared to be declining in later years in response to the compulsory iodization salt and is no longer considered a serious

nutrition problem. Several studies of specific population groups and geographic regions, however, have found very high levels of nutritional anemia (Freire and Polanco p. 41).

A study by INNE found that malnutrition was greater in rural than in urban areas and more prevalent in the Sierra than the Costa. The same study found infants, preschool children and pregnant and lactating females to be most at risk. A number of studies over the last two decades based on samples of local population groups have found evidence of growth faltering which has been attributed by some analysts to protein-energy deficiencies among children (Meneses and Proaño).

The national-level survey by CONADE in 1986 provides the first comprehensive analysis of malnutrition among children (Freire).[14] The study utilized anthropometric measurements to determine the incidences of acute, chronic and global malnutrition among children ages 0-59 months.

Acute malnutrition (underweight for height) appears in the second semester of life among 2 percent of children, rises to 16 percent in the second year, falls to 7 percent in the third year and then to zero. This is an alarming statistic because it indicates that a relatively large number of children are malnourished during one of the most critical phases of physical growth and development--the weaning period. The resultant loss of body weight, if it is sustained, leads to permanent stunting. Acute malnutrition disappears after age three, suggesting that nourishment becomes adequate for children after weaning.

Permanent stunting because of acute malnutrition during the weaning period is evidenced by the increasing proportion of children suffering chronic malnutrition (too short for age). The Freire study showed that 16 percent of infants 0-5 months were too short for their age, increasing to 56 percent of five-year olds. The short height for age of 16 percent of newborns and infants is inconsistent with the almost complete absence of acute malnutrition in this age group. The explanation appears to be that a significant proportion of mothers are of relatively small stature, and give birth to short babies. If infants are classified as chronically malnourished when, in fact, they were born short the Freire study may overestimate the incidence of chronic and global malnourishment (see Nelson). Global malnutrition (underweight for age) is negligible among infants but jumps to 47 percent of children ages 12-23 months, reflecting the combined effects of acute and chronic malnutrition. Global malnourishment then declines to 38 percent for ages 24-59 months, suggesting that some children who were previously underweight for their age gained enough weight to drop out of the classification. This finding is consistent with the disappearance of acute malnutrition in older children and suggests that some children receive sufficient food after age two to reverse the earlier effects of acute malnutrition.

A key question is the reason for the high incidence of acute malnutrition (underweight for height) during ages 6-35 months and especially during ages 11-23 months. One possible explanation is that has gained wide acceptance in Ecuador is that there is not enough food available to meet minimum nutritional requirements of children and especially weanlings. This is the rationale for the plethora of feeding programs that have been implemented with the assistance of various international donors.

Another explanation focuses on diseases and feeding practices during the weaning period (Nelson; Jonnson). There is evidence that traditional but improper feeding practices, in association with unfounded home remedies for treatment of diseases, severely limit energy consumption among infants of weaning age (Nelson p. 4; Grijalva, et al.). One study clearly demonstrates that mothers routinely fed inadequate food during weaning and in the presence of disease, because of poor

feeding practices and remedies based on folklore (Novotny). The weaning period coincides almost perfectly with the very high incidence of acute malnutrition observed by Freire when most permanent stunting occurs.

Almost nothing is known about the nutritional status of older children, youth and adults in Ecuador due to lack of representative studies of these groups. The next section, however, will demonstrate that access to food by many families is severely constrained by economic realities and that the cost of food again is increasing relative to other consumption goods. The implication is that some in these population subgroups are malnourished because of insufficient quantity or quality of food and that the magnitude of the problem may be worsening. Thus, it appears that malnutrition among children is a function of poor feeding practices, diseases and of absolute lack of food for some families, and the interaction of these variables.

VI. The Cost of the Diet

This section focuses on the economic aspects of adequate nutrition. The level of income necessary to meet minimum nutritional needs and other basic requirements, the number of people who fall below this level and the degree of their poverty are of critical importance to government agencies concerned with health and welfare and more generally with development planning. The trend in food prices also is of concern in understanding the dynamics of access to food by the poor. Finally, poverty and relative food prices affect prospects and options for agricultural and economic development. Each of these factors is considered in turn.

The Degree of Poverty

Critical poverty is defined as having insufficient income to afford even a minimally nutritious diet. The threshold of critical poverty is the level of income needed to just purchase adequate food to meet minimum nutritional needs and is referred to as basic food income. Relative poverty is defined as having enough income to meet minimal nutritional needs but not enough for all other basic necessities. The threshold of relative poverty is the level of income needed just to meet all basic needs and is referred to as basic needs income. The terms "basic food income" and "threshold of critical poverty" are used synonymously, as are the terms "basic needs income" and "threshold of relative poverty". The usual approach for determining the degree of critical and relative poverty is as follows. The basic food income is estimated by calculating the cost of the minimally nutritious diet from nutritional recommendations and food prices. This threshold of critical poverty then is divided by the Engel coefficient (the share of income spent on food out of total expenditures) in order to estimate basic needs income or the threshold of relative poverty. These two thresholds then are compared with the distribution of income to determine the share of the population which falls below them and thus measure the magnitude of critical and relative poverty.

This approach identifies three groups: those which have incomes above the threshold of relative poverty and can afford a nutritious diet and other basic necessities, with surpluses for other wants; those whose incomes fall between the thresholds of relative poverty and critical poverty who can afford an adequate diet, but not all of the other basic necessities; and those whose incomes are below the threshold of critical poverty, who can not afford even basic food.

Several studies have examined the issue of critical and relative poverty and

the distribution of income in Ecuador or provide sufficient data to make gross estimates of the poverty thresholds and degree of poverty: Barreiros and Teekens, Vos, World Bank 1979, Ministry of Agriculture (MAG) and France's Office of Overseas Science and Technology Research (ORSTOM), the National Planning Commission (JUNAPLA--a predecessor agency of CONADE) and BCE. Unfortunately, data on income distribution and household consumption patterns are for the mid-1970s so estimates of the magnitude of critical and relative poverty are based on data which now are nearly 15 years old.

The results of these studies and estimates by the authors based on data presented in them suggests substantial levels critical and relative poverty in both rural and urban areas (Table 3.12).[15] The three estimates of poverty in urban areas are quite similar and suggest 21-25 percent of urban people are below the critical poverty level and another 29-35 percent are in relative poverty. These results indicate that 50-60 percent of all urban people are in critical or relative poverty. The two estimates of rural poverty are quite different from each other ranging from 13-28 percent in critical poverty and another 19-62 percent in relative

Table 3.12 Magnitude of Critical and Relative Poverty in Ecuador, 1975

Class	Urban			Rural	
1. Critical Poverty	Barreiros-Teekens (1984) (per capita)	World Bank (1979) (per family)	JUNAPLA (1977) (per family)	Synthesis[d] (per family)	MAG-ORSTROM (1978) (per family)
Threshold (Basic Food Income) 1975 Prices	S/. 5,000	S/.23,170	S/.23,170	S/.18,900	S/.18,900
Share of Population Below Threshold[a]	21%	25% +	25% ±	13-16%	26-28%
2. Relative Poverty					
Threshold (Basic Needs Income) 1975 Prices	S/.12,800	S/.59,410	S/.59,410	S/.48,461	S/.48,461
Share of population in class[b]	29%	35%	30%	19-25%	59-62%
Share of population Below Threshold[c]	50%	60% ±	55% ±	32-41%	85-87%

Source: See References for full citation of each of the studies.

a Those in a state of critical poverty.
b People with incomes above critical poverty, but below the threshold of relative poverty, or in a state of relative poverty.
c All those below the threshold of relative poverty including those below the threshold of critical poverty.
d Estimates by authors based on World Bank, Vos, and MAG-ORSTROM sources.

poverty. The higher estimates are based on a field survey by MAG-ORSTROM that enjoys a reputation for quality and the higher-level estimates are deemed more accurate. If they are, rural poverty is more pronounced than in urban areas, with 85-87 percent of rural people in critical or relative poverty. The data upon which these results are based are quite old however and these conclusions are subject to validation for the present.

Prices of Food

The relative changes in the price of food, compared to the price of all other non-food items in the consumer price index have been calculated for Quito, Guayaquil and Cuenca for 1965-1988 (Figure 3.4, Appendix Table 3.12). These data, reported in BCE (1988b, 1987) illustrate that food and non-food items experienced a modest secular trend of increasing prices. The price of food has tended to increase at about the same rate as for non-food items, for most of the period. There are, however, two important exceptions and what appears to be the beginning of a third.

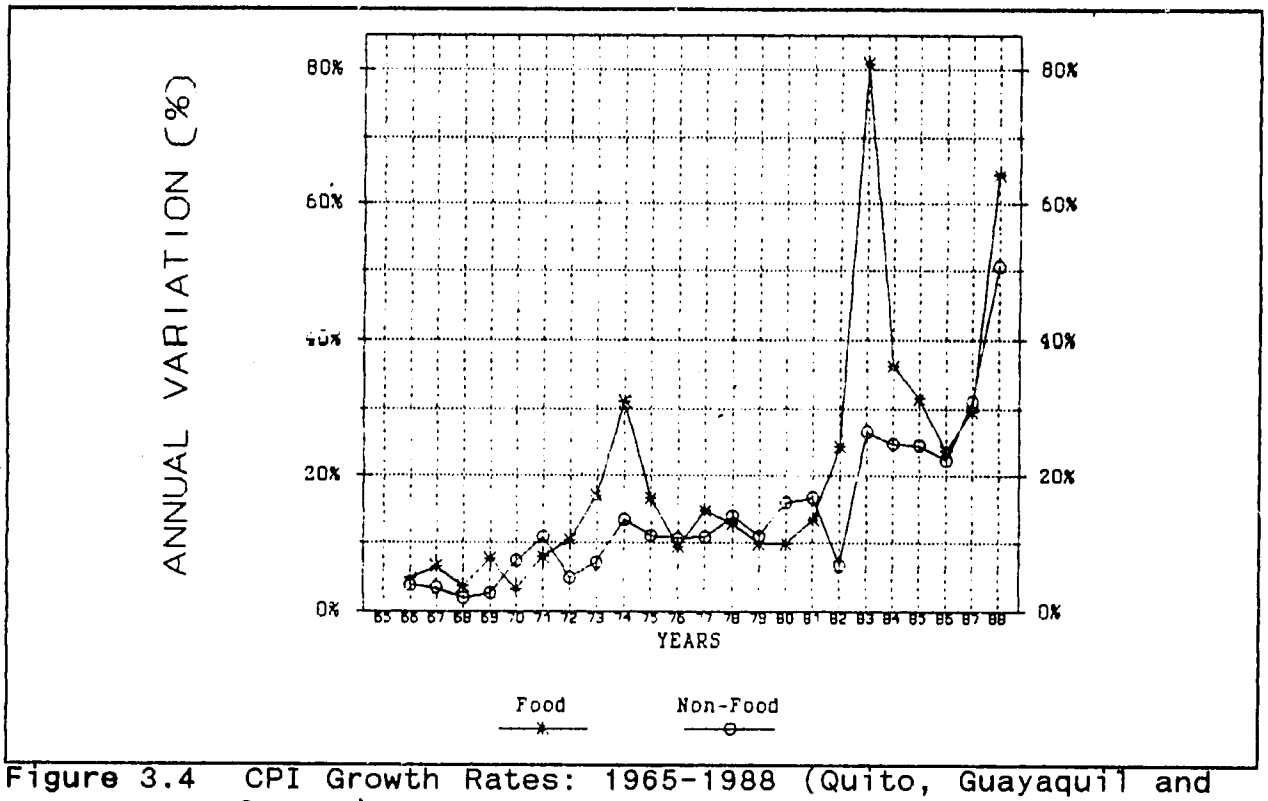

Figure 3.4 CPI Growth Rates: 1965-1988 (Quito, Guayaquil and Cuenca)
Source: Appendix Table 3.12.

The first is the period 1973-1975 when the price of food increased much more rapidly than the cost of other basic consumption goods. One explanation is the El Niño phenomenon of 1973 which reduced supply. The inelastic nature of demand for agricultural products is well known; decreases in supply result in relatively larger increases in price. Another explanation is based on increased demand for food from the large windfall gains from the petroleum boom. A large percentage of these gains went to civil servants and urban workers in the form of higher wages and were translated into increased demand because of relatively high income elasticities of demand for many food items.

The second period when food prices increased much more rapidly than non-food items was during 1983-1984. The large increase in relative food prices is explained by the El Niño phenomenon where food production was reduced drastically in 1983 and had not fully recovered by 1984. Once recovery had occurred, food prices increased at the same rate as non-food items during 1985-1987. The relative increase in food prices appears to have started again between 1987 and 1988.[11] This is at least in part due to the drought in the Sierra during the winter crop season of 1987 (September 1987-February 1988). It also may reflect the clandestine export of foodstuffs to Colombia and Peru.

VII. Summary and Conclusions

The Ecuadorian economy grew at the very rapid rate of 8.2 percent per year during the period 1965-1981, led by import-substitution industrialization and a boom in petroleum production and prices in the 1970s. The agricultural sector barely kept pace with population growth expanding at only 3.4 percent, as macroeconomic policies subsidized industry and other urban-based sectors of the economy at the expense of agriculture and rural people. As a result, the importance of agriculture declined from 26 percent of GDP at the beginning of the period to only 14 percent at the end.

A major recession hit the economy in 1982 and growth has been stagnant since then, averaging less than 2 percent per year during 1982-1988. Austerity measures taken throughout this period to address the recession partially restored incentives to agriculture although industry and the urban-based economy still enjoyed substantial subsidies.

The agricultural sector responded to these improved incentives and grew at an annual average rate of over six percent during 1982-1988 in contrast to its relatively poor performance during 1965-1981. As a result of this pattern, agriculture's share of GDP increased to nearly 17 percent from the low of 14 percent at the beginning of the period. Exhaustation of import-substitution possibilities resulted in complete stagnation of industry. This pattern affected most of the other urban-based economic sectors which also had negative or very low growth rates.

Agricultural exports burgeoned in the post-1982 period due to the improved macroeconomic policy environment and improved incentives. They became the single most important class of exports in 1986 at nearly $1.2 billion exceeding petroleum for the first time since 1971 and maintained this level in 1987. Agriculture is likely to retain this position well into the future, given the expectation of continuing low prices and the reality that petroleum reserves will be exhausted in 10-15 years. Principal agricultural exports include the traditional bananas, coffee and cacao and fresh shrimp.

The agricultural sector has made a major contribution to economic growth and development by generating trade surpluses in every year of both the import-

substitution and austerity periods. Agricultural exports have been great enough to pay for all imports of capital equipment and inputs for agriculture and all imports of final foods and unprocessed food and fiber, with a relatively large surplus of foreign exchange earnings for purchasing capital, raw materials and consumer goods for the rest of the economy. The magnitude of this surplus is surprisingly large at about $850 million in both 1986 and 1987. During 1984-1987 the surplus was sufficient to pay for 75 percent of all industrial imports which, in turn, accounted for over 50 percent of all imports.

Two major changes are required in order to exploit Ecuador's potential for increasing and diversifying its agricultural export base and agricultural trade surplus.

First, the set of macroeconomic and sectoral policies which still discriminate against agriculture will need to be modified in order to provide equal incentives throughout the economy (see Chapter 2). Such policies have resulted in greater imports of raw materials and capital goods for industry and of foodstuffs while dampening incentives for increasing and diversifying agricultural production and exports.

Second, the science and technology base for agriculture will have to be substantially improved and productivity raised, if Ecuadorian agricultural products are to maintain or improve their competitive position in the world markets (see Chapter 13). Ecuadorian farmers still utilize, on average, relatively high cost, low-productivity technologies which keep Ecuador from exploiting its potential comparative advantage. Both these changes will require policy-makers in the Ecuadorian government to recognize the importance of agriculture in economic growth and development and to provide the requisite additional funding for the science base and leadership and support for modifying the policy environment.

Agriculture also has made a much more significant contribution to the provision of an adequate food supply than conventional wisdom would suggest. The agricultural sector provides all food for the population, either from domestic production, or through the generation of sufficient foreign exchange to pay for food imports four times over.

It also has provided enough food to meet the minimal nutritional requirements of the population, on average. The 1985 analysis of apparent consumption indicates a surplus of energy per capita and a very small shortage of protein relative to ININMS's inflated standards for the population. When more representative standards are used, energy and protein are 116.5 and 124.9 percent of the standard, respectively. Finally, energy availability would be 126.8 percent of the standard were alcohol and homemade brown sugar from sugar cane counted as food. Past studies of apparent consumption showed a deficit of food per capita relative to the average per capita requirements, but made methodological errors and utilized minimum requirements that were too high for Ecuador. Such studies did show a trend of increasing apparent consumption. The 1985 analysis indicates this trend has continued and that the availability of food relative to nutritional requirements is much greater than earlier analyses indicated. It also suggest strongly that the improved policy environment and greater incentives for agriculture had a salubrious effect on availability of food.

There are a significant number of people at the margin who do not have economic access to a minimally nutritious diet, notwithstanding the surplus of food on average. The magnitude of poverty should be a cause for serious concern. An estimated 20-25 percent of Ecuadorians are in critical poverty with not enough income to purchase even a minimally nutritious diet. Another 25-35 percent are in relative poverty with income for basic food but not enough to meet other basic

necessities. Moreover, the situation appears more aggravated in rural than urban areas. Thus, roughly half the population is in a state of poverty relative to a very modest standard of well-being.

The data from which these estimates were made are relatively old and the methodology imprecise and rough. No data exists for more precise or current estimates. Even if the degree of poverty were overestimated by 100 percent, however, the magnitude still would be staggering. This suggests the lack of a true middle income class and a major discontinuity between a relatively large, poverty-stricken segment of the population and a small, urban elite. The condition of the poor reflects one of the more fundamental socio-economic problems facing Ecuador--its highly unequal distribution of income. Lack of effective demand for basic food and other basic necessities constrains and limits prospects for agricultural development and constrains growth in other economic sectors producing basic consumption goods.

The hungry people of Ecuador, whose incomes fall below the threshold of critical poverty, tend generally to be the indigenous populations, especially in rural areas (*campesinos*) and those working in the informal sector, primarily in self-employment and outside the minimum wage structure, in urban areas (Moncayo). They are most likely to be recent migrants, illiterate, have large families and tend to perpetuate the conditions in which poverty breeds. They have extremely limited upward economic mobility which precipitates social and political unrest and contributes to destabilizing the very system which can begin to address the fundamental causes of inequities. According to Barreiros and Teekens, education and family planning are most likely to be effective in breaking the vicious cycle of poverty among these people (pp. 31-42).

A national nutrition strategy for Ecuador would need to be closely coordinated with agricultural and economic development programs. One element of the strategy would be to exploit Ecuador's comparative advantage in agriculture by increasing productivity, production and exports. This leads to the same two policy recommendations as for improving the agricultural trade balance: an improved macroeconomic policy environment, and sectoral research, extension and education programs for increasing agricultural productivity.

The burden of increasing food production and export earnings must be focused on commercial agriculture, if the urban poor are to be helped through greater supply responses and downward pressure on food prices. Agricultural development programs focused on resource-poor, part-time farmers (see Chapter 10) will fail to generate the requisite increases in production and productivity. Focusing such programs on commercial agriculture can be justified on welfare as well as efficiency grounds, given the large number of people in critical and relative poverty and the need to increase food supply and lower prices. Also larger commercial farms have generated significant numbers of jobs and programs to maintain their and Ecuador's competitiveness can be justified as part of broader social program.

A second important element of any nutrition strategy would be a welfare program focused on the poorest and most malnourished groups in the population. This element would identify such population subgroups and provide immediate welfare transfers to address the most urgent and pressing cases of malnutrition and poverty. This element also would comprise education programs to address problems of feeding and associated health care practices, which also could be directed more broadly to middle income groups.

NOTES

1. The import-substitution industrialization period spans from the late 1950s to the present. The principal period of rapid industrialization occurred during the late 1960s through 1981 and corresponds closely to the petroleum boom. The period since 1982 has been characterized by auterity measures and economic stabilization with some movement toward a more outward-oriented economy. Nevertheless, the internally-oriented development model based on import-substitution still dominated the economy at the beginning of the 1990s (see Chapter 2).

2. The growth rate for petroleum of 6.1 percent during 1965-1981 in Table 3.1 is substantially underestimated because of an accounting procedure in the national accounts which resulted in negative levels of production in the petroleum and mining sector between 1965 and 1971. The growth rates for the import-substitution industrialization period of 1965-1981 and for 1965-1988 were estimated with post-1971 data.

3. This growth rate has taken into account the poor harvest of 1983, due to the El Niño floods. When 1983 is removed from the calculation, the growth rate increases to 6.3 percent.

4. The negative share of petroleum in total GDP during 1965-1967 is an anomaly of national accounting methodology (see Endnote 1). In fact, petroleum production was positive but very small during 1965-1967.

5. This section is summarized from Whitaker and Alzamora (1988b) which contains a more detailed analysis of Ecuador's foreign agricultural trade.

6. Capital goods for agriculture do not include vehicles which are reported only as a class and not allocated to each of the productive sectors.

7. Calculated from data in Appendix Tables 3.6 and 3.7.

8. "Industrial consumer goods" is defined to include the non-durables (pharmaceutical, clothing, and others) not included in agricultural imports, and consumer durables. See the footnotes to Appendix Table 3.6.

9. It is important to recognize that this share is distorted by inclusion of "raw materials of agricultural origin for industrial processing" as part of agricultural imports. If they were not included, the share of "agricultural consumer goods" in the total would be much higher.

10. The terms "requirements," "standards," and "recommendations," are used synonymously throughout this study to describe the requisite minimum nutritional intake for both energy and protein.

11. See Whitaker and Alzamora (1988a) for a detailed analysis of the methodological errors in each of these studies.

12. The individual requirement for energy is the average for a particular age and sex class of given body size. The requirements for an individual vary from the average depending on body-weight, ambient temperature, level of physical activity,

altitude and the particular metabolic characteristics of the individual. The individual requirement for protein is the minimum safe level of intake for a particular age and sex class of given body-weight defined as two standard deviations above the average requirement for the class. Thus protein requirements are estimates of the upper range of individual requirements with only 2.5 percent of individuals with physiological requirements above these levels. In contrast, energy requirements are averages.

13. See Whitaker and Alzamora (1988a pp. 7-9) for more detail on how ININMS's standards were corrected for the body-weight regime of FAO-WHO's typical developing country.

14. The following discussion is based in part on the critique by Nelson (1988) of the 1986 CONADE study (Freire).

15. See Whitaker and Alzamora (1988a pp. 14-18) for a detailed description of the assumptions underlying the estimation of poverty thresholds and the share of the population in each poverty class.

16. See Spurrier (1988) for a review of increases in the consumer price index during 1987 and early 1988.

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CHAPTER

4

DEVELOPMENT OF ECUADOR'S RENEWABLE NATURAL RESOURCES

DOUGLAS SOUTHGATE

I. Introduction

Development of renewable natural resources is central to Ecuador's economy. Many of the country's farmers enjoy the benefits of fertile agricultural land and adequate rainfall. Exploiting the biological productivity of coastal ecosystems, Ecuador has developed a large shrimp industry. Timber and fuel wood are extracted from the country's forests. In addition, Ecuador has linked its economic growth to hydroelectricity production, the expansion of irrigated agriculture and other forms of water resource development.

Given the importance of soil, water and natural ecosystems to the national economy, the costs of resource degradation in Ecuador are great. Soil erosion hinders agricultural production and jeopardizes a large share of the anticipated benefits of water resource development. Disturbance of coastal ecosystems harms mariculture and offshore fishing. Likewise, mismanagement of forests bodes ill for future growth of the timber industry.

This chapter addresses human interaction with the country's natural environment and identifies reforms needed to encourage resource conservation. Section II provides a description of the country's varied geography and a classification of eight major agro-ecological zones. Section III analyzes agricultural land use and the potential for agriculture to continue its geographic expansion. The general causes of environmental degradation in Ecuador are the subject of Section IV. New approaches to natural resources policy are discussed in Section V, with particular emphasis on rearranging property rights, improving the scientific base for natural resource management and reducing governmental interference with market forces. Section VI examines five critical natural resource problems: destruction of coastal ecosystems, degradation of tropical forests, erosion of prime agricultural land, waste and misallocation of water, and pesticide contamination. Section VII recommends support that donor agencies could give to conservation initiatives in Ecuador.

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All natural resource development issues currently facing Ecuador cannot be covered in a single paper. Management of offshore fisheries, extraction of petroleum and other mineral resources and development of the Galápagos Islands (which is a matter of global concern) are not addressed here. Even the coverage of environmental problems in rural areas of continental Ecuador is not entirely complete. For example, preservation of the country's biological diversity, which is the subject of a recently completed report (Cabarle et al.) is not discussed. In spite of such omissions, the reader will find that major trade-offs associated with the development of Ecuador's soil, water and natural ecosystems are addressed in this chapter.

II. Ecuador's Environmental Diversity

With 26,266,000 hectares of territory on the South American mainland and 801,000 hectares in the Galápagos Islands, Ecuador is a little larger than West Germany or the state of Colorado. Nevertheless, its geography is astonishingly varied (Figures 4.1 and 4.2). From the deserts of the Santa Elena peninsula, west of the coastal metropolis of Guayaquil, one need travel no more than 150 kilometers (km) to reach the humid tropics. Nowhere is Ecuador's coastal plain, known as the Costa region, wider than 200 km. It is bounded on the east by the precipitous western range of the Andes, which is dominated by Mount Chimborazo (6,310 meters above sea level). Next come temperate intermontane valleys of the highlands, or Sierra region, where elevations generally exceed 2,500 meters. After the eastern range of the Andes has been crested a rapid descent into the Amazonian rain forest of the eastern lowlands, or Oriente region, begins. An Amazonian frontier town, Nueva Loja (formerly called Lago Agrio) is only 400 km from the Pacific Ocean and 300 meters higher than the surface of the Atlantic Ocean, which is more than 3,000 km due east.

In Ecuador, dramatic topography is matched by marked variations in climate and by biological diversity. Twenty-five of the 30 life zones identified by Holdridge are found in the country (Cabarle et al. p. 5). In addition, the number of plant and animal species living in or endemic to Ecuador compares to similar numbers for larger countries in the Western Hemisphere (Cabarle et al.).

Clearly, all of Ecuador's heterogenous environments cannot be captured in a map that is visually tractable. The eight agro-ecological zones described in this section, however, represent a reasonable breakdown of the country given criteria generally used to describe Ecuador's renewable natural resource base.

Criteria for Geographical Classification

Five criteria are typically used to distinguish one part of Ecuador from another. The first two are temperature and water availability. Soil quality and land use are the third and fourth characteristics. Accessibility is the fifth criterion.

Temperature

The National Institute of Meteorology and Hydrology (INAMHI) is the primary source of information on median annual temperatures in different parts of the country. Because Ecuador straddles the equator, a location's temperature is generally a direct function of its altitude. The country's temperature gradient averages a decline of 0.55°c for every 100 meters increase in elevation.

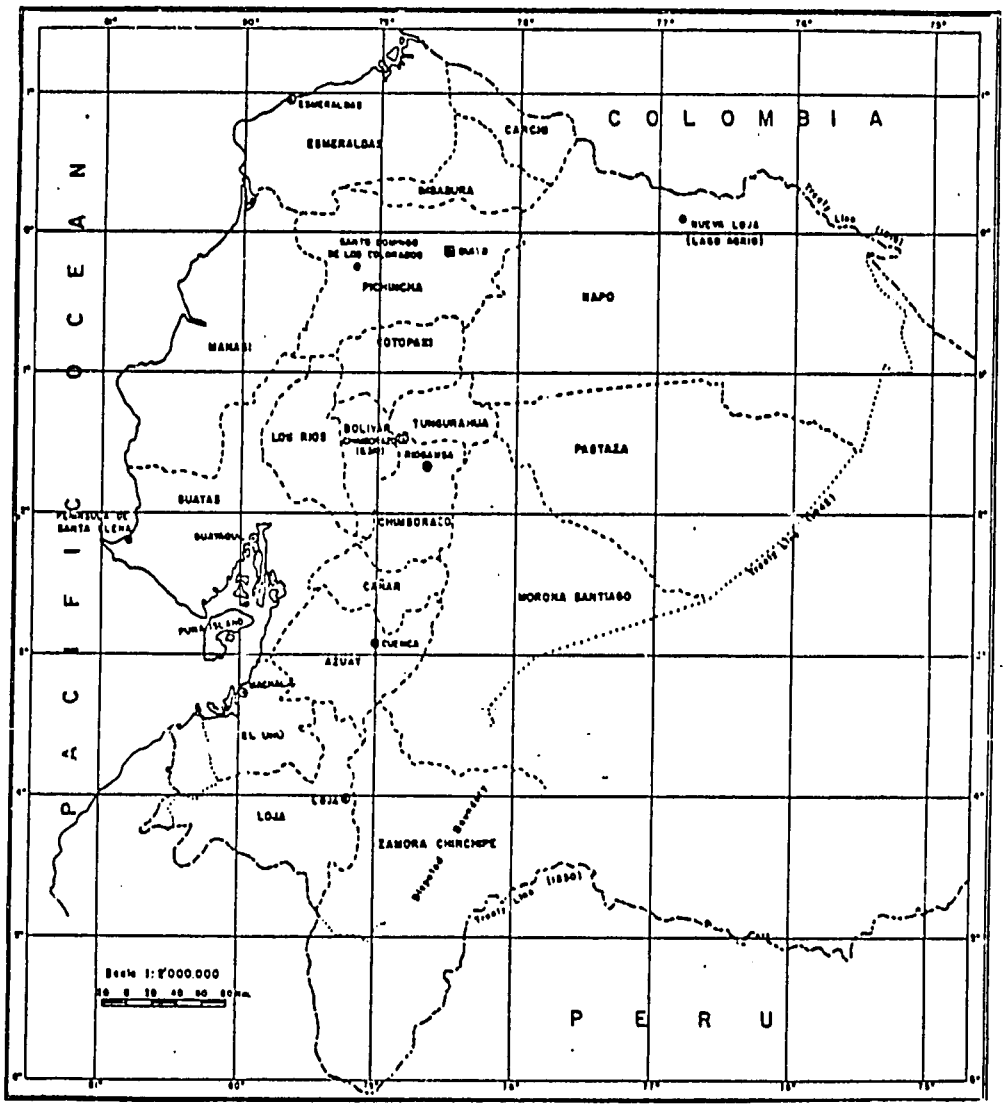

Figure 4.1 Provincial Map of Ecuador
Source : Instituto Geográfico Militar.

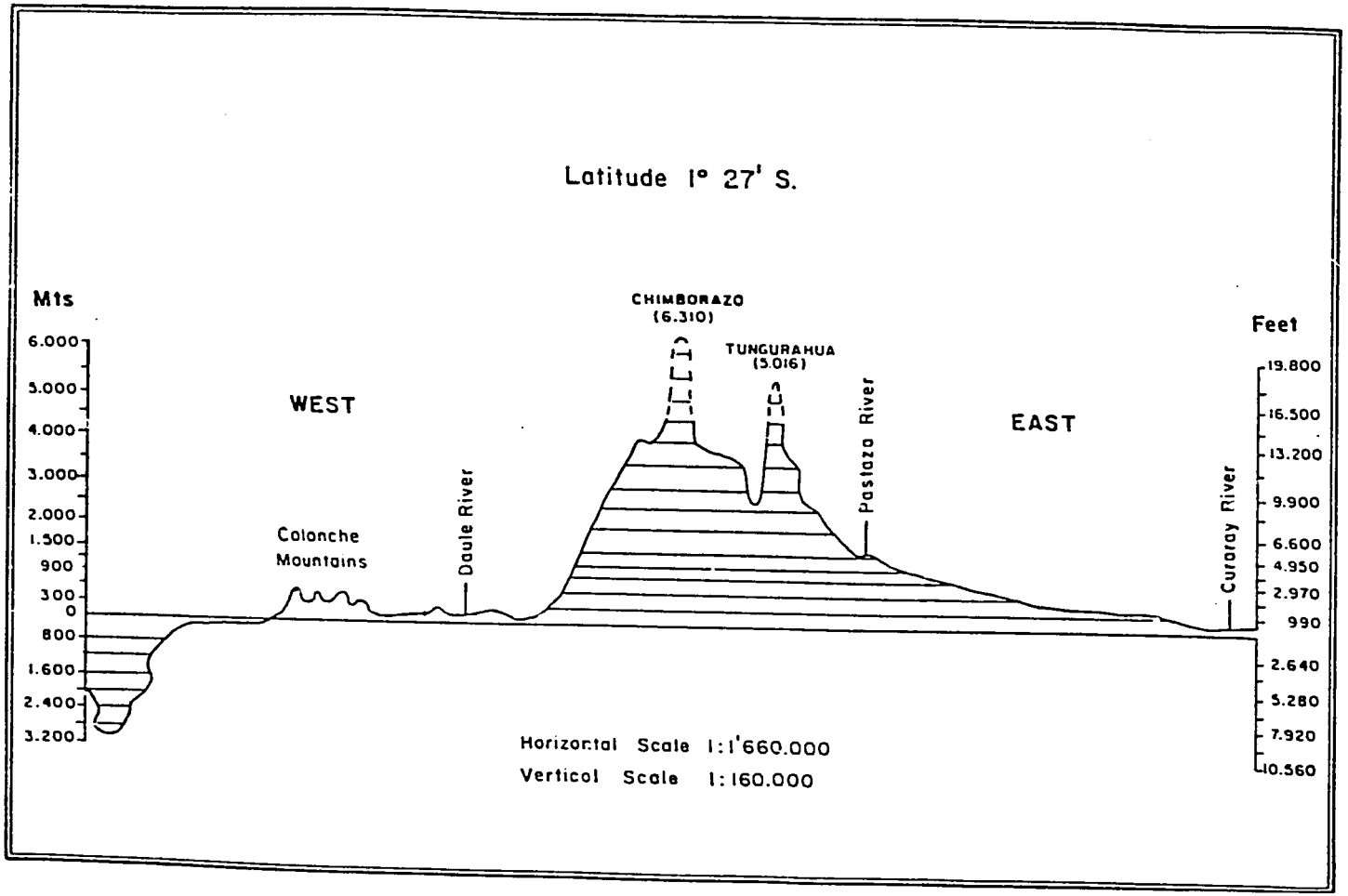

Figure 4.2 Geographic Profile of Ecuador
Source : Instituto Geográfico Militar.

Water Availability

The amount of water that can be used for crop and livestock production in different parts of the country depends both on precipitation and on stream flow. Data on rainfall, both its average yearly total and its monthly variability, are collected at the meteorological stations of INAMHI. Hydrological data are collected by the same agency, by the Ecuadorian Institute of Water Resources (INERHI) which is a part of the Ministry of Agriculture (MAG) and by regional authorities.

Soil Quality

Maps prepared by MAG's National Program for Agrarian Regionalization (PRONAREG) have been used to assess soils' agricultural productivity. When deciding whether land should be used for intensive agricultural production, in permanent pasture, or forested, PRONAREG considers the following soil characteristics: depth, erodibility, rock content, fertility, salinity, drainage and susceptibility to flooding.

Land Use

Regions with extensive natural vegetation (e.g., primary forests) are distinguished from those where most land is used for crop or livestock production. Ecuador's Center for the Survey of Natural Resources by Remote Sensing (CLIRSEN) as well as MAG's National Forestry Directorate (DINAF) are primary sources of land cover data.

Accessibility

Maps showing roads, railways and navigable rivers have been used to rate how well a region is linked with the rest of Ecuador.

Eight Agro-Ecological Zones

The dichotomy between the Sierra region where Ecuador's population was long concentrated and the Costa region where most Ecuadorians currently reside antedates the country's independence. When one keeps in mind the preceding five criteria used to describe different parts of the country, however, neither major region comes close to being homogeneous. It is appropriate to divide the Costa region into three zones: Arid Coastal Plains, Southern Humid Coastal Plains and Northern Wet Littoral. The Sierra, defined by convention as all land in central Ecuador above 1,200 m, is divided among four regions: Outer Faces of the Andes, Northern Hillsides and *Páramos*, Northern Valley Bottoms, and the Southern Sierra. The remainder of continental Ecuador, the Oriente region, is treated as a single zone. Zonal boundaries are indicated in Figure 4.3. A description of each zone follows.

Arid Coastal Plains

Between the equator and the border with Peru, land within a few dozen km of the coast is hot and dry. With the exception of the western part of the Santa Elena peninsula, where the heat is slightly moderated by marine air, average

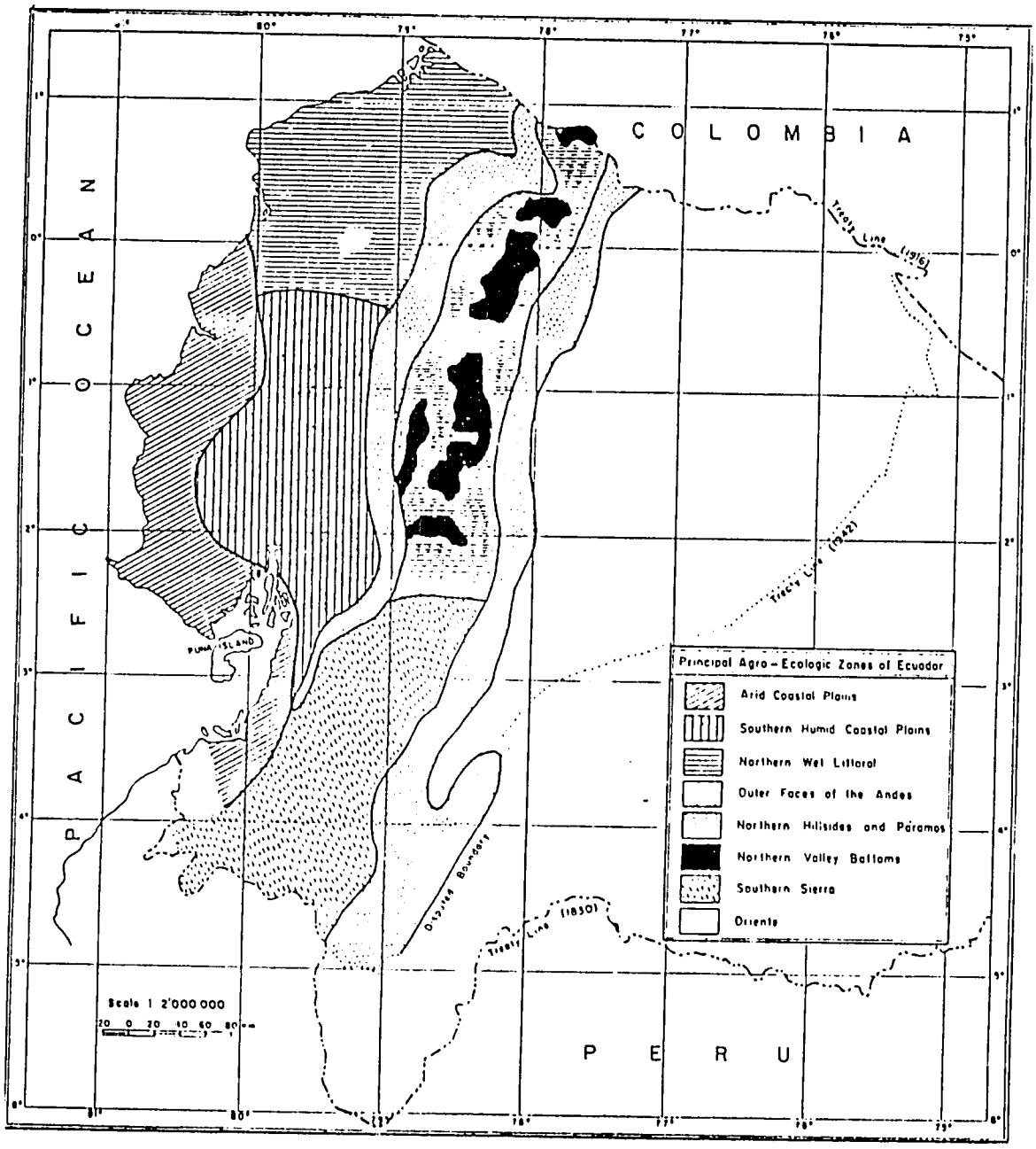

Figure 4.3 Principal Agro-ecological Zones of Ecuador
Source : Prepared by author.

temperatures throughout the region are well above 24°c. Rainfall at Portoviejo, some 20 km inland, averages less than 450 mm a year. Salinas, a resort city at the tip of the Santa Elena peninsula, receives little more than 100 mm of rain in a typical year. As throughout the Costa, precipitation is heavily concentrated in a single rainy season that usually begins in January and is typically over by May or June. Stream flow in the region's few rivers is likewise seasonal.

Vertisols are common along the coast between the equator and the Gulf of Guayaquil. South of Portoviejo, calcium carbonate concentrations are often high. Soils around the Gulf of Guayaquil are saturated with salt water. Except for small pockets of pasture interspersed with cropland (principally along rivers) dry forests and deserts predominate between the equator and the Gulf of Guayaquil. Most of Ecuador's coffee is grown in the hills east and south of Portoviejo. Irrigation water being readily available from rivers flowing out of the Sierra, banana production is the predominant agricultural activity around and to the northeast of Machala. That city is also the center of Ecuador's burgeoning shrimp mariculture industry.

Limited water is a major constraint on agricultural development along the coast between the equator and the Gulf of Guayaquil. It is also a costly constraint to relax. The planned transfer of water into the region will be quite expensive. In addition, farmers in the Arid Coastal Plains face significant competition for water from non-agricultural users. For example, withdrawals of irrigation water from the Poza Honda reservoir, in Manabí province, are greatly reduced in dry years in order to assure adequate potable water supplies for Portoviejo.

Southern Humid Coastal Plains

Lying immediately east of the Arid Coastal Plains is a considerably more humid part of the Costa region. The northern and northwestern borders of the Southern Humid Coastal Plains coincide with the northern and western limits of the Rio Guayas basin, which occupies over half of the region. From a point 50 km due west of Guayaquil, the boundary runs southeastward to within 20 km of the port city, traverses the Rio Guayas and then runs almost directly south. Consistent with conventional practice for determining where the Costa ends, the eastern boundary of the Southern Humid Coastal Plains is defined to be wherever the altitude of the western range of the Andes rises above 1,200 meters. The southern tip of this wedge-shaped region nearly touches the Peruvian border.

Temperatures in the region are as high as in the arid lands immediately to the west. Soils in the Southern Humid Coastal Plains are generally deep and fertile. Except in the low Andean foothills the land is flat or gently sloped. Consequently, soil erosion is not a major hindrance to agricultural development. The agricultural frontier in the Southern Humid Coastal Plains was all but closed by the early 1970s, with only a few forests left standing in the region's Andean foothills. The Southern Humid Coastal Plains are now the agricultural heartland of Ecuador (Bromley). For several decades, rice production has been the dominant agricultural activity in the Guayas river delta. Farther inland, bananas are grown around Babahoyo. Moving northward, up the Guayas river basin, one sees a mixture of cattle pastures, cropland planted to corn, soybeans, sorghum and other annual crops, and tree crops (e.g., African oil palm and citrus). At slightly higher elevations, coffee and cacao production predominate.

The major problem facing farmers in the Southern Humid Coastal Plains is extremely variable precipitation and stream flow. Nearly all the 1,000 mm of rain in Guayaquil, 1,800 mm in Babahoyo (60 km inland from Guayaquil) and 2,100 mm in

Quevedo (an additional 80 km inland) falls during a single wet season that begins in December or January and concludes in June. Stream flow in the region is similarly variable. For example, the Rio Daule crests with a flow exceeding 800 m^3 a second in March and April, two months after the beginning of the Costa rainy season. By July flow has fallen to 100 m^3 a second. Late in the dry season the Rio Daule is little more than a stream, with a flow of 20 m^3 a second during the month of November.

Flooding during the rainy season could be alleviated by constructing more large catchments (like the Daule-Peripa reservoir) by adding more culverts, by protecting forests that remain in the upper watershed or by combining these three approaches. Reservoir construction also would ease agricultural water shortages always experienced during the dry season. If reducing seasonal fluctuations in water availability proves not to be too expensive then opportunities to take additional advantage of the Southern Humid Coastal Plains' rich soils should arise. For example, the two crops of rice currently harvested each year in the lower Rio Guayas basin could be complemented by a third.

However, dams, culverts, and other public works are very costly. The first phase of the Daule Peripa project, undertaken to control flooding and to provide irrigation water and hydroelectricity, is costing US$403 million (in 1988 dollars) (see Chapter 7). Clearly, sound economic analysis of the benefits and costs of improved engineering control of water resources is essential.

Northern Wet Littoral

Extending from the upper reaches of the Rio Guayas basin, a little south of the equator, to the Colombian border is the Northern Wet Littoral. As in the rest of the Western Ecuador, temperatures in the region vary little from month to month and average readings are generally above 24°c. Rainfall is likewise very high with annual precipitation in over half of the Northern Wet Littoral exceeding 3,000 mm. Water availability during the dry season is less of a problem there than it is farther south both because rain falls throughout the year and because rivers flowing through the region originate in the Andes, where monthly fluctuation in precipitation is relatively modest.

Until the 1960s the Northern Wet Littoral was a backwater. Agricultural colonization accelerated rapidly at that time when a new highway linking Quito and Guayaquil passed through Santo Domingo de los Colorados (Bromley). With improvement of the road connecting Santo Domingo to the northwestern port city of Esmeraldas still more farmers flocked into the region. MAG's Ecuadorian Institute for Agrarian Reform and Colonization (IERAC) has adjudicated more land flanking the highway to Esmeraldas than in any other part of the country (Barsky et al.).

After 25 years of agricultural development much of the Northern Wet Littoral has been deforested. Cattle pastures and African oil palm plantations now dominate the landscape around Santo Domingo. Farther to the northwest, towns like Quinindé are surrounded by small farms where various crops and livestock are raised.

Development of additional infrastructure threatens the Northern Wet Littoral's remaining forests. Long in construction, a new highway connecting Ibarra with Ecuador's northernmost port of San Lorenzo is now three-quarters complete. Similarly, a road running northwest from Quito to La Independcia, west of Santo Domingo is in the final stage of construction. This road will reduce travel time from Quito to Esmeraldas from five to three and one-half hours. Finishing these projects will stimulate additional colonization.

Many, both inside and outside of Ecuador, are concerned over continued deforestation in the Costa. The domestic timber industry, which is centered in the Northern Wet Littoral, argues that domestic supplies of wood products could be reduced if forests continue to be converted into pastures and cropland. In addition, fragile soils now covered with forests are not, in general, highly productive for agriculture. Finally, environmental groups in Ecuador and around the world, hoping to maintain national and global biological diversity, propose that measures be taken to protect sites like the Awa Reserve from encroachment.

Outer Faces of the Andes

The Andes being a relatively young mountain chain, the transition from the Costa to the Sierra is abrupt as is the descent into the Oriente, farther to the east. The thin strips of land lying between 1,200 and 3,000 meters on the two outer faces of the Andes are wet, generally receiving at least 2,000 mm of precipitation a year. More than 6,000 mm of rain falls each year in Lita, in Northwestern Ecuador. At 1,200 meters above sea level, median average temperature is around 20°c. At 3,000 meters, it is a little above 10°c.

Building and maintaining roads in wet, steeply sloped areas is a considerable challenge. Consequently, the Outer Faces of the Andes have remained largely inaccessible and covered with forests. However, human pressure, especially on the western face, has grown considerably during the past twenty-five years. Logging is widespread and, although soil erosion from steeply sloped, deforested parcels is often severe, agricultural colonists are penetrating from the Costa. Much of the eastern face of the Andes remains undisturbed. Even there, however, penetration from the Sierra is steadily increasing.

Northern Hillsides and Páramos

Distinct from the land lying below 3,000 meters in elevation on the eastern and western faces of the Andes are the Northern Hillsides and Páramos. This zone extends from the Colombian border on the north almost to Cuenca and includes the steeply sloped lands bordering the Northern Valley Bottoms (which are a separate agro-ecological zone) as well as the gently sloped alpine grasslands (páramos) of the high mountains.

Rainfall varies dramatically throughout the region. Average yearly precipitation south of Quito and along the Colombian border exceeds 1,500 mm. In general, rainfall as well as temperature are functions of elevation. Páramos generally receive at least 1,000 mm of rain a year. At 3,000 meters above sea level, average temperatures are a little over 10°c. A thousand meters higher up, average readings are below 6°c and the risk of frost is appreciable.

Soils in the Northern Hillsides and Páramos are generally of recent volcanic origin. *Cangagua*, which is hard-packed and sterile, covers at least 35 percent of the region (Caujolle-Gazet and Luzuriaga p. 60).

Although land use statistics in Ecuador are highly aggregative (see Section III) it is clear that the agricultural frontier has been advancing steadily into the Northern Hillsides and Páramos for several decades. Hacienda owners had long planted wheat, barley, and other crops on the hillier portions of their estates. Agricultural pressure on the hillsides increased after the 1964 land reform. Holding onto more productive agricultural land in valley bottoms, hacienda owners only allowed marginal hill lands to be redistributed, as *minifundios*, to their former tenants (Commander and Peek).

Soil erosion is a constant problem in the Sierra. Many small farmers gave up trying to farm steeply sloped lands rising from valley bottoms and moved to the higher-elevation páramos. This pattern of migration, which seems to be especially strong around Latacunga and Ambato, might have been promoted in recent years by global warming, which reduces the risk of frost at higher elevations. PRONAREG personnel claim, for example, that crops are being produced in protected "eco-niches" located some 4,000 meters above sea level.

Northern Valley Bottoms

The mild climate of the Andean valleys has long attracted settlement. Average annual temperatures in Northern Valley Bottoms are, in general, above 12°c. In some locations (e.g., Ibarra) average readings approach 18°c. The transition from warm afternoons to cool nights is far more pronounced than monthly variation in temperature.

With the exception of the area south of Quito, the Northern Valley Bottoms tend to be the driest places in the Sierra. Around Ibarra and west of Latacunga, Ambato and Riobamba, less than 500 mm of rain falls in a typical year. However, precipitation in surrounding hills insures that streams flowing through the valley bottoms are a dependable source of irrigation water. The region's soils are similar to those of the surrounding Northern Hillsides and Páramos (see above).

Because the prices of dairy products and meat have generally increased relative to those of wheat, barley and other traditional Andean crops, extensive agricultural holdings in the Northern Valley Bottoms have been used for livestock production. Because that activity is less labor intensive than crop production, the conversion of cropland into pasture was also strongly reenforced during the 1970s and early 1980s by strong growth in urban demand for labor, which pulled up wages in the countryside (Commander and Peek). In spite of the shift to livestock production, production of beans, potatoes and other crops remains significant in the Northern Valley Bottoms.

Southern Sierra

The Southern Sierra, which runs from the Peruvian border to slightly north of Cuenca, is similar in many ways to the rest of Ecuador's Andean highlands. Average yearly rainfall varies from 600 mm to over 1,000 mm. Median temperatures are likewise very mild. Depending on elevation, average readings range from 10 to 15°c.

The most important distinguishing characteristic of the Southern Sierra is its soils which are not of recent volcanic origin. Vertisols with a high calcium carbonate content are common in the hills around Cuenca. Kaolinite clays, which are easily compacted, are found in abundance around Azogues and Loja.

Another difference between the Northern and Southern Sierra is that the latter region's river valleys, where good agricultural land is concentrated, tend to be narrow. Since the region's major cities are also located in river valleys, there is intense urban competition for land well suited for crop production.

Crop production outside of the river valleys is difficult. Poverty stricken minifundios surround Cuenca and Azogues and cattle ranching is a predominant activity throughout the region. Much of the Southern Sierra, however, is covered with dry forests and other natural vegetation.

Oriente

The Oriente is similar in many ways to the Northern Wet Littoral. Average temperatures in the region vary from 20 to well over 24°c. Rainfall is torrential, totalling more than 3,200 mm a year at Limoncocha, a little southeast of Nueva Loja. Precipitation is higher closer to the Andes with over 4,400 mm of rain falling each year at Puyo. Different from precipitation in the Costa, rainfall in Eastern Ecuador follows no strong seasonal pattern and there is no regularly "dry" month. For this reason, stream flow in the Oriente is less variable than it is on the western side of the Andes.

Regardless of President Plaza Lasso's warning that the Oriente is a myth, many Ecuadorians and their political leaders continue to think that the region has great agricultural potential. Ongoing surveys of the Oriente, however, indicate that limited soil fertility, poor drainage, or both renders sustainable crop production uneconomical in most of the region. MAG has found that no more than 16 percent of Northeastern Ecuador should be in cropland or pasture.

Agricultural colonization of the Oriente was largely to a few lower Andean valleys until the late 1960s. Extensive road construction in the region, mostly undertaken to service oil production around Nueva Loja, began during the 1970s. Improved infrastructure, in turn, has stimulated rapid settlement. For example, although forests continue to cover well over half of northeastern Ecuador, 36 percent of the region has been claimed by agricultural colonists, each of whom is gradually deforesting his respective parcel (MAG).

III. Agricultural Land Use in Ecuador

As indicated in the preceding section, the agricultural frontier has expanded in several parts of the country during the last few decades. Farmers have penetrated the forests of the Northern Wet Littoral and the Oriente. At the same time, agricultural land use has been increasing in the Northern Hillsides and Páramos.

Existing data do not allow for documentation of changes over time in agricultural land use in each of the eight zones discussed in the preceding section. In this section, those changes are only summarized for the Costa, Sierra and Oriente as a whole and the current extent of cropland and pasture is compared to PRONAREG assessments of appropriate land use in continental Ecuador. Also, the implications for Ecuadorian forestry of additional land clearing can only be assessed by referring to forest inventories conducted during the 1980s.

Changes over Time in Agricultural Land Use

Through 1985, MAG collected data on agricultural land use and crop and livestock production in each of Ecuador's provinces. No single year's estimate of cropland or pasture is very reliable since it is based on information provided by an under-funded and under-manned network of extension agents. However, some trends in agricultural land use are indicated by the MAG data set.

The area planted to tropical crops (almost entirely in the Costa) increased by 145,068 hectares between the middle 1960s and the middle 1980s (Table 4.1). This increase was exceeded, however, by a simultaneous 337,192 hectare decline in Sierra cropland. Meanwhile, pastures in the five coastal provinces (El Oro, Guayas, Los Ríos, Manabí and Esmeraldas) were quadrupling, from 516,500 to 2,033,630 ha. The area in pastures also more than doubled in the Sierra to 1,838,194

Table 4.1 Agricultural Land Use Trends (hectares)

Land Class	1965-69	1980-85[a]	Change
Land Planted to Sierra Crops[b]	571,606	234,414	-337,192
Land in the Costa and Oriente Planted to Tropical Crops[c]	1,166,106	1,311,174	+145,068
Total Cropland	1,737,712	1,545,588	-192,124
Pasture	1,718,946	4,292,830	+2,573,884
- Sierra	955,456	1,838,194	+882,738
- Costa	516,500	2,033,630	+1,517,130
- Oriente	247,000	421,006	+174,006

Source: Tables 6.5 and 6.6.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.
[b] Include barley, fruits, legumes, potatoes, soft corn, vegetables and wheat.
[c] Include bananas, cacao, cassava, castor oil, coffee, cotton, fruits, hard corn, manila hemp, oil palm, peanuts, plantains, rice, soybeans and sugar cane.

ha.

MAG data yield a misleading impression of agricultural land use change in Sierra provinces for two reasons. First, the Costa region's agricultural frontier has traversed the western portions of several of Sierra provinces (e.g., Cañar, Cotopaxi, and Pichincha) in recent years. Second, far from being intensively managed grasslands, much of the area classified as pasture in the Sierra is unproductive, abandoned cropland on which livestock occasionally graze. Consequently, MAG's report that highland pastures doubled between the middle 1960s and middle 1980s actually masks a significant decline in the quality of a large area in the Ecuadorian Andes that used to be planted to crops.

Twenty-five years ago the area planted to crops in the Oriente was negligible. As MAG surveys indicate that area had risen to 63,100 hectares by 1985. Cattle graze on most of the agricultural land in the Oriente, however. Pastures increased from 247,000 to 421,006 hectares between the middle 1960s and the middle 1980s (Table 4.1).

Current versus Potential Land Use

The application of improved technology has contributed significantly to increased agricultural production in Ecuador during the past quarter century (Chapter 6). However, extension of the agricultural frontier has been a more important cause of expanded production in the country. The latter approach to agricultural development cannot continue for long because the quality of land not now being used for crop or livestock production is, by and large, fairly poor.

The primary source of information on land use capabilities in Ecuador is PRONAREG. That agency is completing a detailed study of potential land use in the Sierra and Costa with only the marginal land around Jipijapa and Salinas remaining to be classified. Also the area surveyed includes most of the lower slopes of the Andes in the Oriente region (Table 4.2).

Table 4.2 Potential Land Use, Sierra and Costa Combined[a]

Category	PRONAREG Classifications	Area (hectares)	Share (%)
Prime farmland	C1a through C3b	3,081,700	21.7
Marginal Cropland	C3c through C4d	1,307,000	9.2
Pastures Only	Pa through Pd	2,451,900	17.3
Forests Only	Ba through Bd	5,905,300	41.7
No Use	S	1,451,900	10.2
		14,197,700	100.0

Source: PRONAREG.

[a] Evaluation of potential use of the areas around Jipijapa and Salinas had not been completed at the time this paper was being written. Also, the area includes most of the lower slopes of the Andes of the Oriente region in Eastern Ecuador.

Although PRONAREG reports data on precipitation and average temperature, it ranks land primarily according to soil characteristics. It has determined that approximately 3,100,000 hectares of land in the western two-thirds of Ecuador (corresponding closely to the Sierra and the Costa regions) are relatively fertile, well drained, not highly erodible and free of other serious natural limitations. Consequently, those 3,100,000 hectares are an excellent site for intensive crop production, provided that water is available and temperatures do not drop too low (Table 4.2). Agricultural land use depends on the relative prices of different commodities and not just on the suitability of soils for crop production. Consequently, it is best to regard the 3,100,000 hectares as "prime farmland,"

rather than as prime cropland.

Sustained crop production on an additional 1,300,000 hectares in the Sierra and Costa is possible once measures to deal with serious erosion or drainage problems, for example, have been put in place. Livestock grazing is the only suitable agricultural use of an additional 2,500,000 hectares of land with fragile soils. Finally, in addition to the 5,900,000 hectares of fragile lands that PRONAREG has determined can be used for production forestry, there are 1,500,000 hectares that should remain undisturbed (Table 4.2).

Although data on the exact use of the 3,100,000 hectares classified by PRONAREG as prime farmland are not available, virtually all that land appears to be planted to crops or in intensive pasture. Observing that forages are produced on many of those 3,100,000 ha, some critics of agricultural development in Ecuador claim that under-utilization of prime farmland is a major problem in the country. Sometimes, such a claim reflects a misreading of PRONAREG's sound recommendation that pastures be established where crop production would cause excessive soil degradation. Quite often, however, the charge of under-utilization of prime farmland reflects economic ignorance. Improved pastures are among Ecuador's most intensively used agricultural lands, particularly in the Sierra and the decision to establish pastures rather than to raise crops should be regarded as a rational response to market forces. Forage crop production is often an efficient use of prime farmland.

To assess agricultural use of other land in the Costa and Sierra, it is appropriate to assume that all of the two regions' 3,100,000 hectares of prime farmland is in intensively managed pasture or planted to crops and that half (i.e., 919,097 ha) of the highland area classified as pasture by MAG is actually degraded and abandoned cropland (see above). These two assumptions imply that current agricultural land use in the Costa and Sierra (4,498,315 ha) exceeds prime farmland in the same two regions by 45 percent. Current agricultural land use even exceeds the sum of prime farmland and marginal cropland (i.e., 3,100,000 plus 1,300,000 ha) by a slight amount. In some parts of the country, then, the agricultural frontier has already extended onto lands characterized by PRONAREG as very fragile.

Increased settlement of the Oriente does not constitute a satisfactory solution to the problem of scarce prime farmland in Ecuador. MAG (p. 60) has determined that slightly more than 850,000 hectares in Northeastern Ecuador (approximately 16 percent of its land area) can be used for agriculture and that the remaining 4,490,000 hectares (or 84 percent) of the region should remain covered with forests. However, 1,120,000 hectares has already been colonized or is in the process of being settled by farmers and ranchers (MAG p. 14).

Even if good agricultural land remains covered with trees in the Oriente, the investment in infrastructure needed to link that land with agricultural markets in the rest of the country will be sizable. Indigenous inhabitants of the region will reject outsiders' attempts to take over land for intensive agricultural production. Also, continuing to deforest the Oriente will do additional harm to the region's biological diversity. Finally, clearing land in the Oriente with limited agricultural potential carries a sizable opportunity cost in the form of foregone development of the region's timber resources.

Almost certainly, the net social benefits of continued agricultural colonization in Eastern Ecuador are negative.

Standing Timber in Primary Forests

Ecuador's forest resources are considerable by any measure. Alone, standing commercial timber in the Costa's major forests approaches 61 million metric tons (mt) (Table 4.3). Since commercial demand for timber in Ecuador is less than 2.5 million mt (Montenegro and Durini p. 12) those forests, which yield most of the country's supply of wood, could supply the timber and wood products industry with raw materials for several decades to come. When the enormous resources of the Oriente are taken into account, the danger that excessive logging will, at some future date, significantly restrict timber supplies in Ecuador is very remote.

The future adequacy of timber supplies is threatened, instead, by the

Table 4.3 Standing Timber by Region

Region	Inventoried Area (hectares)	Total Wood[a] --(1,000,000 metric tons)--	Commercial Timber[a]
Costa:			
Esmeraldas Province	800,000	71.0	50.1
W. Rio Guayas Basin	176,000	11.2	4.8
E. Rio Guayas Basin	110,000	11.5	5.9
Oriente:			
Napo Province	2,492,300	220.0	
Pastaza Province	3,229,600	371.2	207.8
Southeast	1,897,600	219.6	82.2

Source: AIMA 1985 for the Costa; DINAF and CLIRSEN surveys for the Oriente.

[a] Assumes .7 mt per m^3 of wood.

planting of crops and the establishment of pasture where forests used to stand. DINAF officials indicate that the current deforestation rate is approximately 200,000 hectares a year. Land use conversion is particularly rapid in the northeastern part of the Oriente where agricultural colonists settle alongside roads leading to centers of oil exploration and extraction and in the Northern Wet Littoral, which is the heart of the country's timber industry. As indicated in the preceding subsection, a little over 20 percent of Northeastern Ecuador has been or is now being colonized. More than half of the land in Esmeraldas province, which was covered with forests 25 years ago, is now or soon will be used for crop or livestock production (MAG p. 14).

Relative to the pace of deforestation, cumulative reforestation has been

negligible. From 1962 through the middle 1980s around 100,000 hectares had been planted to trees (AIMA 1985, p. 43). A significant portion of reforested area was in the Sierra, where few natural forests had survived into the current century. Virtually nothing has been done to reverse deforestation in Ecuador's humid lowlands.

IV. The Causes of Environmental Degradation in Ecuador: General Perspectives

Reviewing the ample evidence of resource degradation in developing countries and bearing in mind that human populations in Africa, Asia, and Latin America are expanding rapidly, one is tempted to explain depletive human interaction with third world natural environments in simple Malthusian terms. Certainly, "blaming" resource degradation in Ecuador on population growth is appealing since the country is the most densely populated in South America.

Accepting a Malthusian perspective hardly causes one to be cptimistic about the prospects for resource conservation in a place like Ecuador. Fertility rates have been declining in the country since the middle 1970s (INEC 1982). However, median age, 17.6 years in 1982, is low (United Nations). Given that the number of women of child-bearing age will increase for several more years, Ecuador's population is projected to grow by 2.6 percent a year through the turn of the century (INEC, CONADE and CELADE).

Ultimately, conservation of renewable natural resources probably requires that population growth be checked because of direct increases in the demand for food and the reality that agriculture in Ecuador is largely based on exploiting natural resources. But the Malthusian perspective fails to suffice as a comprehensive explanation of resource degradation. Rural population density in the Costa exhibited no strong secular trend between the 1974 and 1982 censuses. Indeed, the rural population of three of the Costa's five provinces (including Esmeraldas, where deforestation has been rapid) actually declined during that eight-year period. Similarly, three of the ten Sierra provinces lost rural population. In the Oriente, rural population density has been rising. However, Eastern Ecuador's Amazonian lowlands were lightly populated in 1974 and remained so in 1982 even after a large relative increase (Table 4.4).

Appreciating the limitations of a simple Malthusian analysis, one is obliged to seek other explanations of resource degradation in Ecuador. As is the case throughout Latin America, inappropriate tenurial arrangements, governmental interference with market forces and inadequate investment in research and extension both for agriculture and better management of natural resources are largely responsible for inefficient exploitation of the country's renewable natural resources.

Inappropriate Tenurial Arrangements

That severe institutional crises often underlies environmental degradation in Ecuador is most obvious where government "properties" are being managed poorly. Those properties are extensive. Subsurface resources have always been under government control. With passage of the 1972 Water Law all water resources were nationalized. Costa wetlands are national patrimonies. Similarly, most of the country's tree-covered land is designated as forest patrimony (*patrimonio forestal*) or is part of a publicly owned park or reserve.

These claims far outstrip the government's capacity to manage resources or

Table 4.4 Rural Population by Province, 1974 and 1982

Province	1974	1982	Percentage Change
Sierra	1,943,769	2,078,767	6.9
- Azuay	249,831	271,713	8.8
- Bolívar	125,549	119,274	-5.0
- Cañar	126,749	146,308	15.4
- Carchi	82,763	75,496	-8.8
- Cotopaxi	203,935	236,236	15.8
- Chimborazo	226,145	232,455	2.8
- Imbabura	146,423	152,768	4.3
- Loja	266,607	238,744	-10.5
- Pichincha	329,515	405,165	23.0
- Tungurahua	186,252	200,608	7.7
Costa	1,708,855	1,719,671	0.6
- El Oro	135,157	119,986	-11.9
- Esmeraldas	131,005	126,142	-3.7
- Guayas	555,732	623,243	12.1
- Los Rios	285,998	308,155	7.7
- Manabí	599,963	542,145	-9.6
Oriente	150,492	206,246	37.0
- Morona Santiago	43,805	53,599	22.4
- Napo	57,926	95,099	64.2
- Pastaza	18,104	21,452	18.5
- Zamora Chinchipe	30,657	36,096	17.7

Source: INEC 1985, 1977.

even to ensure that its claims are honored by the public at large. Consequently, encroachment on public sector properties is widespread. Trespassers tend to treat the resources they use as a free good, neglecting the costs society as a whole associates with environmental degradation. This is the crux of what Hardin calls the "tragedy of the commons," which describes well the state of many public properties in Latin America.

In many cases, the Ecuadorian government tacitly recognizes that environmental damage results from an imbalance between its extensive formal claims on natural resources and its limited capacity to manage them and to control access. It chooses, then, to vest property interests in users of idle lands (*tierras baldias*) which are nominally under governmental control. However, those property rights are rarely structured so as to encourage resource conservation. Destruction of natural vegetation is usually a prerequisite for formal tenure in a colonized parcel.

The Ecuadorian government also influences the use and management of privately held natural resources by rendering private tenure in those resources insecure. To approve a private claim for formal land tenure, IERAC executes ten separate procedures (Seligson). Because its record-keeping system is extremely

cumbersome (IERAC did not acquire its first computer until the late 1980s) adjudication can take years. In the meantime, the property rights of the individual making a claim are insecure. Tenure insecurity discourages the adoption of soil conservation measures and other land improvements partly because the BNF (National Development Bank) is reluctant to issue loans to farmers lacking title (Ramos p. 34). In addition, farmers with insecure tenure do not make land improvements because they cannot be sure that they will capture the long term benefits of their investment.

Governmental Intervention in Markets

Public sector interference with market forces has long been a prominent feature of third world economies. Among major features of development strategies pursued by the Latin American region's governments were overvalued exchange rates, tariff and non-tariff barriers to protect domestic industry from foreign competition, controlled prices of agricultural and natural resource commodities and extensive subsidization (Valdés). Import substitution and industrialization have clearly been the aim of the Ecuadorian government since the late 1950s (see Chapter 2).

By arresting the growth of agriculture and other sectors of the rural economy, this approach to development diminishes the derived value of land, water, forests, and other renewable resource inputs. Consequently, incentives to manage and to conserve those resources are reduced.

Governments also interfere with factor markets in agriculture in an attempt to compensate for development strategies biased toward urban areas and industry. Compensation in the form of subsidized prices for agricultural inputs, however, can result in inefficiency and pollution in the countryside. Subsidizing pesticides, for example, often causes environmental concentrations of toxic chemicals to rise (Repetto). The waste of irrigation water in Ecuador as well as strong political pressure to pursue inefficient irrigation projects are explained largely by the low prices public sector agencies charge for water (see Chapter 7).

On a larger scale, Ecuador's long standing policy of subsidizing the use of gasoline, electricity and other forms of energy has led to widespread waste and inefficiency. One consequence of that policy has been to encourage excessive expansion of the agricultural frontier.

Failure to Invest in the National Scientific Base

While the Ecuadorian government has often extended subsidies and otherwise interfered with market forces, it has been slow to develop the national scientific base on which growth in agriculture, forestry and fishing depends. Research and extension networks tend to be fractured. Separate entities created for agriculture, forestry and fishing do not usually cooperate on basic scientific research. In addition, coordination among narrowly focused and disparate public and private entities providing extension services is often poor. Funding of research and extension institutions is also meager, as is investment in human capital and especially sine qua non scientists and technicians (see Chapter 12).

Inadequate investment in the national science base has, in turn, led to the "mining" of land and other renewable natural resources. Weak agricultural research and extension, for example, has translated into low crop and livestock yields (see Chapter 12). If agricultural productivity exhibits no strong, increasing secular trend, then growing demand for agricultural commodities must be met

primarily by bringing additional land, which is usually of marginal quality, into production and exploiting other natural resources. In Ecuador, roughly two-thirds of the increases in crop production occurring between the mid 1960s and the mid 1980s were accounted for by an expanding agricultural frontier. Improved productivity explained only the remaining third (see Chapter 6).

Research and extension for crop and livestock production should always reflect an agricultural economy's factor endowments. Like many other Latin American countries, however, Ecuador continues to under-invest in agriculture's scientific base even though most suitable land has long been used for crop or livestock production. Under these circumstances, the pressure to bring environmentally fragile lands with limited agricultural potential into production will be strong for years to come.

V. New Approaches to Natural Resource Policy In Ecuador

Satisfactory resolution of Ecuador's environmental problems ultimately requires that population growth decline. However, progress on the demographic front always comes slowly. Consequently, reform of government policies that currently discourage natural resource conservation is an immediate priority. Desirable changes in macroeconomic and general pricing policies, and in a science base for agriculture, which influence human interaction with the natural environment, are discussed elsewhere in this agricultural sector assessment and are not reiterated here. Instead, special emphasis is placed in this chapter on tenurial reform, reducing governmental intervention in markets for natural resource commodities and improving the scientific base for renewable resource management.

Rearranging property rights is a necessary condition for the conservation of many of Ecuador's natural resources. Indeed, changing non-tenurial influences on human interaction with the environment without addressing the tenurial causes of environmental problems could actually exacerbate those problems. For example, if over-valuation of the Sucre were to cease, disturbance of open access Costa wetlands and primary forests would probably increase in the rush to export more shrimp and timber.

In and of itself, however, tenurial reform is often insufficient to induce resource conservation. As indicated later in this chapter, creating private interests in forested land will be insufficient to induce improved forest management, generally, or reforestation, specifically, if the log export ban, which depresses timber prices, remains in effect and if forestry research and extension remains at an incipient stage of development. A combined program addressing the tenurial, regulatory, and technological causes of environmental degradation is usually required.

No element of such a combined program is entirely free of controversy. Reservations about transferring natural resources from government to the private sector arise from the suspicion that prices offered for public sector resources will fall short of the true value of those resources. Perhaps the best way to address this problem is to expand the number of bidders participating in resource auctions. Where auctions have only been open to domestic firms, for example, foreign companies could be invited to participate. Another strategy for raising bids is to use an auction method proposed by William Vickery, a North American economist, during the 1950s. The distinguishing characteristic of a "Vickery auction" is that the firm submitting the winning bid does not have to pay the amount it offered.

Instead, it pays the second-highest amount offered. Firms participating in a Vickery auction of some natural resource are reluctant to understate the value they associate with that resource, because doing so might allow some competitor to obtain the resource at a low price.

Debate over natural resource policy can also reflect differences over ideology. In particular, redistributing property rights is often a politically charged undertaking. Ideologues of the right, who have supreme confidence in the workings of the marketplace, argue that all natural resources should be divided among private holdings, the owners of which can be expected to develop their properties efficiently. They distrust any deviation from a perfectly comprehensive regime of private tenure, expecting that a tragedy of the commons will arise wherever resources are not privately owned. By contrast, ideologues of the left doubt that market exchange of private property rights can ever result in the wise use of natural resources. Only government, they reason, is capable of developing resources efficiently. Furthermore, both the dogmatic right and the rigid left tend to ignore the value of "intermediate" tenurial arrangements: the rules and procedures governing resource use that local communities tend to develop in order to avoid environmental degradation (Hayami).

More than anything else, applying the broad menu of tenurial solutions to Ecuador's environmental problems requires hard-headed economic objectivity (rather than a venting of one's ideological predilections). That is, all costs and advantages of different tenurial approaches to any particular environmental issues must be carefully assessed. For example, before deciding to draw on the undeniable strengths of a regime of private property rights, the costs of establishing and administering such a regime, which can be considerable (Runge) need to be investigated. Similarly, heavy reliance on community-level arrangements is best when trade-offs associated with natural resource development are confined to a small area. Finally, even when the impacts of resource degradation are broadly distributed, governmental action is called for only if expected improvements in environmental quality compare favorably with the costs of that action.

VI. Critical Natural Resource Issues in Ecuador

The causes of environmental degradation have been discussed in broad terms, as have general approaches to natural resource policy. Let us consider now some of the specific natural resource issues facing Ecuador. As indicated in this section, applying a combined program of tenurial reform, deregulation of markets for natural resource commodities and technological innovation would contribute greatly to the solution of problems like the destruction of Costa ecosystems, tropical deforestation, soil erosion and water misallocation. The problem of pesticide contamination is somewhat different in that increased, rather than reduced, regulation is appropriate. However, reforming policies and programs that discourage efficient development of soil, water and other natural resources should free up public sector resources needed to promote the safe and effective use of agricultural chemicals.

Disturbance of Costa Ecosystems

Problems

During the past fifteen years, Ecuador's shrimp industry has expanded rapidly. This growth has come about exclusively through mariculture development. About 8,000 mt of shrimp have been captured off the Ecuadorian coast each year since the late 1970s. Meanwhile, the amount of shrimp collected from maturation ponds has increased several-fold, from less than 5,000 mt in 1979 to around 50,000 mt in 1987.

Mariculture development has been achieved largely at the expense of Costa ecosystems that support the shrimp industry. Of the 117,729 hectares of shrimp maturation ponds established between 1969 and 1987, 28,524 hectares displaced mangrove swamps, where all shrimp must spend a portion of their lives (CLIRSEN). Thus, 14 percent of the mangrove swamps existing in Ecuador in 1969 had been displaced by the middle 1980s, almost exclusively from construction of shrimp ponds (Table 4.5). In some localities, the impacts of mariculture development have been far more extreme. In El Oro province (south of Guayaquil), which is the center of the Ecuadorian shrimp industry, extensive tracts of mangrove swamps have been lost. Between 1969 and 1987, 10,231 hectares (equal to 30 percent of the original 33,634 ha) were displaced there (CLIRSEN). The situation is even more extreme in Manabí province where almost half of the original mangrove area of 12,371 hectares has been converted to shrimp ponds.

Table 4.5 Area in Shrimp Maturation Ponds and Mangrove Swamps, Selected Years (hectares)

Year	Shrimp Ponds		Mangrove Swamps
	Total	From Mangroves	
1969	0	---	203,700
1984	89,368	21,587	182,108
1987	117,729	28,524	175,126

Source: CLIRSEN.

Mangrove swamp displacement is accelerating. Recent surveys conducted by CLIRSEN indicate that 6,937 hectares of coastal swamps were converted to shrimp ponds between 1984 and 1987, as compared to 21,587 in the preceding fifteen years. Moreover, the area of shrimp ponds authorized by government permits as of the mid-1980s exceeded pond area existing at that time (Zapata and Fierro p. 70). Consequently, more wetlands have been lost during the late 1980s.

The expansion of shrimp farms has caused increasing environmental damage according to a 1989 study by the Agricultural Policy Institute (IDEA). Even when mangrove swamps are not directly displaced, Costa ecosystems are affected by the discharge of waste water from ponds. That effluent tends to be highly saline and

to feature high concentrations of algae (Snedaker et al. p. 32). In addition, Costa ecosystem disturbance takes the form of over-fishing. Excessive collection of larvae and egg-laden female shrimp, which is undertaken to help stock maturation ponds, is a cause of declining shrimp populations along the coastline. Larvae used to stock shrimp maturation ponds are captured with hand-held nets in shallow coastal waters. This method results in damage to all organisms in that environment because larvae fishermen dispose of all undesired species (IDEA). Over-fishing for crab in mangrove swamps and for shrimp and other species in the ocean likewise takes a toll.

Determining the environmental impacts of mariculture development is difficult. The effects of water quality changes have not been determined. Neither do reliable estimates of marine populations of commercial species exist. However, it is apparent that reduced shrimp populations are affecting the Ecuadorian economy. By the middle of 1988, the price of an egg-laden female shrimp had risen US$10.00. Another indicator of declining populations is the 23 percent reduction in the volume of shrimp exports occurring between the first half of 1988 and the first half of 1989, which has been attributed to the cumulative impacts of excessive larvae collection (EIU p. 10).

Causes

Other than periodic over-valuation of the Ecuadorian Sucre and a modest export tax, Ecuador's shrimp producers are relatively free of public sector intervention in markets for their output. However, tenurial incentives to conserve the industry's natural resource base are weak. At the same time, the chances that coastal ecosystems will be mined rather than managed are enhanced by inadequate investment in the scientific base for mariculture and fishing.

Depletive management of Ecuador's Costa ecosystems has much to do with property rights. By law, wetlands are a national patrimony. But because the government has virtually no capacity to control access to those areas, they are, in effect, the property of no one. For example, a community of crab fishermen has established itself without any sort of governmental approval or interference in the Churute Ecological Reserve, a mangrove swamp 40 km south of Guayaquil.

Unrestricted access, in turn, guarantees resource depletion. Excessive collection of female shrimp and shrimp larvae, like other forms of over-fishing, are classic tragedies of the commons. Any fisherman knows that he can capture the benefits of extra fishing effort (in the form of payments for his catch). By contrast, the costs associated with decreased breeding populations and other forms of fishery depletion are shared by all who make their living, directly or indirectly, from the sea.

But Costa ecosystem disturbance is worse than a standard tragedy of the commons since Ecuadorian property law obliges the shrimp industry to encroach on swamps. A maricultural enterprise can secure a formal legal interest (i.e., a use permit) in a parcel of coastal wetlands only by promising to destroy that parcel (i.e., by constructing a maturation pond).

The future of Ecuador's Costa wetlands and marine shrimp populations depend on the state of the country's scientific base. If that base does not improve significantly Ecuador will lose its comparative advantage in shrimp production to the United States, Mexico and several Asian nations, which have technologically superior mariculture. Losing comparative advantage will, in turn, enhance the temptation to "mine" mangrove ecosystems and other coastal and marine resources in an attempt to maintain production and exports. Knowing that the long-term

prospects for mariculture are unfavorable, no individual producer will ever hesitate from damaging mangrove habitats or collecting excessive numbers of larvae in order to enhance short-term profits.

Solutions

Costa wetlands could continue to be treated as a national patrimony. However, the government would have to devote far more effort to controlling access. The additional budgetary and manpower costs needed for such an effort to be effective would be considerable. As an alternative, the government should consider divesting itself of more Costa wetlands. Destruction of natural ecosystems should not continue to be a prerequisite for the acquisition of private tenure. Instead, where a well-defined community is making use of a tract of wetlands, the government could deed that tract to the community. The onus would then be on the community, itself, to develop a system of rules governing management of the tract's fishery resources. Where no such well-defined community exists, wetland leaseholds could be auctioned off to private enterprises. Winning bids would reflect some of the economic value of mangrove swamps and the funds generated by these auctions could be allocated to public sector management of wetlands.

Firms and communities cannot be given complete control of Costa wetlands since complete internalization of the costs associated with the degradation of that resource is impossible. In particular, any enterprise or community would regard the decline in offshore fishing or coastal larvae collection associated with the destruction of or excessive fishing in wetlands as an external cost. Recognizing this, the government would have to include strict conservation guidelines in wetland leaseholds. A company's or community's failure to abide by guidelines governing land use and fishing in its tract would result in that company or community losing current property rights as well as the prerogative to acquire other wetland tracts in the future. Bonds posted to assure compliance with conservation guidelines would likewise be subject to forfeiture.

Just as leasing Costa wetlands should be possible, the government can issue rights to collect larvae along given stretches of the Ecuadorian coastline to specific groups or people. They would then undertake to manage their resources as efficiently as they know how, subject to conservation guidelines stipulated in larvae collection leases.

The legal interests of private firms and communities in mangrove swamps and other coastal and marine resources need to be transferable. If a prospective owner thinks he can use a resource more profitably than the current owner, then the former should be able to buy out the latter. As long as conservation guidelines stated in the original leasehold agreement continue to be observed, then government should facilitate the transaction.

Finally, investment in the scientific base underpinning the shrimp industry should reduce the temptation to mine mangrove swamps and other coastal and marine resources for two reasons. First, excessive larvae collection should abate. Second, maricultural enterprises using larvae bred in laboratories will have a much weaker incentive to construct ponds in or close to the ecosystems that are the natural source of larvae.

Forest Depletion and Deforestation

As Cabarle et al. point out, tropical deforestation is the major threat to biological diversity in Ecuador. Those same authors also indicate specific measures

for protecting threatened species. Those measures are not reiterated here. Instead, this analysis of forest depletion and deforestation focuses on opportunities for timber industry development that are lost as tree-covered land is cleared by agricultural colonists. Policy reforms needed to encourage forest conservation are also identified.

Problems

Compared to maricultural enterprises and shrimp fishermen, the timber industry's contribution to the national economy is modest. Because domestic demand for pulp and paper is satisfied almost entirely through imports, Ecuador generally runs a negative balance of trade in forest products. Central Bank data indicate that logging accounts for 0.9 percent of Ecuador's gross national product. The processing of wood products, broadly defined to include furniture manufacturing, accounts for an additional 0.8 percent. Montenegro and Durini (p. 13) estimate that extracting, transporting and processing timber and manufacturing wood products employs around 45,000 Ecuadorians. These figures probably understate the economic importance of the forest products industry since the volume of fuel wood extracted from Ecuador's forests far exceeds the volume of wood used in other ways (AIMA 1987, p. 4; Montenegro and Durini p. 12) and since fuel wood is exchanged largely outside of the formal economy.

The capacity of the forest products industry to contribute more to gross national product and net exports while generating additional employment is seriously threatened by deforestation. As indicated earlier in this chapter, at least 200,000 hectares of tree-covered land is being converted into cropland and pasture each year. This current annual rate exceeds the 100,000 hectares reforested between the early 1960s and the middle 1980s (AIMA 1985, p.43). Land clearing is particularly rapid in Northeastern Ecuador where agricultural colonists settle alongside roads leading to centers of oil exploration and extraction, and in the Northern Wet Littoral, which is the heart of the country's timber industry (MAG p. 14).

The immediate waste of timber associated with deforestation is enormous. Addressing the efficiency with which agricultural colonists harvest commercial timber, DINAF officials indicate that at least 25 percent (and perhaps as much as two-thirds) of standing commercial timber is destroyed when colonists clear their parcels and that poor transport and handling techniques severely damages a good portion of the timber delivered to sawmills and other assembly points. Over the long term, of course, raising crops and livestock on sites with major forestry potential (e.g., in the Northern Wet Littoral) carries a very high opportunity cost.

Causes

Deforestation in Ecuador is a clear illustration of how inappropriate tenurial arrangements, governmental intervention in markets and inadequate investment in research and extension combine to cause resource degradation.

As indicated earlier in this chapter, most of the country's tree-covered land is designated as forest patrimony or is in a park or reserve. However, the government's capacity to control access to "its" forests is modest. For example, no rangers have been assigned to the 2,000,000 hectares of forest patrimony delimited in Northwestern and Northeastern Ecuador (MAG). Funds and personnel allocated to parks and reserves, covering about 2,100,000 hectares in continental Ecuador, are negligible. In 1987, a mere two administrators, 25 technicians, and 119

permanent and seasonal rangers were assigned to parks and reserves (DINAF).

Implicitly acknowledging that a discrepancy between extensive public sector claims and limited public sector capacity to control access can provoke a tragedy of the commons, the Ecuadorian government allows for the transfer of its forest lands to private parties. However, the terms of that transfer assure ecosystem destruction. By law, IERAC must insist that at least half of a 50 hectare claim be cleared before it adjudicates that claim. The only direct fiscal check on the conversion of forests into agricultural land is the adjudication fee, which was raised in 1989 from a nominal US$2/ha to a minor US$20/ha. Furthermore, tenure insecurity associated with the many years IERAC requires to adjudicate a colonist's claim on frontier lands accelerates deforestation, as Southgate, Sierra and Brown have demonstrated in a statistical analysis of the causes of settlement and land clearing in eastern Ecuador.

The tenurial regime inducing colonists to clear the forest patrimony causes indigenous inhabitants of Ecuador's tropical forests to follow suit. Macdonald reports that the periodic fallowing scheme long practiced by the Amerindian community of Pasu Urcu, in the eastern part of the country, was abandoned during the 1970s after members of that community had been informed by IERAC agents that fallow lands could be claimed by agricultural colonists, who were 50 km away at the time.

To the list of tenurial factors discouraging efficient development of Ecuador's tropical forests, one must add the ban on logging concessions imposed in 1982. That ban makes the forest products industry in lowland Ecuador almost entirely dependent on agricultural colonists, who inefficiently harvest and sell timber to sawyers. The degree to which prohibiting logging concessions enhanced the importance of timber sales to colonists is indicated by the increase in chainsaw imports during the early 1980s. In 1981, imports amounted to US$1.8 million (CIF, 1988 dollars). In 1985, three years after the ban went into effect, US$5.2 million worth of chainsaws were brought into the country (Montenegro and Durini) as colonists switched to clearing techniques allowing for the marketing of commercial species.

Along with inappropriate tenurial arrangements, the Ecuadorian government's interference with market forces discourages forest conservation. Gasoline prices rarely rose above US$0.10/gallon during the 1970s or US$0.30/gallon during the 1980s. As a result, migration to far flung areas in the Oriente and elsewhere was heavily subsidized. In addition, prohibiting log exports has depressed domestic prices for unprocessed timber and, hence, reduced private incentives to manage existing forests or to establish new stands of trees. The severity of price distortions associated with the log export ban, which in effect has converted the domestic market for timber into a local monopsony, are illustrated by the price offered in early 1989 by a Spanish firm for 10 meter eucalyptus logs: US$30 each. The prevailing domestic price ranges from US$2 to US$4 a log. Among the impacts of such price distortions is negligible reforestation (see above).

Finally, inadequate investment in the scientific base for agriculture and forest management complements tenurial and pricing policies as a cause of deforestation in Ecuador. As has already been discussed in this chapter, there is strong pressure to use increasing amounts of land for agricultural production when crop and livestock yields are low and exhibit no strong temporal trend. In addition, weak forestry research and extension diminish the returns to forest management. Aside from one or two companies undertaking species trials, private sector research in Ecuador is nil. Governmental forestry research is correspondingly negligible and, for all intents and purposes, there is no forestry

extension service. Under these circumstances, no individual colonist is likely to perceive that the conversion of forests into cropland or pasture involves a substantial opportunity cost.

Solutions

Central to any strategy for encouraging the efficient development of Ecuador's forests is the removal of tenurial conditions and timber market regulations that currently encourage people to degrade the country's tree-covered land. In addition, the future management of forests depends greatly on improved forestry research and extension.

A ban on logging would be exactly the wrong kind of tenurial reform. Countries imposing such bans (e.g., the Dominican Republic) have found them very difficult to enforce because forest guards, who tend to be poorly paid and few in number, are easy to bribe. More importantly, prohibiting timber harvesting removes all private incentive to reforest land, or to manage forests.

Instead, the Ecuadorian government needs to strengthen private incentives to conserve the country's forests. More important than anything else, neither agricultural colonists not indigenous groups should have to clear land in order to acquire property rights. By the same token, the government should allow for leaseholds in logging sites. Payments for leaseholds should not take the form of a severance tax (i.e., a charge on timber removed from a parcel) since such a tax tends to encourage "high-grading" of timber resources. Neither should a tax on standing timber be assessed since such a tax interferes with an efficient schedule of resource extraction. Instead, government revenues should come as front-end lump sums paid by firms offering the highest bids in auctions for forested parcels. In addition to encouraging efficient extraction of timber, an auction system would raise funds that could be used to underwrite management of the forest patrimony.

Investing in forestry research and extension would also contribute to the conservation of tree-covered lands. For example, if information on improved forest management and timber extraction techniques can be extended to colonists who have tenure in tree-covered land, then that group will be less inclined to convert their properties to cropland or pasture. Similarly, the net returns that the timber and forest products industry associates with the management of tree-covered land depends on the scientific base underpinning Ecuadorian forestry, which is currently rudimentary for the most part.

Finally, the log export ban should be abolished. Free trade will drive up timber prices in Ecuador. As a result, land owners will have a stronger incentive to reforest cleared land and to take better care of existing forest lands.

Soil Erosion

Problems

Many consider erosion to be rural Ecuador's most serious environmental problem. The potential for soil loss is great in 47.9 percent of continental Ecuador, principally along the precipitous outer faces of the Andes and the sides of intermontane valleys. Erosion is active or in the process of becoming active in 12.1 percent (3,150,000 ha) of the country (de Noni and Trujillo p. 6). Major soil loss occurs in the Costa hills of Manabí province and along agricultural frontiers in the Northern Wet Littoral and in the Oriente. In addition, soil erosion is particularly severe in the Sierra (Figure 4.4).

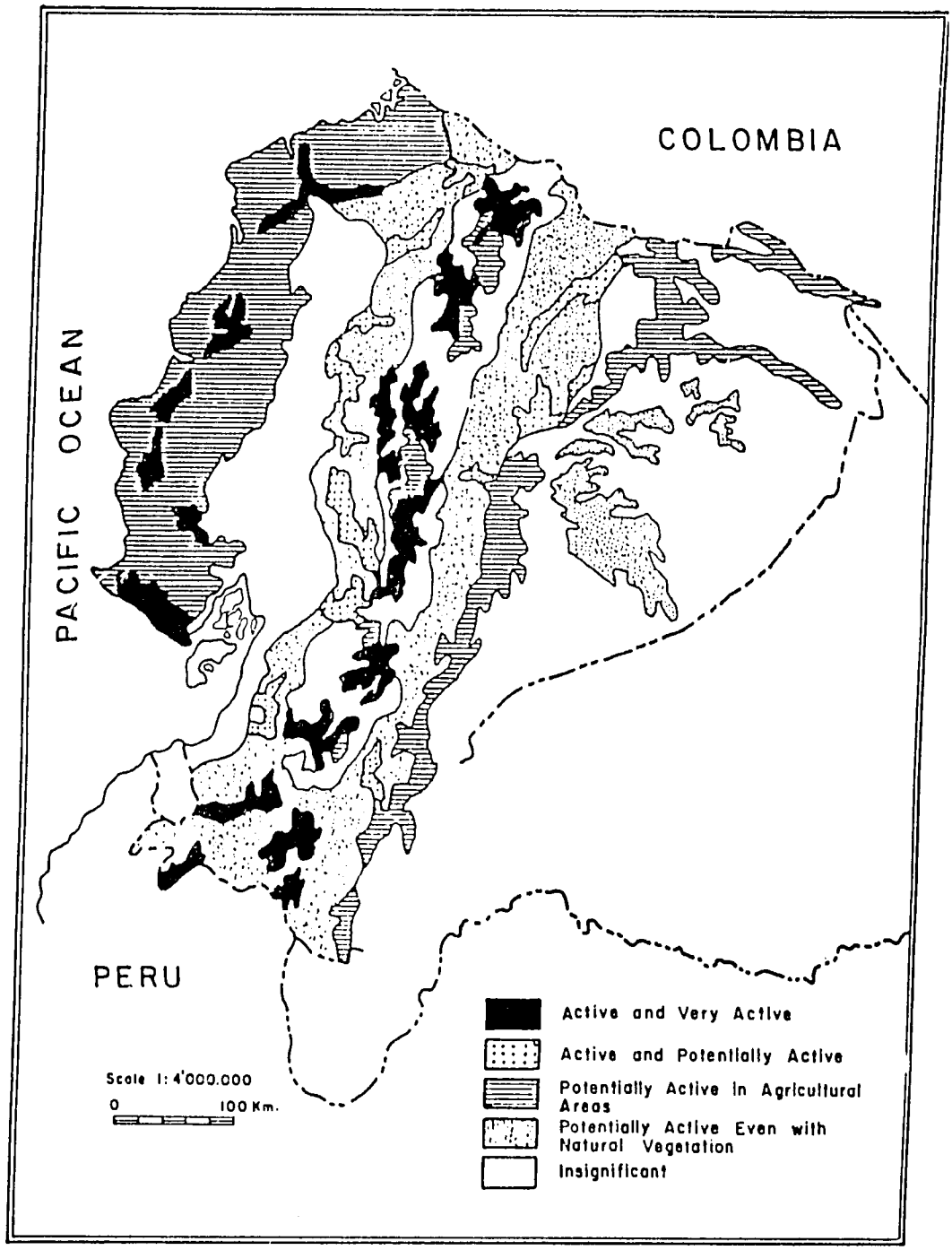

Figure 4.4 Soil Erosion in Ecuador
Source : de Noni and Trujillo.

As in other parts of the world, soil erosion in Ecuador induces a temporal decline in land productivity. For a few years, farmers can apply fertilizer to compensate partially for erosion's impact on yields. But after cumulative land degradation crosses a threshold, crop production often becomes economically infeasible. In the Sierra, that threshold has been reached quickly on the steep hillsides surrounding intermontane valley bottoms. Stopping crop production allows for natural land regeneration, which can be a slow process. However, soil continues to be lost from many Sierra fields formerly planted to crops becauselivestock are routinely allowed to graze on abandoned land.

Soil erosion is not simply a problem for agriculturalists who use Ecuador's fragile lands. It also impedes water resource development. Serious reservoir sedimentation problems have arisen at the Paute complex, which produces a major share of the country's hydroelectricity (Southgate and Macke). Similarly, plant nutrients in eroded soils contribute to water quality problems that have arisen in Poza Honda and other reservoirs in the Costa.

Causes

Where land is steeply sloped and soils are easily displaced, which is the case in much of Ecuador, natural erosion can be appreciable. However, soil loss is considerably accelerated by human activity. Policies influence expansion of the agricultural frontier onto fragile lands, the adoption of soil conservation practices inside agriculture's extensive margin, as well as the state of abandoned cropland.

Tenurial incentives that foster excessive land clearing in the humid tropics (described above) are in force along other agricultural frontiers in Ecuador. Article 48 of Ecuador's Land Reform Law, for example, stipulates that idle Andean páramos, like tropical forests, are subject to agricultural colonization. Inevitably, colonization accelerates soil loss. Another parallel with tropical deforestation is that agriculture's expansion into the páramos and other Sierra hinterlands is a consequence of inadequate investment in the scientific base for crop and livestock production.

Government policies also contribute to rapid erosion from farms within the agricultural frontier. Tenure insecurity, associated with IERAC's cumbersome adjudication procedures, is widespread among the owners of Ecuador's small farms (minifundios). As a result, those owners are not inclined to invest in soil conservation measures and other forms of land improvement. That disinclination is reinforced as *minifundistas* suffer the consequences of policy-induced distortions in markets for agricultural inputs and outputs.

Consider, for example, who bears the costs of credit rationing brought about by interest rate controls. Among others, Gonzalez Vega documents that lenders restricted from charging more than a certain rate allocate credit to larger borrowers with substantial collateral. This practice allows them to minimize loan processing costs as well as the riskiness of loan portfolios. Denied access to formal credit lines, small farmers rely on informal credit markets in which interest rates are considerably higher than those that would be observed in an unregulated formal credit market.

Sporadic attempts to maintain producer prices above market clearing levels have not helped Ecuador's small farmers either. The financial resources and warehouse capacity committed to the government's price support schemes have typically fallen short of what is needed for those schemes to succeed. With relatively good access to market information, larger farmers tend to be the first-in-line to sell their output to government warehouses at the support price. Small

farmers, by contrast, are more apt to sell their grain after efforts to maintain minimum prices have collapsed.

Receiving relatively low prices for their output and paying high interest rates for informal credit, minifundistas are less willing than they would be in an unregulated market economy to invest in soil conservation measures. In addition, soil conservation on Ecuador's minifundios is discouraged by inadequate research and extension since small farmers are unlikely to benefit from whatever limited improvements are made in the country's scientific base. Scientists at the country's agricultural research centers spend little time working on farming systems that would enhance minifundistas' income and conserve soil and Ecuador's extension service is not prepared to teach those systems to small farmers.

Tenurial, research and extension policies also contribute to excessive erosion from abandoned lands. IERAC regards abandoned cropland as tierras baldias and, hence, subject to colonization. This attenuation of former land users' property rights reduces private incentives to invest in restorative measures (e.g., the planting of pasture grasses). Even if tenurial disincentives to restore degraded abandoned lands were overcome, land restoration would still be seriously impeded by limited investment in the national scientific base. Other than a few trials with *setaria* (a genus with species that are indigenous to the Sierra) during the 1970s, no research has been done on grass and legume species that promote soil formation or simply hold remaining soil in place.

Solutions

Since soil erosion is severe along expanding agricultural frontiers, removing tenurial incentives that promote excessive land clearing (e.g., article 48 of the Land Reform Law) will contribute to soil conservation in tropical forests, páramos, and other hinterlands in Ecuador. Similarly, poor management of privately owned agricultural land is largely a consequence of macroeconomic, pricing, and trade policies that penalize the agricultural sector. As those policies are reformed, then farmers will be more inclined to adopt erosion control measures and otherwise to invest in the management of their soil resources.

Special attention should be given to correcting the policies that discourage small farmers, whose soil resources tend to be especially fragile, from adopting conservation measures. In particular, IERAC's land adjudication procedures need to be streamlined so that small farmers' tenure will be more secure. This will, in turn, improve their access to formal sources of credit, which can then be used to finance investments in erosion control. Also, information on improved erosion control and agricultural production techniques needs to be extended to small farmers working on erodible lands. The likely influence of policy reform should not be exaggerated, however. As off-farm employment opportunities improve, as they did in Ecuador throughout the 1970s, then wages are pulled up. In turn, this discourages the adoption of some soil conservation measures. For example, terracing and other labor-intensive measures are difficult for a land owner to justify when wages are high. In contrast, other soil conservation measures may be enhanced, such as reduced tillage and other labor-saving techniques.

Finally, reducing soil erosion from open access, abandoned lands requires tenurial reform as well as technical innovation. Communities and individuals could bid for government contracts to recuperate unused, degraded parcels. Contractors would receive not only a government payment for successful establishment of tree plantations or pastures but also title to recuperated lands. To enhance the effectiveness of such a scheme, however, considerably more research on trees and

pasture grasses that can survive on degraded lands is needed. As indicated above, the absence of research on pasture grasses that can be planted on degraded abandoned cropland is particularly deficient at present.

Water Misallocation

Problems

Between 80 and 140 billion m^3 of surface water flow from continental Ecuador into the Pacific Ocean each year. Alone, this annual runoff could cover the country's 1,600,000 hectares of cropland with 5 meters of water, when the average required on INERHI's irrigation projects is 1.9 meters. In addition, 210 to 370 billion m^3 a year flow toward the Amazon River. There are also several aquifers in the country that have consistently provided significant quantities of water. It is no exaggeration to say that Ecuador is abundantly endowed with water resources (Delavaud pp. 12-13).

As pointed out earlier in this chapter, however, those resources are unevenly distributed, both geographically and seasonally. In general, precipitation is meager along the Costa, in the Southwestern Ecuador and in many intermontane basins. In addition, a unimodal rainfall pattern typical of the tropics is pronounced throughout the Arid Coastal Plains as well as the Southern Humid Coastal Plains. River hydrology in those two regions is correspondingly unimodal.

Given geographic and temporal variations in precipitation and hydrology, agriculturalists in several parts of the country vigorously demand access to irrigation water. Over the years, INERHI and other public sector agencies have responded to this demand by committing over S/. 100 billion (1988 Sucres) to irrigation investment. Water utilization at many projects is extremely inefficient. For example, currently operating INERHI projects were designed to deliver water to 79,300 ha. However, irrigation water was actually used on only 65.6 percent of that area in 1987 (see Chapter 7).

Whereas substantial sums have been expended addressing Ecuadorian farmers' water *quantity* problems, relatively little has been said about agriculture's emerging water *quality* problems. The latter are serious. Citing studies conducted by INERHI in 1983 and 1984, Landázuri and Jijón (pp. 55-60) report that E. coli and other pollutants are very high in the waterways carrying untreated sewage from Quito and neighboring towns. Irrigating crops with water drawn from those rivers and streams can be hazardous to human health. By the same token, agriculture is a significant contributor to water quality problems in Ecuador's cities (see below).

Causes

Optimistic assumptions about the efficiency with which irrigation water is or will be used account for part of the marked discrepancy between areas originally projected to benefit from irrigation projects and areas that actually receive water (see Chapter 7). However, low water prices are the major cause of inefficient use of irrigation water throughout the country. INERHI water tariffs cover only 4.2 percent of irrigation systems' capital and operating expenses (see Chapter 7).

When the prices of irrigation water are low, farmers with reliable supplies of cheap water do not monitor water use carefully. They also substitute water for other inputs. As a result, their water use will be far more than had been anticipated by the planners of irrigation projects. This behavior reduces the reliability of water supplies for other farmers. To avoid risks, the latter group

tends not to plant crops requiring large amounts of water. This explains the under-utilization of land at the margins of irrigation projects.

Pricing irrigation water far below its cost also intensifies political pressure to undertake additional irrigation projects. Potential beneficiaries of new projects count on society as a whole to bear most of the financial burden. One wonders, for example, how many of the farmers who will benefit from the Santa Elena project would be keen to see it go forward if they had to internalize its capital costs, which will exceed US$9,000 for each hectare of irrigated land (see Chapter 7).

There is another opportunity cost of heavily subsidizing irrigation water. The 1972 Water Law gave INERHI broad authority to regulate and to develop the country's water resources. However, because water tariffs cover a small portion of the costs of on-line projects and because INERHI is under strong political pressure to undertake new, heavily subsidized irrigation projects, over 95 percent of that agency's budget is absorbed by operating expenses and by the planning and construction of new projects (see Chapter 7). This leaves INERHI in a poor position to deal with urban and agricultural water pollution problems.

Solutions

Irrigation water will never be used efficiently as long as the price farmers pay for that commodity is significantly less than its replacement cost. In addition, the political demand to undertake expensive new projects will remain strong as long potential beneficiaries know that subsidies will remain high.

To dampen the latter demand, the government should make clear that water tariffs paid by the beneficiaries of future projects will fully cover operating and maintenance as well as capital costs of the water they receive. Subsidization of projects that are already on line can only be reduced over a period of time. If subsidies were curtailed immediately, many of those projects' beneficiaries would go bankrupt (because the value of their land, which reflects low water prices, would plummet).

The public sector might find collecting payments for non-subsidized irrigation water from individual farmers difficult since metering can be expensive in the countryside. As an alternative, it can sell its water to communities of water users (at prices approaching efficient levels). Each community would then develop a scheme for allocating water among and collecting payments from its members.

Pesticide Contamination

Problems

Concern over careless use of agricultural chemicals in Ecuador was initially aroused by a Fundación Natura report on pesticides. Particularly alarming was a list of twenty-three chemicals, including DBCP and 245T, that had been banned or that could only be used subject to restriction in several countries around the world. Because of these bans and restrictions, the international prices of those chemicals were relatively low and Ecuador's imports of them were rising steadily (Sevilla Larrea and Pérez de Sevilla).

By now, pesticides have worked their way to the top of the food chain. Agricultural chemicals are washed into streams from which downstream cities withdraw drinking water. Those chemicals are also found in food. In a study carried out in Esmeraldas, Guayaquil and Quito, MAG/CONACYT found human breast milk contained BHC, Aldrin, DDT and other hazardous agricultural substances.

Causes

The other environmental problems discussed in this section are exacerbated by governmental interference with the market mechanism. For example, the log export ban discourages forest conservation. Similarly, excessive soil erosion is partly a consequence of failed commodity price support programs and interest rate controls. By contrast, pesticide contamination is excessive in Ecuador precisely because the government's regulation of the sale and use of agricultural chemicals is weak.

One should bear in mind, however, that laissez faire treatment of the market for agricultural chemicals is, in a sense, a consequence of misdirecting government resources. For example, heavy subsidization of irrigation water leaves INERHI with virtually no financial, technical and human resources to fulfill its statutory obligations to manage water resources. As a result, anyone wishing to use Ecuador's rivers and streams as a dumping ground for hazardous substances faces no serious regulatory impediments.

Solutions

An economic perspective on the allocation of scarce public sector resources goes a long way to explain the importation of sizable volumes of "dirty dozen" substances, like Aldrin and Dieldrin, into the country (Sevilla Larrea and Pérez de Sevilla) in recent years. So too does such a perspective explain why relatively little has been done to inform farmers about the safe and effective use of agricultural chemicals, in general.

As Ecuador discards regulations and subsidies that hinder efficient development of soil, water, and natural ecosystems, the personnel and budgets needed to control the importation and internal sale of potentially hazardous agricultural chemicals should become available. So too should it be possible to expand extension programs for informing farmers about the safe and effective use of those substances.

VII. What Can Donor Agencies Do To Encourage Resource Conservation in Ecuador?

Recommendations for donor agency action to promote resource conservation in Ecuador follow from this chapter's analysis of the causes of environmental degradation in the country. That is, donor agencies should assist Ecuador as it addresses tenurial, regulatory, and technological factors contributing to the mismanagement of soil, water, and natural ecosystems.

The preceding description of property arrangements that discourage resource conservation is preliminary. Future study of those arrangements, which should be a top priority for donor agencies, should focus on the transition to alternative regimes. Among specific topics to be addressed would be how to structure efficient auctions for transferring government-owned resources to the private sector and what restrictions to be written into leasehold interests in Costa wetlands, the forest patrimony, and other properties. Technical assistance should also be provided to governmental initiatives to address tenurial crises underlying visible environmental problems.

Donor agency support is also needed to phase out subsidies and regulations

in markets for natural resource commodities. For example, donor agencies can facilitate studies and provide technical assistance needed to develop a schedule for eliminating subsidies on irrigation water. Similar action might be needed to eliminate the log export ban.

Finally, it is important to support improvements in the scientific base directly serving renewable natural resources. Support of forestry research and extension by the United States Agency for International Development (USAID) for example, should be continued and expanded.

Two other major policy reforms suggested elsewhere in this study for strengthening and improving agriculture and general economic growth also are of critical importance in conserving renewable natural resources. The first is improvement in the science base serving agriculture (Chapter 12) while the second is improvement in macroeconomic policies (Chapter 2). These two reforms will induce the production of new technical knowledge and modern, industrial inputs for agriculture. These inputs can be substituted directly for the renewable natural resources upon which agriculture now is largely dependent and thus save these increasingly scarce endowments. These two policy reforms are clearly of major importance to better conservation of natural resources. The recommendations presented in this chapter are complementary to them and will have only limited impact on improving the conservation of natural resources if these two more pervasive constraints are not released.

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CHAPTER

5

THE HUMAN FACTOR AND AGRICULTURE

MORRIS D. WHITAKER

I. Introduction

The rate of agricultural growth, economic development and the distribution of production are highly dependent on the nature of population growth and the size and quality of the labor force. Economic growth and improvements in equity also are highly dependent on how efficiently labor markets mobilize human resources and allocate them among economic sectors, regions and rural and urban areas. Ecuador's population and labor force continue to grow very rapidly. Agricultural and overall economic growth must occur at even higher rates in order for per capita consumption to improve and levels of employment to increase, on average. Thus, high rates of population growth tend to limit improvements in individual wellbeing. Such improvements are further constrained to the extent that labor markets function inefficiently.

The population censuses (1950, 1962, 1974 and 1982) and projections based on them to 2000 provide the principal data for analyzing changes in demographic indicators, the labor force, employment and the labor market. Inferences about these elements are constrained for the post-1982 period by lack of census data and other data limitations, especially for the labor force and employment. There are several more recent projections and household surveys which provide enough data, however, to permit some tentative conclusions to be drawn about the 1980s.

This chapter examines the human factor in agricultural growth in the context of its relationship with the development of the rest of the economy. Section II considers several characteristics of Ecuador's population, including size, growth rates, geographic and rural-urban distribution, migration patterns, and density. Section III analyzes the growth and composition of the labor force and examines the extent and nature of unemployment. The level of sectoral employment, sectoral labor flows and absorptive capacity, and underemployment are treated in Section IV. Section V analyzes labor markets, including rigidities and possible market segmentation in the public sector. Evidence on how well labor markets have

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allocated labor between the productive sectors and between rural and urban areas is presented in Section VI. Section VII summarizes the findings and conclusions.

II. Population: Characteristics and Indicators[1]

Censuses of the population were carried out on November 29, 1950 (Ministry of Economy); November 25, 1962 (INEC 1964); June 8, 1974 (INEC 1977); and November 28, 1982 (INEC 1985b) but all tended to underestimate the population.[2] In 1984 the National Institute of Statistics and Census (INEC) the National Development Council (CONADE) and the Latin American Demographic Center (CELADE) published adjusted, global census data, estimates of the population from 1950 to 1980 and projections from 1980 to 2000 (see INEC, CONADE and CELADE). The estimates of population are only modestly greater than the censuses of population and the growth rates are very similar. Projections were made under assumptions of low, medium and high global rates of fecundity with the medium rate being generally accepted as most likely. INEC (1985a) completed a more refined and detailed set of projections of rural and urban population by age and sex and by province and canton for 1982-1995, with global projections consistent with the 1984 projections.

Global Population

Total population in 1990 is projected to be 10,781,613, and is expected to grow to 13,949,400 by the year 2000 (Table 5.1). The population has more than tripled from 3,310,080 in 1950, growing at a relatively high annual average rate of 3.0

Table 5.1 Population and Growth Rates According to Adjusted Censuses, Estimates and Projections

Year	Population	Growth Rates	
		Period (years)	Annual Average (%)
Adjusted Censuses:			
November 29, 1950	3,310,080	---	---
November 25, 1962	4,695,805	12.00	2.96
June 8, 1974	6,829,467	11.53	3.30
November 28, 1982	8,606,116	8.47	2.77
Estimates/Projections:			
1990	10,781,613	8.00	2.86
1995	12,314,210	5.00	2.69
2000	13,939,400	5.00	2.51

Source: INEC, CONADE and CELADE.

percent for the 40 year period.

There were marked differences in the rate of population growth in each of the inter-census periods. The high rate of population growth between 1950-1962 of 2.96 percent was due to a very high birth rate of about 47 per thousand and a relatively high death rate of about 17 per thousand (CONADE and UNFPA Chapters 2 and 3). The growth rate increased to a very high 3.3 percent between 1962-1974 because of a combination of a large and fairly quick fall in the death rate to about 11 per thousand during 1962-1974 accompanied by only a modest decrease in the birth rate to around 43 per thousand. The birth rate fell even more in the ensuing inter-census period 1974-1982 to less than 37 per thousand. The death rate also continued to fall but only by a little more than one point. The net effect of these changes was a decrease in the population growth rate to 2.77 percent, a decline of over 16.1 percent from the 1964-1972 inter-census growth rate.

The population growth rate is projected to increase slightly to 2.86 percent during the 1982-1990 period because the death rate is expected to decline slightly faster than the birth rate. Then population growth is projected to fall to 2.69 percent between 1990-1995 and to 2.51 percent between 1995-2000 as the birth rate is expected to fall more rapidly than the death rate.

Population growth of 2.5 percent still is very high for a developing country to accommodate and afford. At this rate the projected population of 13,939,400 in 2000 would double to nearly 28,000,000 by 2028.

Geographic Distribution[3]

The distribution of population among the principal regions has shifted substantially since 1950, with major political, economic and social implications. The Costa has replaced the Sierra as Ecuador's most populous region and the Oriente has nearly tripled its population, although it is still relatively small (Table 5.2, Appendix Tables 5.1 and 5.2).[4] The share of the population located in the Costa increased between 1950 and 1990 from about 40.5 to nearly 49.7 percent and from 1.5 to 3.5 percent in the Oriente, while the Sierra's share fell from 58.0 percent to 45.7 percent. The Costa has become much more influential in politics and has emerged as the dominant economic region of Ecuador. While the Sierra is the seat of national government its political and economic importance have waned.

The changing concentration of population among principal regions of the country reflects differential rates of population growth. The Costa experienced more rapid rates of population growth than the Sierra during all three inter-census periods, with population growth rates declining substantially for both regions during 1974-1982. The Oriente experienced the fastest rates of population growth of the three major regions since 1962 and more than doubled its share of the population between 1950 and 1982. The Galápagos grew faster than any other region but on a very small base and accounted for a little more than .5 percent of the population in 1982. Nevertheless, the rapid population growth of the Oriente and Galápagos is a cause for major concern, given the fragile ecologies of these two regions and especially the Galápagos with its unique and internationally acclaimed flora and fauna.

The trend of increasing concentration of population in the Costa is expected to continue according to INEC projections (1985a). The Costa will grow at nearly 3.0 percent during 1982-1995 while the Sierra is projected to grow at about 2.4 percent for the same period. The Oriente is projected to have the most rapid rates of population growth of any of the regions at about 5.0 percent through 1995. Growth in the Galápagos is expected to slow substantially to about 3.0 percent but still will

Table 5.2 Population, Share and Growth Rates by Regions, Census Years and Projections

	Unadjusted Censuses				Projections		
	1950	1962	1974	1982	1982	1990	1995
Population							
A. Ecuador	3,202,757	4,476,007	6,521,710	8,060,712	8,606,116	10,781,613	12,314,210
B. Sierra	1,856,445	2,271,345	3,146,565	3,801,839	4,047,182	4,926,776	5,527,360
C. Costa	1,298,495	2,127,358	3,179,446	3,946,801	4,214,289	5,359,743	6,171,622
D. Oriente	46,471	74,913	173,469	263,797	275,690	407,330	513,873
E. Galápagos & other	1,346	2,391	22,230	48,275	68,955	87,764	101,355
Shares (%)							
A. Ecuador	100.0	100.0	100.0	100.0	100.0	100.0	100.0
B. Sierra	58.0	50.7	48.2	47.2	47.0	45.7	44.9
C. Costa	40.5	47.5	48.8	49.0	49.0	49.7	50.1
D. Oriente	1.5	1.7	2.7	3.3	3.2	3.8	4.2
E. Galápagos & other	0.0	0.1	0.3	0.6	0.8	0.8	0.8
Growth Rates[a] (%)							
A. Ecuador	---	2.83	3.32	2.53	---	2.86	2.69
B. Sierra	---	1.70	2.87	2.26	---	2.49	2.33
C. Costa	---	4.20	3.55	2.59	---	3.05	2.86
D. Oriente	---	4.06	7.55	5.07	---	5.00	4.76
E. Galápagos & other	---	4.90	21.34	9.59	---	3.06	2.92

Source: Appendix Tables 5.1 and 5.2.

[a] Rates are for each inter-census or inter-projection period and are the compound (geometric) growth rate. For example the rates in the column labeled "1962" are for the inter-census period 1950-1962 (12 years).

be faster than the national average. As a result of these differential growth rates, the Costa will have more than half of Ecuador's population in 1995, the Oriente will have over 4 percent, the Galápagos' share will increase to nearly 1 percent while the Sierra's share will decline further to less than 45 percent.

Rural-Urban Distribution

There also have been large relative increases in the urban population between 1950 and 1990 (Table 5.3, Appendix Table 5.1).[5] In 1950 Ecuador was a predominantly agrarian society with 71.5 percent of its 3.2 million people living in rural areas. By 1990 this scenario was reversed with 55.4 percent of the population of 10.8 million living in urban areas. The urban population increased by over six times between 1950-1990--an absolute increase of 5.1 million inhabitants. The rapid growth of the urban population imposed a major burden on local governments to provide the necessary services (health care, education, sewer and potable water, electricity, and transportation).

The trend of increases in urban population have been especially strong in

Table 5.3 Distribution of the Rural and Urban Population by Geographic Area for Census Years, and Projections

	Unadjusted Censuses				Projections		
	1950	1962	1974	1982	1982	1990	1995
Population							
A. Ecuador	3,202,757	4,476,007	6,521,710	8,060,712	8,606,116	10,781,613	12,314,210
Urban	913,932	1,612,343	2,698,722	3,968,362	4,225,653	5,976,833	7,237,242
Rural	2,288,825	2,863,664	3,822,988	4,092,350	4,380,463	4,804,780	5,076,968
B. Sierra	1,856,445	2,271,345	3,146,565	3,801,839	4,047,182	4,926,776	5,527,360
Urban	485,475	744,387	1,202,796	1,707,022	1,817,272	2,512,670	3,007,550
Rural	1,370,970	1,526,958	1,943,769	2,094,817	2,229,910	2,414,106	2,519,810
C. Costa	1,298,495	2,127,358	3,179,446	3,946,801	4,214,289	5,359,743	6,171,622
Urban	422,893	857,530	1,470,591	2,199,296	2,343,101	3,354,241	4,084,477
Rural	875,602	1,269,828	1,708,855	1,747,505	1,871,188	2,005,502	2,087,145
D. Oriente	46.471	74,913	173,469	263,797	275.690	407,330	513,873
Urban	5,564	10,426	22,979	57,551	60,493	101,789	134,258
Rural	40,907	64,487	150,490	206,246	215,197	305,541	379,615
E. Galápagos and other	1,346	2,391	22,230	48,275	68,955	87,764	101,355
Urban	0	0	2,356	4,493	4,787	8,133	10,957
Rural	1,346	2,391	19.874	43,782	64,168	79,631	90,398
Share (%)							
A. Ecuador	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Urban	28.5	36.0	41.4	49.2	49.1	55.4	58.8
Rural	71.5	64.0	58.6	50.8	50.9	44.6	41.2
B. Sierra	58.0	50.7	48.2	47.2	47.0	45.7	44.9
Urban	15.2	16.6	18.4	21.2	21.1	23.3	24.4
Rural	42.8	34.1	29.8	26.0	25.9	22.4	20.5
C. Costa	40.5	47.5	48.8	49.0	49.0	49.7	50.1
Urban	13.2	19.2	22.5	27.3	27.2	31.1	33.2
Rural	27.3	28.4	26.2	21.7	21.7	18.6	16.9
D. Oriente	1.5	1.7	2.7	3.3	3.2	3.8	4.2
Urban	0.2	0.2	0.4	0.7	0.7	0.9	1.1
Rural	1.3	1.4	2.3	2.6	2.5	2.8	3.1
E. Galápagos and other	0.0	0.1	0.3	0.6	0.8	0.8	0.8
Urban	0.0	0.0	0.0	0.1	0.1	0.1	0.1
Rural	0.0	0.1	0.3	0.5	0.7	0.7	0.7

Source: Appendix Tables 5.1 and 5.2.

the Costa. In 1950 the Sierra had the largest share of urban dwellers in the total population of any region at 15.2 percent while the urban population of the Costa accounted for 13.2 percent of Ecuador's population. By 1990 Costa urban dwellers had increased to 31.1 percent of the total population, while the Sierra's urban population increased at a more modest rate to 23.3 percent of the total. The Costa now has the largest urban population of the major regions and nearly one out of three Ecuadorians live in urban areas of the Costa.

Even though Ecuador has been transformed into a society with a majority of urban people there has been a significant increase in the absolute number of rural people who still account for 44.6 percent of the population in 1990. There are now 4.8 million rural people, an increase of 2.5 million since 1950, which also has strained government's capacity to serve their needs. The rural population is concentrated in the Sierra with 2.4 million in 1990 (50.2 percent of the total) compared to 2.0 million (41.7 percent) in the Costa and .4 million (8.1 percent) in the Oriente and Galápagos.

The changes in the relative importance of national and regional rural and urban populations since 1950 reflect differences and changes in the underlying growth rates for each of these population subsets (Table 5.4, Appendix Table 5.2). Urban population grew rapidly during all the inter-census periods. The rate of growth was greater in the Costa and averaged 4.87 percent during 1974-1982

Table 5.4 Global, Rural and Urban Population Growth Rates by Geographic Area for Census Years: 1950, 1962, 1974 and 1982, and Projected for 1982, 1990 and 1995

	Inter-censuses			Inter-projections	
	1950-62	1962-74	1974-82	1982-90	1990-95
Growth Rates (%)					
A. Ecuador	2.83	3.32	2.53	2.86	2.69
Urban	4.84	4.57	4.66	4.43	3.90
Rural	1.88	2.54	0.81	1.16	1.11
B. Sierra	1.70	2.87	2.26	2.49	2.33
Urban	3.63	4.25	4.22	4.13	3.66
Rural	0.90	2.12	0.89	1.00	0.86
C. Costa	4.20	3.55	2.59	3.05	2.86
Urban	6.07	4.79	4.87	4.59	4.02
Rural	3.15	2.61	0.26	0.87	0.80
D. Oriente	4.06	7.55	5.07	5.00	4.76
Urban	5.37	7.09	11.45	6.72	5.69
Rural	3.87	7.63	3.79	4.48	4.44
E. Galápagos and other	4.90	21.34	9.59	3.06	2.92
Urban	---	---	7.92	6.85	6.14
Rural	4.90	20.16	9.77	2.74	2.57

Source: Appendix Table 5.2.

compared to 4.25 percent in the Sierra.

The rural population grew at much lower rates reflecting fairly rapid rural to urban migration in all the inter-census periods. The rural population growth rate plummeted to .81 percent during 1974-1982 because of significant decreases in the birth and death rates combined with greatly increased rural to urban migration. The quickened pace of outmigration was in response to relatively greater employment and income opportunities in urban areas associated with the oil boom and the urban-biased macroeconomic policies focused on import-substitution industrialization (see Chapter 2). The rural population of the Sierra grew at only .89 percent during this period, a decrease of 58 percent from 1962-1974, while that of the Costa fell even more precipitately by 90 percent to grow at only .26 percent.

Rural population is expected to grow at about 1.1 percent per year during 1982-1995, slightly faster than the last inter-census period. A total of 695,605 people will be added to the rural population with 24 percent of these in the Oriente. The Oriente will experience growth rates of rural population nearly twice the national average and will about double its rural population. The rural population of the Sierra is expected to grow at about .9 percent during 1982-1995 and the Costa at about .8 percent, both much slower than the global growth rate.

Urban population growth is expected to slow to 4.4 percent during 1982-1990 and to 3.9 percent during 1990-1995 but still will be substantially faster than the global population growth rate, so that the share of urban population will be increasing. Urban growth is expected to be fastest in the urban centers of the Oriente and Galápagos, followed by the urban areas of the Costa. The Sierra will experience the slowest urban population growth of any region but still much faster than the national average.

Urban Growth in Provincial Capitals and County Seats

Ecuador's cities grew very rapidly during the last three decades which severely strained their capacity to provide for the needs of their burgeoning populations (Table 5.5). For example, Santo Domingo, Quevedo and Machala have emerged from relative obscurity to become major secondary cities. One only has to drive through Ecuador's cities, and especially the secondary cities, to observe how rapid influxes of people have outstripped capacity to provide basic services.

Increases in urban population tend to be concentrated in the provincial capitals, especially in Quito in the Sierra and in Guayaquil in the Costa. The population of these two cities increased by a combined total 2,577,121 people between 1950-1990, and accounted for 50.9 percent of the increase of 5,062,091 in urban population (Table 5.6). An additional 22.2 percent is explained by increases in the population of other provincial capitals, while the balance of 26.9 percent is accounted for by growth in the population of the smaller county seats (*Cabeceras de Cantones*).

Urbanization in the Sierra is heavily concentrated in the capital cities. Quito alone accounted for 52.9 percent of the increase in the urban population of Sierra, with the other provincial capitals accounting for 29.6 percent; only 17.5 percent of the increase was in Sierra county seats.

The increase of urban population is more disperse in the Costa. The principal city, Guayaquil, accounted for 51.4 percent of the increase in the urban population of the Costa, about the same share as for Quito in the Sierra. However, a relatively large 32.2 percent of the increase in the urban population of the Costa was in its county seats while only 16.5 percent was due to increases in the urban

Table 5.5 Seventeen Principal Cities in Ecuador by Census Years, Ranked by Size

City	Province	Capital	1982	Rank	1950	Rank
Guayaquil	Guayas	yes	1,199,344	1	258,966	1
Quito	Pichincha	yes	866,472	2	209,932	2
Cuenca	Azuay	yes	152,406	3	39,983	3
Machala	El Oro	yes	105,521	4	7,549	15
Portoviejo	Manabí	yes	102,628	5	16,330	7
Ambato	Tungurahua	yes	100,454	6	31,312	4
Manta	Manabí	no	100,338	7	19,028	6
Esmeraldas	Esmeraldas	yes	90,360	8	13,169	11
Milagro	Guayas	no	77,010	9	13,736	10
Riobamba	Chimborazo	yes	75,455	10	29,830	5
Loja	Loja	yes	71,652	11	15,399	8
Santo Domingo	Pichincha	no	69,235	12	NA	17
Quevedo	Los Rios	no	67,023	13	4,168	16
Ibarra	Imbabura	yes	53,428	14	14,031	9
Babahoyo	Los Rios	yes	42,266	15	9,181	13
Chone	Manabí	no	33,839	16	8,046	14
Tulcán	Carchi	yes	30,985	17	10,623	12

Source: INEC 1985b; Ministry of Economy.

population of other provincial capitals. The Costa accounted for almost 70 percent of the increase in the population of county seats nationally between 1950-1990. Given the initially larger populations of the Costa county seats and their more rapid growth, the divergences between the urban populations of the county seats of the two regions has become more pronounced. In contrast, the increase in population of the provincial capitals is more evenly divided between the two regions, with the Costa accounting for 54 percent.

Population Density

Population density increased from 11.9 to 40.1 people per square kilometer (p/km^2) between 1950 and 1990 and is expected to be at 45.8 p/km^2 by 1995 (Table 5.7). The Costa and Sierra each have about one-fourth the total land area and their population densities are very similar at 80.3 and 77.5 p/km^2 in 1990, respectively. The Costa surpassed the Sierra as the most densely populated region of the country in the mid-1970s as its population density more than quadrupled between 1950-1990. The Sierra's population grew more slowly than the Costa but its population density still increased by 2.7 times between 1950-1990. The Oriente, with about half of the total land area, is very sparsely populated with only 3.1

Table 5.6 Changes in Rural and Urban Population Between 1950 and 1990

	1950	1990	Differences	Share of Differences (%)		
				National	Urban	Capitals
A. Ecuador	3,202,757	10,781,613	7,578,856	100.00	- -	- -
Urban	913,932	5,976,833	5,062,901	66.80	100.00	- -
Capitals	683,458	4,386,820	3,703,362	48.86	73.15	100.00
Quito	209,932	1,281,849	1,071,917	14.14	21.17	28.94
Guayaquil	258,966	1,764,170	1,505,204	19.86	29.73	40.64
Others	214,560	1,340,801	1,126,241	14.86	22.24	30.41
County seats	230,474	1,590,013	1,359,539	17.94	26.85	- -
Rural	2,288,825	4,804,780	2,515,955	33.20	- -	- -
B. Sierra	1,856,445	4,926,776	3,070,331	100.00	- -	- -
Urban	485,475	2,512,670	2,027,195	66.03	100.00	- -
Capitals	375,386	2,047,522	1,672,136	54.46	82.49	100.00
Quito	209,932	1,281,849	1,071,917	34.91	52.88	64.10
Others	165,454	765,673	600,219	19.55	29.61	35.90
County seats	110,089	465,148	355,059	11.56	17.51	- -
Rural	1,370,970	2,414,106	1,043,136	33.97	- -	- -
C. Costa	1,298,495	5,359,743	4,061,248	100.00	- -	- -
Urban	422,893	3,354,241	2,931,348	72.18	100.00	- -
Capitals	305,195	2,293,682	1,988,487	48.96	67.84	100.00
Guayaquil	258,966	1,764,170	1,505,204	37.06	51.35	75.70
Others	46,229	529,512	483,283	11.90	16.49	24.30
County seats	117,698	1,060,559	942,861	23.22	32.16	- -
Rural	875,602	2,005,502	1,129,900	27.82	- -	- -
D. Oriente	46,471	407,330	360,859	100.00	- -	- -
Urban	5,564	101,789	96,225	26.67	100.00	- -
Capitals	2,877	43,223	40,346	11.18	41.93	100.00
County seats	2,687	58,566	55,879	15.48	58.07	- -
Rural	40,907	305,541	264,634	73.33	- -	- -
E. Galápagos & Other	1,346	87,764	86,418	100.00	- -	- -
Urban	0	8,133	8,133	9.41	100.00	- -
Capitals	0	2,393	2,393	2.77	29.42	100.00
County seats	0	5,740	5,740	6.64	70.58	- -
Rural	1,346	79,631	78,285	90.59	- -	- -

Source: Appendix Table 5.1.

Table 5.7 Population Density by Regions and Provinces, Ecuador, 1950, 1982 and 1990

Regions and Provinces	Area (km^2)	Total Population (1,000) 1950	1990	1995	Persons/km^2 1950	1990	1995
Ecuador [a]	269,055	3,202,757	10,781,613	12,314,210	11.9	40.1	45.8
Sierra	63,608	1,856,445	4,926,776	5,527,360	29.2	77.5	86.9
Carchi	3,750	76,595	150,778	159,092	20.4	40.2	42.4
Imbabura	4,466	146,893	300,298	323,011	32.9	67.2	72.3
Pichincha	12,870	386,520	1,984,743	2,368,704	30.0	154.2	184.0
Cotopaxi	6,248	165,602	332,962	355,483	26.5	53.3	56.9
Tungurahua	3,128	187,942	403,484	438,519	60.1	129.0	140.2
Chimborazo	6,523	218,130	383,544	397,793	33.4	58.8	61.0
Bolivar	4,106	109,305	168,034	172,113	26.6	40.9	41.9
Cañar	3,185	97,681	213,364	230,830	30.7	67.0	72.5
Azuay	8,118	250,975	562,725	626,645	30.9	69.3	77.2
Loja	11,214	216,802	426,844	455,170	19.3	38.1	40.6
Costa	66,778	1,298,495	5,359,743	6,171,622	19.4	80.3	92.4
Esmeraldas	15,152	75,407	335,229	386,845	5.0	22.1	25.5
Manabí	18,744	401,378	1,126,310	1,240,680	21.4	60.1	66.2
Guayas	20,247	582,144	2,841,945	3,330,736	28.8	140.4	164.5
Los Rios	6,825	150,260	591,550	667,821	22.0	86.7	97.8
El Oro	5,811	89,306	464,709	545,542	15.4	80.0	93.9
Oriente	130,659	46,471	407,330	513,873	0.4	3.1	3.9
Napo	53,764	17,695	192,109	253,836	0.3	3.6	4.7
Pastaza	29,135	7,730	44,376	52,469	0.3	1.5	1.8
Morona	25,785	16,285	99,365	118,218	0.6	3.9	4.6
Zamora	21,975	4,761	71,480	89,350	0.2	3.3	4.1
Galápagos	8,010	1,346	87,764	101,355	0.2	11.0	12.7

Source: INEC 1985a; Ministry of Economy; INEC, División de Cartografía, unpublished data on area.

[a] Undefined areas not included (1,611.7 km2).

people per km^2 in 1990. However, its population density increased by nearly eight times between 1950-1990 due to a rapid influx of settlers during the 1970s and 1980s. The permanent population density of the Galápagos increased the most dramatically, by over 55 times and now is 11.0 p/km^2. This permanent increase, along with rapid influxes of tourists has imposed significant stress on the fragile ecology of the Galápagos and threatens the survival of this important nature reserve.

These averages mask important differences among provinces. Pichincha and Guayas provinces which contain the principal cities of Quito and Guayaquil have population densities of 154.2 and 140.4, respectively and are the most densely populated provinces of Ecuador. The next greatest population density is in Tungurahua province, Ecuador's smallest, at 129.0 p/km^2. The most sparsely populated province (outside the Oriente) is Esmeraldas in the Costa, followed by Loja in the Sierra.

While overall population density has increased, population density on agricultural land has declined, with large decreases in the Costa and in the Oriente and a slight decrease in the Sierra (Whitaker and Alzamora Appendix Table 8). Population density on cropland increased for every region between 1962 and 1982, as area in crops declined (see Chapter 6). But population density decreased

significantly on pasture lands because area in pastures increased much faster than population during the same period. Because increases in pasture lands were much greater than decrease in cropland, population density on all agricultural land has declined, on average.

Changes in the density of the rural population on agricultural land tend to follow they same pattern as national population densities but are not as great. This is because the rural population grew much more slowly than the global population.

Rural to Urban Migration

Differences in the global, rural and urban population growth rates for Ecuador and its regions reflect differences in underlying determinants of population growth including the death rate, the birth rate, net migration and reclassification of parishes (*parroquias*) from rural to urban between censuses. Limited data make it difficult to disaggregate the relative importance of each of these determinants of net population growth rates. There is evidence, however, that migration from rural to urban areas is very important in explaining the rapid rates of urban population growth and the relatively low rates of rural population growth. Data on the death and birth rates for rural and urban areas indicate that the natural rate of population growth is somewhat higher in rural than urban areas, primarily because of a much higher levels of fecundity (CONADE and UNFPA Chapter 2). Since the observed population growth rates are much higher in urban areas, rural to urban migration and reclassification of rural areas as urban must explain a significant share of urban population growth.

Rural to urban migration can be estimated by assuming that the rate of population growth in rural and urban areas is the same as the national average, projecting rural and urban populations at this rate and calculating the difference between actual and projected rural and urban populations (Table 5.8). Since the natural rate of population growth likely is higher in rural than in urban areas, this

Table 5.8 Estimates of Rural to Urban Migration, 1962-1974 and 1974-1982

	Unadjusted Census	Projected [a]	Estimated Migration (difference)
1982			
Rural	4,092,350	4,724,007	(631,657)
Urban	3,968,362	3,334,769	633,593
1974			
Rural	3,822,988	4,173,190	(350,202)
Urban	2,698,722	2,349,652	349,070

Source: Appendix Table 5.1; Projections by author.

[a] Projected from previous census year at Ecuador's average growth rates of 2.53 percent between 1974-1982 (8.47 years) and at 3.32 percent between 1962-1974 (11.53 years). See Appendix Table 5.1.

assumption will result in a lower-limit estimate of net rural to urban migration. These estimates will include actual rural to urban migration and reclassification of rural parishes as urban.

Rural to urban migration is estimated to have been about 632,500 between 1974-1982 using this procedure.[6] The same analysis for 1962-1974 suggests rural to urban migration of approximately 350,000. These results indicate that a little less than one-third of the increase in Ecuador's urban population between 1962-1974 was due to rural to urban migration. Migrants were a much more important share of the increase in urban population of 1,269,640 between 1974-1982, accounting for almost half.

A recent study by Padilla came to a similar conclusion. It found that between 1962-1974 a little more than 35 percent of urban population growth was explained by net migration from rural to urban areas, including rural to urban migration per se and reclassification of jurisdictions from rural to urban. Between 1974-1982 more than 50 percent of urban growth was explained by such transfers. The same study estimated that the natural growth of population in rural areas was reduced by 29 percent between 1962-1974 and by 75 percent between 1974-1982 by rural to urban migration and reclassification of parishes from rural to urban.

CONADE and UNFPA (pp. 244-46) estimate the global effects of reclassification of rural areas as urban as relatively minor. It found that the population of areas reclassified as urban represented 6.6 percent of urban population growth during 1962-1974 and 5.8 percent during 1974-1982. This suggests that the major part of net rural to urban migration as estimated here and by Padilla is due to rural to urban migration. Moreover the increase in the share of urban population growth due to rural immigrants, from about 35 percent to over 50 percent between the two inter-census periods indicates that the rate of rural to urban migration increased substantially during 1974-1982.

One striking aspect of the rural and urban migration patterns is their complexity. It is tempting to conclude that rural to urban migration is a dominant pattern but this is not so. Data from the 1982 population census for "last migratory movement" tabulated by rural and urban areas illustrate the nature of rural and urban migration patterns (Table 5.9). The largest outmigration was from urban areas and at 1,071,355, was substantially greater than outmigration of 644,810 from rural areas. While most urban outmigration was to other urban areas, a substantial portion was to rural areas. Moreover, this flow of people from urban to rural areas offset more than half of rural to urban migration as captured in the 1982 census by people reporting a "last migratory movement."[7]

III. The Labor Force

A country's labor force, or economically active population (EAP) usually is defined to include all those who are employed and those who are unemployed and actively seeking employment, including new entrants into the job market. The size of the labor force at any point in time is dependent upon two principal variables: the share of the population of working age, which in turn depends on past demographic trends; and the rate of participation in the labor force of various segments of the population of working age. Growth in the labor force depends on how these two variables change over time.

Recent Growth

The 1962, 1974 and 1982 censuses of population present data on the labor

Table 5.9 Rural and Urban Migration Patterns, According to "Last Migratory Movement," 1982

	Emigrants From					
	Ecuador	Rural	Urban	Sierra	Costa	Oriente
Immigrants to:						
Ecuador	1,716,165	644,810	1,071,355	863,756	811,752	40,657
Rural	418,078	63,081	354,997	202,458	199,684	15,936
Urban	1,298,087	581,729	716,358	661,298	612,068	24,721
Sierra	731,746	263,341	468,405	565,180	148,769	17,797
Costa	881,585	339,799	541,786	230,087	647,862	3,636
Oriente	102,834	41,670	61,164	68,489	15,121	19,224

Source: INEC 1985b.

force, defined to include those age 12 and over, but female participation rates were substantially underestimated. The censuses under-counted women, because many indicated they were housewives (defined in the censuses as not economically active) when in fact they were employed, especially in agricultural activities. The 1962 and 1982 census data on EAP were corrected by the Institute of Social Studies of Holland (ISS) and the United Nations Regional Employment Program for Latin America and the Caribbean (PREALC) (1984a, 1984b) and by INEC (1979) for 1974. Corrected data were reported in Gutiérrez (1984a Table 11) and are summarized here.

There were an estimated 2.9 million people in Ecuador's labor force in 1982, up from 2.3 million in 1974 and 1.7 million in 1962. The rate of growth in the labor force also increased from 2.2 percent between 1962-1974 to 2.9 percent between 1974-1982. These data suggest the annual increases the labor force more than doubled in 20 years, from 39,000 in 1963 to 83,000 in 1983.

The increase in rate of growth of the labor force between the two inter-census periods reflects the net effect of changes in two key variables. The first is the share of the population of working age in the labor force (commonly referred to as the participation rate). The second is the growth rate of the population of working age.

Gutiérrez (1984a pp. 15-19) documented a continual decline in the first key variable--the participation rate--from 60.7 percent in 1962 to 54.0 percent in 1974 to 51.8 percent in 1982. This decline reflected primarily: (a) greatly increased enrollment in school among 12-24 year old men and women in both rural and urban areas, but especially for rural males; (b) much broader social security coverage among older workers and especially for urban males over age 55; and (c) the process of urbanization which provided greater access to school and social security for urban people.[8] The continual decline in the participation rate between 1962-1974 and between 1974-1982 tended to reduce the rate of growth of the labor force.

The rate of growth of the population of working age--the second determinant of labor force growth--increased from 3.29 percent during 1965-1975 to 3.44 percent between 1975-85 (INEC, CONADE and CELADE Tables 2 and 9).[9] This increase placed

significant upward pressure on the rate of growth of the labor force.

The net effect of changes in the two prime determinants of labor force growth between the inter-census periods was to increase the rate of growth. The positive effect of the increased rate of growth of the population of working age was greater than the negative effect of declining participation rates and the pace of growth in the labor force increased by almost 30 percent during 1974-1982 relative to 1962-1974.

Future Labor Force Growth

CONADE-UNFPA made projections of growth in the labor force for five-year intervals from 1985 to 2000 using the uncorrected census data as a basis (pp. 289 ff.). Consequently, these projections started from too low a base because the 1982 census had significantly under-counted rural women in the EAP. As a result, the projected levels of the EAP also are too low, especially for women. For example, the 1985 projections were for a total EAP of 2,854,100, while the corrected census data reported an EAP of 2,864,800 in 1982, three years earlier. Also, the number of women in the labor force in 1982 according to corrected census data was 893,818, while the CONADE-UNFPA projections were for 592,600 in 1985.

The rates of growth in the CONADE-UNFPA projections appear to be more reliable and consistent with the rapid growth of the population of working age discussed above. They indicate a rapid increase in the labor force of 3.2 percent annually between 1985-2000, with especially high rates of growth during 1985-90 of 3.4 percent. These projections indicate that the urban EAP will increase to 64.4 percent of the total by 2000, up from 54.0 percent in 1985. They also indicate a slight increase in the share of women in the labor force.

Estimates of the labor force were made utilizing the corrected 1982 census data as the base, the 2.9 percent inter-census growth rate in the labor force between 1974-1982 (from corrected census data) for projecting the EAP in 1985 and the growth rates for the five-year intervals implicit in the CONADE-UNFPA projections for projecting the EAP in 1990, 1995 and 2000 (Table 5.10). These estimates indicate an annual increase in the labor force of 104,579 in 1986, 117,789 in 1991, 131,848 in 1996 and 153,293 in the year 2001, about 10 percent greater each year than in the CONADE-UNFPA projections.

Characteristics of the EAP

There were significant changes in the nature of the labor force between 1962 and 1982 with respect to rural and urban location, sex and age.

The labor force became increasingly concentrated in urban areas, especially since 1974 (Gutiérrez 1984a, Table 9). In 1962, only 29.8 percent of the labor force was in urban areas; this increased to 36.7 percent by 1974 and 44.6 percent by 1982. This phenomena reflects the subsidization of industry and other mainly urban-based economic sectors at the expense of agriculture and rural people analyzed elsewhere in this assessment (see Chapter 2). As a result, employment opportunities became much more lucrative in nonagricultural activities, the pace of rural to urban migration quickened, the urban labor force grew rapidly and agricultural employment actually declined (see below). The labor force is projected to become even more concentrated in urban areas, reaching 64 percent of the total by 2000 (CONADE and UNFPA p. 301). Thus, urban areas will have to absorb the majority of increases in the EAP during the next decade.

Another important change in the labor force is the increasing share of women

Table 5.10 Corrected Censuses and Projections of the Labor Force

	EAP (1,000)	Annual Average Growth Rate[a] (%)	Annual Average Increase[b]
Corrected Censuses			
1962	1,745.6	---	39,175
1974	2,278.3	2.24	66,179
1982	2,864.8	2.90	83,215
Projections			
1985	3,121.8	2.90	104,579
1990	3,680.9	3.35	117,789
1995	4,308.8	3.20	131,848
2000	5,009.6	3.06	153,293

Source: Growth rates, 1985-2000, derived from estimates of EAP by CONADE and UNFPA (p.300); 1962-1982, Gutiérrez (1984a Table 11); Projections of EAP by author.

[a] The annual average rate between the census or projection years. For example, the rate of 2.24 percent is for the period 1962-1974.

[b] Calculated from the EAP in the base year and the growth rate for the period. For example, 39,175 is the annual increase in 1963 given the 1962 base and the annual average growth rate of 2.24 percent between 1962-1974. The increase for 2001 is calculated at the same rate as for 1995.

in the total. Corrected census data indicated that 28.9 percent of the labor force were women in 1962 and this increased slightly to 31.2 percent in 1982 (Gutiérrez 1984a, Table 10). The participation rate for women has remained relatively constant although a decline in fecundity likely will result in increased participation rates, especially among women of childbearing age. Also, increased levels of education may increase the participation rate, particularly for urban women over school age.

Finally, the composition of the labor force has tended to become more concentrated among people ages 25-64. This is because the younger ages increasingly are in school instead of the labor force and because older people are covered by social security and are not working. In 1962, 58.7 percent of the EAP was concentrated in ages 25-64; this had risen to 64.0 percent in 1982 (Gutiérrez 1984a, Table 9).

Unemployment

Unemployment is an emotional issue in Ecuador. Discussion of its extent and how to resolve it composes a significant part of the national public debate about economic issues (see, e.g. El Comercio p. B/1). This debate is rendered more subjective by inadequate data and differing concepts about what is meant by unemployment. Periodic surveys by the National Employment Institute (INEM) to

measure unemployment started in 1987. Past occasional studies and surveys of unemployment tended to use different methodologies and concepts so the results are not strictly comparable. The unemployed in Ecuador traditionally are defined to include all those who are seeking employment for the first time and those who are looking for work after quitting or being dismissed from their jobs.

The magnitude of unemployment is relatively low, although it appears to have been increasing since the mid-1970s. Urban unemployment, as measured by data from the uncorrected censuses and three different household surveys, ranged from 4.4 to 5.8 percent of the EAP through the 1970s and early 1980s, with a modest trend of increasing unemployment in both the census and survey data (Gutiérrez 1984a, p. 59). In one survey of poorer neighborhoods in Quito and Guayaquil the rate was 9.7 percent in 1983, a year of severe economic recession, compounded by the El Niño floods. Rural unemployment measured in the 1974 and 1982 censuses was much less than urban unemployment but shows the same increasing trend. There are no data for rural unemployment more recent than the 1982 census but rural unemployment probably continues to be much lower than in urban areas. Also the trend of increasing rural unemployment between 1974-1982 probably reversed in the 1980s. Agricultural growth recovered substantially after 1982, after being relatively stagnant in the 1970s (see Chapter 3). Indeed, agriculture has led economic development since 1982 and likely has generated new jobs, although data are lacking on this point.

The most recent primary data on unemployment are from household surveys in Quito, Guayaquil and Cuenca during November 1987 (INEM). This survey revealed an urban unemployment rate of 7.24 percent for the three principal cities. This rate suggests that the trend of rising unemployment during the 1970s and early 1980s continued through the mid-1980s. This interpretation is consistent with the general stagnation of the economy after 1982 and especially in urban-based economic sectors (see Chapter 3).

The INEM survey data also reveal an unemployment rate for females twice that for males and a rate for female heads of households three times that for male heads. The data also indicate that unemployment is much higher among young workers, those with less education and new entrants into the labor force.

The level of unemployment indicated in the INEM survey is relatively low and close to the norm for frictional unemployment. Matching displaced workers and new entrants into the labor market with jobs consumes time and resources. Thus, at any point in time some level of unemployment is compatible with the concept of full employment. Levels of unemployment of less than 6 percent are considered to be compatible with full employment in developed economies. Viewed in this light, the unemployment rate of 7.2 percent in the three principal cities of Ecuador is relatively low, considering the likely greater inefficiencies in the information system and corresponding greater delays in matching skills and jobs.[10]

IV. Labor Absorption and Employment

There have been significant changes in the capacity of the economy to generate new jobs and to absorb the burgeoning labor force. The sectoral composition of employment experienced a significant transformation and absorptive capacity changed greatly over the last three decades.

Changing Sectoral Composition

Agriculture was the largest employer of any economic sector in 1982 with

1,172,700 workers but its share had declined to 44.7 percent of the total from over 59.0 percent in 1970 (Table 5.11). Agriculture's capacity to generate employment and to absorb increases in the labor force actually declined absolutely during 1974-1982, after reasonable performance during 1970-1974. Agriculture accounted for

Table 5.11 Employment by Sector, 1970, 1974, and 1982 (Thousands)

Sector	1970	1974	1984	Growth 1970-74	Growth 1974-82
Total	1,959.2	2,119.7	2,626.3	160.5	506.6
Agriculture	1,155.9	1,192.5	1,172.7	36.6	-19.8
Mining/Petroleum	5.1	6.2	7.1	1.1	0.9
Industry	203.5	228.0	270.6	24.5	42.6
Construction	70.9	86.4	153.6	15.5	67.2
Utilities	6.9	8.7	12.4	1.8	3.7
Commerce	155.5	190.6	253.1	35.1	62.5
Transportation	50.1	54.8	104.9	4.7	50.1
Finances	16.3	20.0	37.6	3.7	17.6
Services	295.0	332.5	614.3	37.5	281.8
Other [a]	43.2	72.3	57.6	29.1	-14.7
Shares (%)					
Total	100.0	100.0	100.0	100.0	100.0
Agriculture	59.0	56.3	44.7	22.8	-3.9
Mining/Petroleum	0.3	0.3	0.3	0.7	0.2
Industry	10.4	10.8	10.3	15.3	8.4
Construction	3.6	4.1	5.8	9.7	13.3
Utilities	0.4	0.4	0.5	1.1	0.7
Commerce	7.9	9.0	9.6	21.9	12.3
Transportation	2.6	2.6	4.0	2.9	9.9
Finances	0.8	0.9	1.4	2.3	3.5
Services	15.1	15.7	23.4	23.4	55.6
Other [a]					

Source: Gutiérrez 1984a, Table 19.

[a] Not included in total since it cannot be allocated among sectors.

36,600 new jobs in the earlier period, or 22.8 percent of the total increase. However, agricultural employment declined by 19,800 during 1974-1982 as rural people sought more lucrative jobs in other sectors of the economy.

The sharp decline in agriculture's capacity to generate new jobs is explained by three interrelated factors. First, agricultural growth stagnated relative to the rest of the economy as the macroeconomic policy matrix subsidized industry and urban development at the expense of agriculture. Second, agricultural wage rates increased as labor was pulled out of the sector by the lure of higher wages and other nonpecuniary benefits of urban-based employment. Agriculture responded to reduced incentives and more expensive labor by adopting production processes which substituted capital for labor. Third, the macroeconomic policy matrix also resulted in the subsidization of capital which further enhanced agriculture's adoption of capital intensive techniques.

Services, which includes both government and household services, was the second most important sector in terms of employment in 1982 at 614,300.[11] It accounted for slightly more of the increase in employment between 1970-1974 than

agriculture (37,500) and on a much smaller base. Then, between 1974 and 1982 it nearly doubled its employment absorbing a very large 281,800 new entrants into the labor force, or 55.6 percent of the increase for the period. As a result, its share increased from 15.1 percent of employment in 1970 to 23.4 percent in 1982.

Industry and commerce were the third and fourth most important sectors in terms of employment in 1982 at 270,600 and 253,100 employees, respectively. Both however, reduced their rates of labor absorption during 1974-1982 relative to the earlier period, with commerce accounting for 12.3 percent of increases in employment for the period and industry only 8.4 percent.

Construction, the fifth the most important sectoral employer in 1982, accounted for more of the increase in employment between 1974 and 1982 (67,200) than any other sector excepting services. Transportation and finances also increased their absorption of the growing labor force, with each nearly doubling the number of people employed between 1974 and 1982. None of the sectors changed their relative importance since 1970.

Absorptive Capacity

The capacity of each of the sectors to generate employment is quantified in employment elasticities (Table 5.12). These elasticities measure the percentage

Table 5.12 Employment Elasticities, 1970-1974 and 1974-1982

Sector	1970-74	1974-82	Percentage Change
Total [a]	0.13	0.43	238.4
Agriculture	0.16	(0.07)	(147.7)
Industry	0.31	0.19	(39.5)
Construction	0.52	2.56	388.0
Utilities	0.58	0.54	(6.6)
Commerce	0.57	0.46	(19.2)
Transportation	0.23	0.91	301.4
Finances	0.56	1.17	110.3
Services	0.41	1.08	163.3

Source: Table 5.11; Appendix Table 3.1.

[a] "Others" not included in total since it cannot be allocated among sectors.
"Mining and Petroleum" not included in total because of its relative unimportance in employment and negative GDP in 1970.

change in employment relative to the percentage change in production (GDP) over a given period. The absorptive capacity of the economy increased substantially between 1970-1974 and 1974-1982 from .13 to .43. This global increase masked some important changes in the structure of employment generation, however. The threefold increase in the capacity of the economy to employ new workers was due to very large increases in the employment elasticity in construction, transportation, finances and services which collectively accounted for 39 percent of GDP in 1982. These increases were sufficiently large to offset the large decline in the employment elasticity in agriculture and modest decreases in industry, commerce, and utilities, so that the economy-wide employment elasticity more than tripled.

Underemployment

The concept of underemployment is at once less precise and more emotion-laden than unemployment. The underemployed are, by definition, a subset of that part of the labor force which is employed in some way. The literature on employment problems in developing countries generally identifies two kinds of underemployment: (a) open underemployment where a worker is employed for fewer hours per day or week than some standard; and (b) disguised or hidden underemployment where the worker is employed full time but earns less than some standard, usually related to a minimum wage or similar index of well-being (Fletcher, Marquez and Sarfaty pp. 37-40). Obviously, the magnitude of open and hidden underemployment depends on the absolute level of the standards utilized. The higher the standard the greater will be the observed levels of underemployment. Thus, subjectivity in defining the standard impinges directly on the magnitude of unemployment.

Open underemployment in Ecuador is measured in the INEM survey in relation to the legal workweek of 40 hours. The rate of open underemployment in November 1987 was relatively low at 4.8 percent of the labor force. This low rate reflects labor law in Ecuador which limits less than full time employment in almost all circumstances by setting a 40-hour work week and making hourly hiring generally illegal. The low rate also reflects the reality that unemployed workers quickly become self-employed in the services sector where they can earn enough to support their families by working long hours. Finally, most employed workers in a recessionary economy are unwilling to participate in arrangements for sharing work even where labor law so permits.

Hidden underemployment in Ecuador is a much more serious problem, with a rate of 21.9 percent for Quito, Guayaquil and Cuenca in 1987 according to the INEM survey. This rate was established by comparing earnings of full-time workers with the minimum wage including all compensation established by law.

The rate of hidden underemployment in Ecuador does not distinguish between the causes of hidden underemployment. The concept of hidden underemployment basically is concerned with measuring the extent to which workers with the same skills earn different wages, because of segmentation in the labor market. However, lack of requisite wage data usually precludes measurement of hidden underemployment caused by market segmentation.[12] Such is the case with the INEM estimates which used the minimum wage as the standard. Consequently, the hidden underemployment rate can not be interpreted solely as a measure of labor market segmentation. It is entirely possible that all those in the INEM survey who earned less than the minimum wage did so because that was the value of their very low skills in a competitive market, not because they were employed in a low-paying component of a segmented labor market.

The high level of hidden underemployment more likely reflects limited investments in human capital, especially in rural areas, rather than market segmentation. The majority of rural emigrants appear to be trapped in low-paying jobs in urban areas because of their limited skills. By far the greatest expansion of employment has occurred in the low-skill services and construction sectors in recent years. Also, the number of new jobs created in the more modern sector has been substantially constrained by macroeconomic policies which have resulted in a capital-intensive economic growth pattern. Workers are trapped in menial, low-paying jobs, not only because of their extremely limited education and skill levels, but because very few higher-paying jobs are being created by the internally-oriented model of economic development employed in Ecuador during the last three decades. There is little incentive for poor people to invest in literacy, or improved skills if prospects for recouping such investments are constrained by a stagnant economy and very slow growth in better jobs.

V. The Labor Market

There is a continuing debate about the extent to which labor markets function efficiently in developing countries.[11] One body of evidence suggests that markets are efficient and that employment problems originate in the distortions introduced by macroeconomic and sectoral policies (Kannappan, Berry and Sabot; Kahnert; Gregory). There are a few studies which suggest that market segmentation does exist in the U.S. and some developing countries, indicating that competition can not produce a common wage for workers with similar skills (Uthoff; Krueger and Summers). The policy prescriptions are quite different. Increased investment in human capital, especially in primary and secondary education and improved skills are the best way to increase incomes and wellbeing of poor people when labor markets are relatively efficient. But if institutionally induced wage differentials exist, the basic policy approach would be to foster growth in employment in the high-wage industries, or to intervene in the market for labor in the high-wage industry by reducing or eliminating the institutional barriers to interindustry labor mobility.

There are no empirical studies on the degree of segmentation in labor markets in Ecuador. One study argues intuitively that some segmentation must exist in high-wage industries, because it does in a few other countries (Fletcher, Marquez and Sarfaty). A second study found some segmentation in the private sector and especially the public sector but argues that markets have been relatively efficient in transferring labor from agriculture to the informal urban sectors, with low productivity being the major problem (Hannette and Franklin). At the same time one important sector of the economy--public services--appears to be segmented from the rest of the economy, especially for lower skill workers.

Principal Characteristics

Ecuador's labor markets are characterized by limited public support, regionalization and fragmentation, informality and high opportunity costs associated with finding employment consistent with skills and abilities. The recessionary economy has cast a pall over the market, as the primary ingredient for a bullish labor market--rapid economic growth--has been absent since 1981. In this environment, people increasingly sought non-market influence to obtain the very scarce, good jobs that became available.

Public support for the labor market is practically nonexistent. Employment

services, which match unemployed workers with jobs in many countries do not exist. There is no unemployment insurance so that the costs of being unemployed are borne completely by the individual. This, in turn, tends to force the mismatching of skills with jobs as the individual can not afford to wait for the "right" job. The inadequate and increasingly costly communication system also tends to limit the efficient functioning of the labor market. However, a relatively good system of roads and highly subsidized fuel prices have facilitated the movement of people and have enhanced the efficient functioning of the labor market.

The labor market is very poorly developed at the national level. While there tends to be movement among the principal regions of the country for higher skill jobs, regional and local markets for labor are the norm. The principal cities are the centers for matching people to jobs, with various interrelated markets in smaller, secondary cities. Little is known about how such markets function and how they integrate rural and urban areas.

Labor markets tend to operate informally. Most information about new jobs, especially those requiring unskilled labor, is spread via informal communication networks. Newspaper advertisements often are utilized to solicit applications for skilled labor, professional services and some lower skill jobs (such as maids) in the urban areas. But no formal, publicly supported system for matching workers with jobs exists.

The combination of limited public support, regionalization and fragmentation and the informal nature of labor markets results in high opportunity costs associated with employment. Individuals must spend substantial time and effort to explore all the job opportunities that may be available to them even in the context of a local labor market. The high cost of information and the exigencies of meeting immediate needs must result in some mismatching of skills and jobs and, thus, in less efficient allocation of labor.

Rigidities and Market Segmentation

One major rigidity affecting the labor market generally, is the Ecuadorian labor code, or *Código del Trabajo*. This law, one of the most ambitious pieces of social legislation in Latin America, was promulgated during the liberal era of the late 1930s and was intended to improve income distribution by increasing payments to labor. It was substantially revised and broadened during the euphoria of the petroleum boom and rapid economic expansion of the late 1970s. It provides for minimum wages for firms with less than 15 workers, domestic servants, agricultural workers and employees of large firms; a 40 hour work week; long-term contracts; three extra monthly salaries and other bonuses; and a variety of other compensations associated with tenure of employment, transportation and dismissal, among others. In addition, workers also are covered by social security legislation, which requires significant additional payments. The transactions costs associated with compliance with these laws are substantial and are an additional element of labor costs. The principal effect of labor and social security legislation is to make labor relatively more expensive as it receives compensation unrelated to its productivity. Labor concomitantly tends to become a relatively fixed factor of production with a quasi-permanent commitment by employers, which is an important element of its increased cost. These effects, in conjunction with heavy subsidies to capital inherent in the macroeconomic policy matrix, have encouraged substitution of capital for labor throughout the economy but especially in industry.

The share of the labor force which is employed under the aegis of the labor

code is not known. It is well known, however, that particular elements of the labor force work outside the purview of the law. A large share of agricultural labor in the Costa is employed by the day. It is common to employ unskilled labor in Quito and Guayaquil for temporary jobs by the day, by going to certain locations and selecting laborers from groups that congregate there. It is believed that most workers in the relatively large informal sector are employed outside the purview of the labor code, often in self-employment. Entrepreneurs have circumvented the labor code in a variety of inventive ways. One approach is to contract with a number of individuals, or small firms to produce something from delivered components, such as sewing clothing by the piece. Since no employer-employee relationship is established, minimum wages and other provisions of the labor code are not in effect. It is thought that there is substantial avoidance of compliance with the code through such arrangements. It may be that such innovative mechanisms often involve the informal sector. It also is thought that enforcement of the code is generally greater in the larger, more visible firms in the modern industrial sector and in the public sector, and that smaller firms and those in the informal sector are less subject to enforcement and regulation. Again, there are almost no data to substantiate these positions.

Fletcher, Marquez and Sarfaty argue for Ecuador from one study in the U.S. and three unpublished studies for other Latin American countries, that "...some labor market segmentation and nonpure competition most likely exists...in high-wage industries while too many poorly paid workers are trapped in the low-productivity informal sector..." (p.vi). They suggest that the reduction of labor regulations and institutional arrangements will help to alleviate such segmentation but do not identify specific regulations, institutional arrangements or cases of segmented markets.

There is not, however, any empirical evidence for Ecuador to substantiate their intuitive argument. It is more likely that most workers in high wage industries earn more that the minimum wage because of higher productivity and that workers in the informal sector earn lower wages because of lower productivity. Indeed, a recent review of literature on the subject from various developing countries suggests, strongly, that urban labor markets are quite efficient, with little evidence of segmentation (Kannappan).

There may be, however, segmentation of the labor market in the public sector. The following discussion of this possibility is proffered as a hypothesis, because definitive data are lacking. Public sector employees fall under two different laws: the labor code, which encompasses lower-skill workers; and the civil service code, which covers professionals and administrators. All public sector employees are subject to one of the two laws, each of which is fully complied with across the gamut of public sector entities, including autonomous agencies.

Public sector jobs are highly sought after. The work load usually is perceived of as relatively light and the compensation as relatively good. Job tenure is practically guaranteed for life, especially among the lower skill workers who are organized into unions (*sindicatos*).

The low productivity of public sector employees is notorious, and it is likely that the institutional wage received by many workers is higher than the value of their production. If low-skill, public-sector employees were to have to work in another sector of the economy, most undoubtedly would be required to work longer hours or more intensively, at higher levels of productivity in order to earn the same wages. Alternatively, if their productivity was not higher, they would likely receive a lower wage. If so, wages of low-skill workers in the public sector are higher than people with similar skills in the rest of the economy, and the labor

market is segmented by enforcement of the labor code in the public sector.[14] Again, empirical evidence is not available, but the hypothesis seems probable enough to warrant further investigation.

The implication is that the labor code needs to be revised in order to permit a reduction in the wages for public servants, or to increase their productivity.

VI. Evidence of Efficiency

There is some evidence that labor markets in Ecuador are quite competitive and have transferred significant numbers of people to higher-paying jobs. Data indicate that labor productivity is converging between principal economic sectors and between rural and urban areas. This suggests that intersector and interregional labor markets are functioning efficiently and that employment problems are mainly a function of distortions in the macroeconomic policy matrix and extremely limited investments in human capital.

Intersector Labor Markets

Labor markets have allocated human resources efficiently among the principal economic sectors according to relative changes in GDP per worker (Table 5.13). These data indicate a convergence of the productivity gaps between the agricultural sector, and the construction, services, and transportation sectors.

Table 5.13 GDP Per Worker by Sector, 1970, 1974, and 1982

Sector	1970	1974	1982		Growth 1974-82
			Amount	Agriculture Relative	
Total [a]	31,002.4	47,094.9	59,097.2	3.00	25.5
Agriculture	13,591.1	15,844.0	19,699.0	1.00	24.3
Industry	53,086.0	65,508.3	109,327.4	5.55	66.9
Construction	55,571.2	64,641.2	47,428.4	2.41	-26.6
Utilities	69,130.4	79,655.2	100,080.6	5.08	25.6
Commerce	69,009.6	78,483.7	100,995.7	5.13	28.7
Transportation	75,149.7	97,189.8	101,878.0	5.17	4.8
Finances	462,331.3	530,500.0	494,414.9	25.10	-6.8
Services	34,210.2	39,780.5	38,466.5	1.95	-3.3

Source: Table 5.11; Appendix Table 3.1.

[a] "Others" not included in total since it cannot be allocated among sectors. "Mining and Petroleum" not included in total because of its relative unimportance in employment, and negative GDP in 1970.

They also reveal maintenance of the differentials between agriculture, and the commerce and utilities sectors. Industry was the only sector whose labor productivity diverged from agriculture.

Those data must be used with care in attempting to draw inferences about the efficiency of national labor markets. Ideally, such analysis requires comparison of the real wages of labor for the same skill classes among economic sectors, regions or areas. Such data are not available and GDP per worker is used instead. GDP per worker, however, measures income from all productive factors, not just labor. Moreover, GDP per worker is an average, not a payment at the margin. But payments to low-skill labor probably constitute the largest share of GDP, especially in the agricultural, construction and services sectors and is an important element in most of the other economic sectors. If so, average GDP per worker would tend to converge between the sectors as labor transfers occurred, if labor markets were functioning efficiently.

GDP per capita in agriculture rose between 1974-1982 by 24.3 percent to S/.19,699 as massive rural-urban migration was occurring and sectoral employment declined. The most likely sectors of employment for those leaving agriculture, who generally had low skills, was in construction and services. These two sectors had much higher levels of GDP per capita in 1974 than agriculture and experienced rapid increases in employment and employment elasticities between 1974 and 1982 (see above). Construction and services together accounted for a very large 68.9 percent of the increase in employment between 1974-1982. The GDP per capita in construction declined substantially between 1974 and 1982 and slightly for the services sector. In both cases the absolute level of GDP per capita in 1982 still was about two times greater in services and 2.4 times greater in construction, than in agriculture. This differential probably was wide enough to provide continued attraction of rural workers to seek employment in the low-skill economic sectors, especially in urban areas.

The relatively small decrease in GDP per employee in the services sector is explained by the relative importance of professional and administrative jobs in government service in the sector.[15] In 1982, such high-skill labor comprised over 30 percent of employment in the services sector, another 27 percent were lower-skill government employees covered by the labor code and only 43 percent were in the household service subsector (INEC 1985b, Tables 34A and 36A). GDP per worker in the services sector probably was sustained by the rapid increase in the number and higher salaries of highly-qualified government employees. Household services clearly was the principal market for most unskilled, rural emigrants and the location of the informal sector. Consequently, there was a much sharper decline in GDP per capita for household services between 1974-1982, than for the total services sector. Unfortunately, disaggregated data for 1974 are not reported in the census and magnitude of the decline can not be determined.[16]

These data suggest labor markets for low-skill labor functioned very efficiently between 1974-1982. They moved large numbers of people from lower-paying jobs in agriculture to higher-paying jobs in construction and household services and probably into low-skill government services. GDP per capita converged between agriculture and these sectors which is fully consistent with an efficiently functioning labor market.

There is some evidence that the market also functioned relatively efficiently for higher skill workers. GDP per employee increased much faster in agriculture than in transportation so that the gap in labor productivity also narrowed between these two sectors. The transportation sector, which maintains regular, sustained linkages between urban and rural areas, probably absorbed some of the higher skill

workers who left agriculture. Transportation increased its employment between 1974-1982 by nearly as much as construction. Agricultural GDP per worker just about kept pace with utilities and commerce so that gaps in labor productivity were maintained with these sectors.

Only industry's GDP per worker grew significantly faster than that for agriculture during the 1974-1982 period. As noted above, macroeconomic policies subsidized capital intensive industrialization during the petroleum boom of the 1970s. Thus, the divergence in GDP per employee between agriculture and industry could well be consistent with convergence of agricultural and industrial wages, since an increasingly important share of industrial GDP was earned by capital throughout the period. Evidence from several developing countries indicate that wage differentials between manufacturing jobs and the self-employed in the informal sector overlapped substantially for the same skill levels (Kannappan p. 47). Unfortunately no data are available for Ecuador.

Rural and Urban Linkages and Efficiency

A similar analysis for 1974-1982 indicates a convergence of GDP per capita between rural and urban areas, which suggests that labor markets also are efficiently moving people from rural to urban employment.

The rapid rates of rural to urban migration between 1974-1982, and the concomitant decline of agricultural employment are consistent with the notion that nonagricultural productive sectors are located in urban areas, while rural areas contain predominantly agricultural activities. The corollary of this idea is that rural people are employed primarily, if not exclusively, in agriculture.

Data on the distribution of the EAP between rural and urban areas by productive sector expose these intuitive conclusions as fallacious and misleading (Table 5.14)[17]. More than one-third of the EAP in rural areas was engaged in nonagricultural activities in 1982 an increase from just over one-fourth in 1974. In fact, 60.6 percent of the EAP in petroleum and mining, 36.2 percent in construction, 33.4 percent in manufacturing industry, 26.2 percent in utilities, 25.9 percent in transportation, 23.0 percent in services and 18.4 percent in commerce reported that they lived in rural areas in 1982.[18] Only finance can be considered a truly urban sector, since only 5.5 percent of the EAP in finance report that they live in rural areas. In contrast, over 5 percent of agricultural workers lived in urban areas.

Thus, a significant number of people who lived in rural areas (367,152 or 33.6 percent of the rural EAP) were employed in nonagricultural activities in 1982. Moreover, employment in the nonagricultural sectors in rural areas increased by 119,403 between 1974-1982, primarily from increases in services, construction, transportation and commerce, while employment in rural agriculture declined. Given the relatively large and increasing share of rural people in nonagricultural employment and the weight of their incomes in rural income, it is possible that rural people were better off than conventional wisdom would suggest and that their lot was improving relative to urban people.

Data on the EAP, Gross Domestic Product (GDP) and population for 1974 and 1982 were utilized to estimate the GDP per capita in rural and urban areas, in order to test the hypotheses that: (a) the average income of rural people is closer to that of urban people than commonly assumed; and (b) rural people have become relatively better off compared to urban people during the inter-census period 1974-1982. Rural and urban GDP by productive sector were estimated from total GDP per sector in proportion to the EAP in rural and urban areas by productive sector

Table 5.14 Distribution of the Economically Active Population (EAP) by Rural and Urban Areas, and by Productive Sector, unadjusted censuses 1974 and 1982

Productive Sector	1974			1982		
	Total	Rural	Urban	Total	Rural	Urban
Total [a]	1,816,946	1,083,596	733,350	2,224,366	1,091,623	1,132,743
Agriculture	896,894	835,847	61,047	786,972	724,471	62,501
Non Agricultural	920,052	247,749	672,303	1,437,394	367,152	1,070,242
Petroleum/Mining	6,155	3,758	2,397	7,406	4,485	2,921
Manufacturing	226,266	95,147	131,119	286,530	95,635	190,895
Utilities	8,470	2,468	6,002	13,183	3,450	9,733
Construction	86,192	30,178	56,014	158,009	57,182	100,827
Commerce	189,072	40,036	149,036	271,914	49,921	221,993
Transportation	54,650	13,594	41,056	101,321	26,286	75,035
Finance	19,694	933	18,761	44,116	2,405	41,711
Services	329,553	61,635	267,918	554,915	127,788	427,127
Shares (%)						
Total [a]	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture	49.4	77.1	8.3	35.4	66.4	5.5
Non Agricultural	50.6	22.9	91.7	64.6	33.6	94.5
Petroleum/Mining	0.3	0.3	0.3	0.3	0.4	0.3
Manufacturing	12.5	8.8	17.9	12.9	8.8	16.9
Utilities	0.5	0.2	0.8	0.6	0.3	0.9
Construction	4.7	2.8	7.6	7.1	5.2	8.9
Commerce	10.4	3.7	20.3	12.2	4.6	19.6
Transportation	3.0	1.3	5.6	4.6	2.4	6.6
Finance	1.1	0.1	2.6	2.0	0.2	3.7
Services	18.1	5.7	36.5	24.9	11.7	37.7

Source: INEC 1985b, 1977.

[a] Not included new entrants to the labor force, and "Others" that could not be classified by sector.

(Table 5.15).

Rural areas had about one-half the GDP per capita of urban people in 1974 and improved their relative position to over 60 percent by 1982 (Table 5.16). These results suggest that intersector labor flows have narrowed the productivity gap between rural and urban areas and that labor markets have been relatively efficient in moving labor to new employment opportunities in rural and urban areas. They also indicate that rural people are, on average, relatively better off than commonly thought.

There are no data for assessing performance of the labor markets since 1982. It is felt that markets have continued to be relatively efficient, with major structural problems in the macroeconomic policy matrix contributing to a generally stagnant economy and to slow growth in new jobs with increasing levels of unemployment and underemployment.

Table 5.15 GDP in Rural and Urban Areas by Productive Sector, 1974 and 1982 (millions of 1975 sucres)

Productive Sector	1974			1982		
	Total	Rural	Urban	Total	Rural	Urban
Total	102,046	43,783.42	58,262.58	155,265	57,438.78	97,826.22
Agriculture	18,894	17,607.98	1,286.02	23,101	21,266.33	1,834.67
Non Agricultural	83,152	26,175	56,977	132,164	36,172	95,992
Petroleum/Mining	15,597	9,522.91	6,074.09	15,527	9,403.00	6,124.00
Manufacturing	14,936	6,280.73	8,655.27	29,584	9,874.24	19,709.76
Utilities	693	201.93	491.07	1,241	324.77	916.23
Construction	5,585	1,955.45	3,629.55	7,285	2,636.37	4,648.63
Commerce	14,959	3,167.57	11,791.43	25,562	4,692.96	20,869.04
Transportation	5,326	1,324.82	4,001.18	10,687	2,772.56	7,914.44
Finance	10,610	502.65	10,107.35	18,590	1,013.44	17,576.56
Services	13,227	2,473.79	10,753.21	23,630	5,441.61	18,188.39
Other	2,219	745.59	1,473.41	58	13.50	44.50

Source: BCE 1986, 1982; Table 5.14.

Table 5.16 Gross Domestic Product per Capita in Rural and Urban Areas, 1974 and 1982

	Population		Gross Domestic Product (millions of 1975 sucres)		Gross Domestic Product Per Capita	
	1974	1982	1974	1982	1974	1982
Total	6,521,710	8,060,712	102,046	155,265	15,647.12	19,261.95
Rural	3,822,988	3,968,362	43,783	57,439	11,452.67	14,474.18
Urban	2,698,722	4,092,350	58,263	97,826	21,588.95	23,904.66
Rural/Urban (%)	141.7	97.0	75.1	58.7	53.05	60.55

Source: Population from INEC (1985b, 1977); GDP from Table 5.15.

Changing Rural Labor Markets and Sources of Family Income

Significant changes took place in the rural labor markets during the 1970s, in concert with rapid growth of the nonagricultural sectors of the economy and the increased pace of urbanization. An excellent analysis by Commander and Peek of these changes through the early 1980s for the Sierra provides the basis for much of the following discussion. Two interrelated factors impacted directly on rural labor in their analysis. First, the import substitution model of development led to rapid urban growth and rapidly expanding demand for wage goods, especially food. The land reform of 1964 was implemented as part of the overall development model, in an attempt to increase agricultural productivity and production of food and fiber for the burgeoning population. Second, the petroleum boom of the 1970s provided windfall gains to fuel the import substitution industrialization process and resulted in average growth of 8.2 percent annually between 1965-1981 and accelerated urban growth.

These two environmental factors had two principal effects on agriculture. First, they resulted in greatly increased demand for food and fiber in the burgeoning and newly prosperous urban centers. Agriculture generally became more commercial among all farm sizes, both because of the prod of expropriation and because of rapidly expanding demand. A large share of small farms shifted from subsistence to commercial production, with even the smallest marketing the largest share of their production (MAG and ORSTOM). Second, demand for unskilled labor increased rapidly in urban centers, especially in the construction and services sectors. This resulted in greatly increased rural to urban migration and rising rural wages.

The ensuing commercialization of agriculture and the rapid emigration substantially altered the use of labor in agricultural production. In essence, the rural areas of Ecuador were faced with a growing labor shortage during the petroleum boom of the 1970s and responded by economizing the use of labor. Large farms substituted temporary labor for permanent labor as they moved from traditional hacienda agriculture toward commercial farming. This was done to reduce labor costs and reflected the increasing demand for seasonal labor. The rising cost of labor, along with subsidies to capital resulted in labor-saving technical changes and shifts to less labor intensive enterprises, such as pastures and dairying.

Labor use on smaller farms also was substantially modified. Farmers simultaneously faced rapidly growing urban markets for their produce and lucrative off-farm employment opportunities for excess family labor, especially in urban areas. They responded by shifting from subsistence to commercial farming and by hiring temporary labor, instead of utilizing traditional labor exchanges, so that family members could seek higher-paying off-farm employment. The exodus of rural people who were engaged primarily in subsistence agriculture has been amply documented (CONADE and UNFPA; Whitaker and Alzamora). One result has been the increasing involvement of women, the aged and children in family labor in small farm agriculture, as men, and younger women emigrated to urban areas. Also, the phenomena of circulation of rural people between urban employment and rural homes has increased substantially, in part from heavy subsidies to transportation (see Chapter 10).

The net effect of greatly increased demand for food and for labor was to create a new class of part-time farmers, as farmers with small holdings commercialized their agriculture and sought off-farm employment in order to

maximize family incomes. Smaller farmers derived the majority of their family income from off-farm sources in the mid-1970s (Vos Table 20). And the smallest farmers earned higher family incomes than farmers with small to medium-sized holdings (Vos Table 9).

The recession of the 1980s probably has substantially worsened the situation for the small-farm sector. Demand for wage goods has not expanded nearly as rapidly as in the 1970s and growth in the urban economy has been nearly stagnant, with much more limited employment growth. While no data are at hand, it is likely that much of the gains of smaller farmers have been eroded. While agriculture has grown rapidly since 1984, it had moved to a more capital intensive structure and likely has had a low employment elasticity during the last decade.

VII. Summary and Conclusions

Ecuador's population more than tripled since 1950 to 10.8 million in 1990, growing at an average rate of 3 percent annually for the period. The population is projected to continue to grow at 2.6 percent for the next decade and reach nearly 14.0 million in the year 2000. The urban population has exploded due to high levels of net rural to urban migration. The rural population of Ecuador still is growing in absolute terms but the rate of growth has been nearly static, especially in the Costa. Also, the population of the Costa has increased faster than the Sierra and now is Ecuador's most populous region. The Oriente is the fastest growing region albeit on a very small base. These demographic patterns have been heavily affected and conditioned by macroeconomic and sectoral development policies which subsidized industry and urban development at the expense of agriculture and rural areas. In turn, demographic changes also have affected the location of enterprises of the various sectors of the economy and associated patterns economic development and employment, in a recursive process.

The labor force of Ecuador is growing even faster than the population and will add an average of 135,000 new job-seekers to the labor market each year during the 1990s. The rapid rate of growth of the labor force is conditioned by two factors: the relatively rapid increase of the population of working age and the increasing participation rates especially among urban women. This rapid rate of growth in the economically active population is expected to continue for at least the next decade.

The most serious labor problem is hidden underemployment, with 21.3 percent of the labor force trapped in low-productivity jobs, at wages below the minimum, with no clear path to better employment opportunities. Open unemployment rates are relatively low, at about 7.8 percent of the labor force but have been increasing. Open underemployment, where people work less hours than desired, also is very low.

Labor markets functioned quite efficiently between 1974 and 1982, both between sectors and between rural and urban areas. They transferred substantial numbers of workers from lower-paying agricultural employment to higher-paying jobs in other sectors. Moreover, the major share of these movements were from rural to urban areas. As a result, agricultural labor productivity converged with most of the other economic sectors, as did rural and urban labor productivity. Employment actually declined absolutely in the agricultural sector between 1974 and 1982. Employment in the industrial sector increased but was highly constrained by the capital intensive nature of the import-substitution industrialization process. Most new jobs were generated in the rest of the economy, especially in the services sector in urban areas. These jobs were usually low-paying and required minimal

skills.

These data cast doubt on intuitive arguments that segmentation of the labor market is a major employment problem. They suggest the best way to improve the wellbeing of poor people is to substantially increase investments in human capital through primary and secondary education and special skills so that upward mobility is enhanced. They also make the revision of macroeconomic policies and prices more urgent in order to accelerate the rate of economic growth by exploiting Ecuador's comparative advantages in the emerging international economic system.

The principal employment problem is based in unnecessarily low growth rates inherent in Ecuador's internally oriented development model of the last three decades. At the same time, the labor code probably contributes to capital-intensive investments throughout the economy and may introduce some degree of market segmentation in the productive economic sectors where labor unions are strong. There is some indication that labor markets are segmented in the public sector for low-skill workers. To the extent market segmentation exists, revision of the labor code to allow for greater competition will result in increased employment and more efficient production.

But the primary problem is to get the economy growing a quickly as possible through a more outward-oriented macroeconomic policy matrix and greater investments in human capital. The labor market, per se, appears to be making reasonably strong contribution to development by mobilizing labor and moving it to its highest-paying alternatives, given the skill level of the labor force. The labor market could benefit from investments to facilitate the matching of people with jobs, such as employment services. Also, modification of the ponderous labor code would undoubtedly result in increased employment and more rapid economic growth. These latter reforms are likely to be very difficult, politically and will not result in significant gains, if more rapid and sustained economic growth is not realized.

NOTES

1. This section is based primarily on Whitaker and Alzamora which contains a more detailed analysis of various census data and projections and detailed data tables. Also see CONADE and UNFPA (National Development Council and United Nations Fund for Population Activities) for an excellent, detailed analysis of the demographic and socioeconomic implications of the four censuses of population.

2. CONADE and UNFPA (pp. 1-2) estimate the omissions at 4.3 percent in 1950; 5.9 percent in 1962; 4.3 percent in 1974 and 7.6 percent in 1982.

3. All official data, including the censuses and projections of population, are presented for four major geo-political regions with the same names as the major geographic regions but defined in terms of groupings of provinces rather than by strictly geographic criteria (see Note 2, Chapter 2). The four geo-political regions are comprised as follows: the Sierra (Carchi, Imbabura, Pichincha, Cotopaxi, Tungurahua, Bolivar, Chimborazo, Cañar, Azuay and Loja provinces); the Costa (Esmeraldas, Manabí, Los Ríos, Guayas and El Oro provinces); the Oriente (Napo, Pastaza, Morona Santiago and Zamora Chinchipe provinces); and the Galápagos Islands and other small areas (Galápagos province and undefined border areas with Peru). Each of the four geo-political regions corresponds roughly to the four main geographic regions, consistent with common usage in Ecuador.

4. The data for 1950, 1962, 1974 and 1982 for the analyses of changes in various aspects of population in the rest of this section are from the unadjusted census data because adjustments and projections were not made for the population subsets being analyzed. Thus, growth rates for the global population calculated from the unadjusted data are slightly different from those based on the adjusted data but reveal the same general trends.

5. Urban population is defined in the Censuses, and in the INEC projections as the population of capital cities of provinces, plus the population of county seats (*cabeceras*) of cantons (*cantones*). Each *canton* is divided into one urban parish (*parroquia*) and several rural parishes. Each provincial capital, and county seat is located in an urban parish which may contain a rural area outside the city, but inside the boundary of the urban parish, referred to in the census as the periphery (*periferia*). The rural population is defined as the population of the rural parishes in a canton, plus the population of the periphery of the urban parish, summed for all cantones. These geo-political criteria result in some very small county seats of less than 1,000 people being counted as urban, while some fairly large urban cities of more than 20,000 people are counted as rural because they are in a rural parish. The net effect appears not to bias total estimates of rural and urban population although estimates for cantons may be distorted (CONADE and UNFPA pp. 217, 223-24).

6. This estimate assumes rural and urban population both grew at 2.53 percent between 1974 and 1982 (the average rate for Ecuador based on the original census data). If so, the rural population in 1982 would have been 631,567 larger than it was (or alternatively, the urban population would have been 633,593 smaller than it was) with rural to urban migration and reclassification accounting for the difference. The estimate of 632,625 is the average of these two data.

7. The net effects of rural and urban migration calculated from 1982 census data on "last migratory movement" are not as great as those made above. The data on "last migratory movement" indicate a net rural to urban migration of about 227,000 people. However, this data is only for the last migratory movement of those enumerated in the 1982 census and not for all rural to urban migration between 1974 and 1982.

8. See Gutiérrez (1984b) for a more detailed analysis of the labor force participation rates.

9. Data are for the population 15 years of age and older, as corrected data were not available for the census definition of the EAP--people age 12 and older.

10. Fletcher, Marquez and Sarfaty report a calculation from secondary data of a national unemployment rate of 12 percent by the National Development Council (CONADE). They argue convincingly that this rate is too high because of flawed methodology and because rural unemployment tends to be lower than the urban rate. The INEM estimate of 7.2 percent for the three principal cities suggests strongly that the national rate is not any greater.

11. Data are not available to separate employment in government services from household services.

12. See Fletcher, Marquez and Sarfaty for a more detailed analysis of problems in defining and measuring hidden underemployment in Ecuador.

13. See Fletcher, Marquez and Sarfaty for a brief review of the literature in the context of Ecuador.

14. The case of segmentation for higher skill workers is not as clear. Salaries appear to be higher in the private sector, but jobs are limited relative to public sector employment. Many public sector professionals have other employment or businesses in order to augment their low salaries.

15. Many analysts assume services, or the even more aggregate tertiary sector to be the sector of employment of last resort and typify it as employing the lowest-skill laborers and comprising the informal sector (see e.g., Fletcher, Marquez and Sarfaty pp. 17-18).

16. GDP per capita in 1982 for government services was S/.44,959 and was only S/.31,572 for household services.

17. Unadjusted census data were utilized since corrected data do not provide the breakdown by rural and urban areas for 1974 and these data are required for the analysis of changes in GDP per capita in rural and urban areas which follows. Consequently, these data are not strictly comparable with those for EAP from the corrected censuses cited above.

18. This does not necessarily mean that the place of employment was located in rural areas, although there is probably a strong correlation. What is significant is that an important share of the EAP who live in rural areas are productively employed in nonagricultural pursuits.

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CHAPTER

6

PRODUCTION AGRICULTURE: NATURE AND CHARACTERISTICS

MORRIS D. WHITAKER AND JAIME ALZAMORA

I. Introduction

Agricultural production in Ecuador is highly varied both with respect to the technologies utilized and the crops and livestock produced. The country has a large number of distinct agro-ecological zones and numerous microclimatic areas and is capable of producing a wide range of tropical, subtropical and temperate-zone agricultural products (see Chapter 4). There are a variety of enterprise combinations and technologies utilized in the production of each of the major crops and livestock. Techniques of production range from centuries-old farming systems based on animal power and internal generation of inputs to modern agriculture utilizing mainly industrial inputs such as machinery and fertilizers in combination with high-yielding varieties to exploitative slash and burn agriculture in new-lands areas.

Sierra crops and livestock, comprised of tubers, legumes, soft corn, small grains, vegetables, fruits and dairy cattle have traditionally been utilized almost exclusively for internal consumption. These products are produced in a temperate climate largely on smaller farms ranging up to 10 hectares which account for most of the farmland, with larger farms usually involved in dairy production. Crops and livestock produced in the Costa provide an important component of the diet especially rice, sugar, plantains, vegetable oils and beef, while hard corn and soybean meal are utilized by the broiler industry. The Costa also produces major export crops of bananas, coffee, cacao and pond-raised shrimp, which collectively accounted for over half of all foreign exchange earnings in recent years (see Chapter 3). In contrast to the Sierra, Costa crops are produced in a tropical or subtropical climate on relatively large farms of 50 to 100 hectares or more, especially the cereals. The Oriente also produces coffee, African oil palm, livestock

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and other subtropical and tropical crops. Except for African oil palm, the Oriente crops and livestock are relatively unimportant in total agricultural production, although coffee and livestock are becoming more important. The term "Costa crops," as it is used throughout the rest of this chapter, refers to crops produced in the Costa and in the Oriente.

Average productivity is relatively low both for land and labor, as use of modern technologies and inputs are quite limited. Average yields for most crops are less than the average for South America, reflecting the limited extent that improved varieties, fertilizers, irrigation and other complementary inputs are utilized. Wages in agriculture are relatively low, because of the low productivity of labor (see Chapter 5). The low levels of productivity are caused generally by limited investments in a science-base for agriculture to produce flows of new technical knowledge and in human capital at all levels (see Chapter 12).

The analysis of production agriculture is constrained by two data deficiencies. First, 1986-1988 data for cropland and yields are not comparable with the pre-1986 data series because of a change in the methodology for collecting crop production data after 1985. Second, there is not a series of reliable data for livestock numbers and census data for 1954 and 1974 are not strictly comparable to the data that do exist.

This chapter describes and analyzes the production milieu in Ecuadorian agriculture and its evolution since 1965. Section II examines the current structure of production agriculture based on the farmgate value of production, while Section III considers trends in the production of the principal crops. The relative importance of technical changes and of changes in land area in explaining changes in crop production is analyzed in Section IV. Section V presents data on livestock, poultry and shrimp production, while Section VI analyzes the use of modern factors of production in Ecuadorian agriculture. Section VII presents conclusions regarding the causes of major changes in crop and livestock production and associated factor use during the last two decades. Section VIII considers the implications of the findings for the future.

II. The Structure of Production Agriculture

The structure of production agriculture, as measured by the current farmgate value of various products, changed substantially between 1971 and 1988 (Table 6.1, Appendix Table 6.1).[1] Farmgate value for each crop and livestock product was determined from the price received by the farmer and level of production. Current prices were used instead of constant prices in order to account for the importance of changing relative prices as well as changes in production in determining changes in the relative importance of each product in the agricultural economy.

Milk was the most important product in 1988, maintaining its number one position since 1971. Shrimp was in second place, jumping from 15th place in 1971. Moreover, almost all the 1971 production was wild shrimp, while most of 1988 shrimp production was pond-raised. Rice occupied 3rd place in 1988, increasing rapidly in relative importance from 11th place in 1971. The three export crops, bananas, cacao and coffee maintained their importance in the top ten crops, although their ranking shifted as world prices varied and other domestic crops increased in value. Beef was the 6th most important product in 1988 falling from 3rd place in 1971. Chicken and African palm oil both became much more important, with chicken moving up quickly from 16th to 8th place and African palm oil coming from relative

Table 6.1 Farmgate Value and Rank for Principal Crops and Livestock, 1988, 1982, 1978 and 1971 (millions of current sucres)

Product	1988		1982		1978		1971	
	Value	Rank	Value	Rank	Value	Rank	Value	Rank
1. Milk	70,703.96	1	8,002.90	1	4,067.57	1	1,112.64	1
2. Shrimp [a]	58,019.06	2	2,670.30	10	295.60	21	253.15	15
3. Paddy Rice	50,866.90	3	2,690.45	9	1,171.04	9	396.94	11
4. Bananas(Export)	50,593.87	4	3,602.55	5	2,305.89	4	1,106.01	2
5. Cacao	33,496.74	5	3,971.07	4	4,006.93	2	570.63	8
6. Beef	32,443.98	6	4,386.08	3	1,300.88	8	989.07	3
7. Coffee	28,088.19	7	2,826.80	7	2,571.98	3	621.74	7
8. Chicken	27,283.78	8	5,446.04	2	1,589.90	5	243.25	16
9. African Palm oil [b]	21.842.46	9	1,206.15	15	356.87	18	24.56	36
10. Potatoes	19,396.34	10	2,769.19	8	1,427.55	6	722.49	5
11. Hard Corn	18,151.35	11	1,739.55	11	616.89	14	278.72	13
12. Eggs	17,833.49	12	2,833.97	6	1,301.25	7	242.05	17
13. Plantains	11,767.91	13	1,341.27	14	820.41	11	257.06	14
14. Soybeans	9,970.02	14	385.41	25	248.92	24	4.26	44
15. Pork	9,132.79	15	1,445.59	13	530.80	15	655.27	[illegible]
16. Soft Corn	8,583.14	16	589.56	22	257.66	23	567.50	9
17. Watermelon	7,184.35	17	145.33	37	114.05	34	21.08	40
18. Sugarcane	6,699.63	18	962.27	16	737.80	13	449.29	10
19. Tomatoes	6,630.46	19	397.59	24	174.55	26	71.92	30
20. Bananas(Domestic)	6,101.86	20	878.37	17	765.50	12	739.79	4
21. Beans	6,034.01	21	766.85	19	274.94	22	154.86	22
22. Manila Hemp	5,788.60	22	172.10	34	152.22	30	22.68	39
23. Cotton	4,287.29	23	333.01	27	301.61	20	42.44	31
24. Cassava	3,406.05	24	706.29	20	386.35	17	289.54	12
25. Onions	3,268.42	25	612.13	21	146.64	32	159.24	20
26. Barley	2,967.89	26	231.00	30	112.28	35	155.97	21
27. Wheat	2,038.66	27	282.42	28	13[illegible].51	33	172.93	18
28. Oranges	1,805.09	28	1,466.44	12	9[illegible]1.80	10	122.52	23
29. Peanuts	1,488.52	29	149.82	36	176.68	25	79.95	26
30. Apples	1,410.49	30	431.14	23	305.20	19	40.57	32
31. Naranjillas	1,166.52	31	230.32	31	157.51	29	78.01	27
32. Pineapples	1,030.27	32	841.01	18	434.96	[illegible]	87.09	24
33. Tangerines	853.38	33	265.24	29	149.71	31	24.04	37
34. Avocados	806.06	34	357.73	26	163.54	27	36.11	34
35. Peaches	638.88	35	55.91	41	26.31	42	9.75	41
36. Lemons	637.94	36	162.84	35	51.85	38	22.74	38
37. Peas	561.63	37	180.77	32	59.67	37	86.76	25
38. Garlic	537.42	38	104.93	38	32.05	40	40.23	33
39. Broad beans	533.13	39	82.32	40	27.13	41	34.41	35
40. Sheep	486.10	40	172.92	33	63.96	36	160.41	19
41. Lentils	230.35	41	23.38	43	7.63	43	9.08	42
42. Cabbage	211.24	42	87.71	39	160.67	28	75.35	29
43. Sweet potatoes	113.05	43	24.50	42	6.28	44	8.35	43
44. Castor oil	59.49	44	22.23	44	44.35	39	76.52	28

Source: Prices: Appendix Table 6.1; Crop production: Appendix Table 6.2; Livestock, poultry and shrimp production: Tables 6.12 and 6.14.

[a] Whole Shrimp production for 1988 and 1982 was converted to shrimp tails using the factor 1.73, since only prices of shrimp tails were available after 1979.

obscurity in 36th place in 1971 to 9th place in 1988. Potatoes rounded out the top ten products in 1988, but had slipped substantially from 5th place in 1971.

Other major changes in rank include eggs, soybeans, watermelons, tomatoes and manila hemp which all jumped substantially. Several products declined rapidly in relative importance between 1971 and 1988. Included are pork, soft corn, sugarcane, domestic bananas, cassava, wheat, barley, oranges, peas, and castor oil.

These data expose some important myths about the relative importance of various crops and livestock products. Most probably would not guess that milk is as important as it is. Some products which are considered to be relatively important by many observers, such as wheat and barley, were relatively unimportant in 1971 and are even less so in 1988. In contrast, crops and products which are not usually considered to be very important, such as eggs, plantains, watermelons, tomatoes, domestic bananas, dry beans, cassava and onions all are more important than wheat and barley. Sheep, which often are perceived as relatively important, were in 40th place. The magnitude of these differences is substantial. For example, eggs were 8.7 times more valuable than barley while watermelons were 3.5 times more valuable than wheat in 1988.

There was a substantial decline in the farmgate value of Sierra crops relative to those of the Costa between 1971 and 1988 (Table 6.2). Sierra crops accounted for 31.5 percent of the total farmgate value of production in 1971; this had declined

Table 6.2 Comparison of Farmgate Value of Sierra and Costa Crops, 1988, 1982, 1978 and 1971 (millions of current sucres)

Crop	1988		1982		1978		1971	
	Value	Share(%)	Value	Share(%)	Value	Share(%)	Value	Share(%)
Total	319,247.62	100.0	31,095.66	100.0	19,784.36	100.0	7,661.13	100.0
Sierra Crops[a]	55,014.64	17.2	7,202.96	23.2	3,438.55	17.4	2,415.17	31.5
Costa Crops	264,232.97	82.8	23,892.71	76.8	16,345.81	82.6	5,245.95	68.5

Source: Table 6.1.

[a] Sierra crops includes: Potatoes, Soft corn, Tomatoes, Beans, Onions, Barley, Wheat, Apples, Naranjilla, Avocados, Peaches, Peas, Garlic, Broad beans, Lentils, Cabbage from Table 6.1. The balance of 21 crops from Table 6.1 are classified as Costa.

to only 17.2 percent in 1988. The rapid decrease in the relative importance of Sierra crops resulted from major crop diversification programs and subsidies focused mainly on Costa crops which grew at rapid rates while Sierra crop production declined in most cases.

III. Trends in Crop Production

Analyses of trends in crop production, yields and area are complicated by a change in statistical methodology after 1985. Gathering and publication of official production statistics were the responsibility of the Ministry of Agriculture (MAG) through 1985 (MAG 1965-1985). Officials of MAG located in the various *cantones*

(counties) made estimates of area planted, area harvested, yields and production, on the basis of field surveys and interviews with knowledgeable people. These estimates then were aggregated and published. The National Institute of Statistics and Census (INEC) established the National System of Agricultural Statistics (SEAN) and changed the methodology to area sample frames of yields and area for 1986 and later (INEC/SEAN). Thus, production, area and yield data for 1986-1988 are not strictly comparable with earlier years (Appendix Tables 6.2, 6.3 and 6.4). The analyses of crop production which follow in this section and Section IV utilize data through 1985 in order not to confound the results with a different data series for the three most recent years.[3]

There is a significant disparity between the two data sets for yields and area while the production data appear more consistent. Yields fell substantially while harvested area increased for most crops between 1985 (the last year of MAG data) and 1986 (the first year of INEC/SEAN data). For example, the MAG data show harvested cropland of 1,730,540 hectares for 1985 while INEC/SEAN data indicated 2,238,920 hectares for 1986, or 29 percent greater. While some of this gap may be due to expansion cropland between 1985 and 1986, it also suggests that MAG data probably underestimated 1985 harvested area while overestimating yields. The net result of greater land area and lower yields in the 1986 SEAN data was a change in production for most crops between 1985 and 1986 that appears to be more in line with trends in the earlier MAG data series.

There is a markedly different pattern of changes in production of Costa as compared to Sierra crops between the annual averages of 1965-1969 and 1980-1985 (Table 6.3, Appendix Table 6.2).[4] Production increased rapidly for almost all the Costa crops, while it fell at relatively high rates for all the Sierra crops except for a few minor fruits and vegetables.[5] A variety of factors which contributed to this pattern, including the macroeconomic policy matrix, sectoral policies and consumer subsidies, are discussed in Section VII.

Growth in production of Costa crops between 1965 and 1985 was led by soybeans and African oil palm fruit at very high annual average rates of 39.9 and 28.6 percent, respectively.[6] Hard corn, plantains and rice production increased at relatively high rates of 4.9, 4.4 and 3.3 percent, well ahead of the rate of population growth. Production of cacao and coffee increased at 2.5 and 2.0 percent, respectively, while cotton production increased by 1.3 percent. Production of manila hemp, tangerines, watermelons, oranges, and pineapples also increased at rapid rates. Banana production fell by 2.4 percent annually as excess capacity was reduced, while large decreases in castor bean production of 13.0 percent per year resulted from development of synthetic substitutes in the international market. Modest decreases in sugarcane production reflect the cost-price squeeze suffered by this industry and the relative profitability of other Costa crops. Cassava production, principally a subsistence crop, also fell, as did several minor crops.

Production of all the major Sierra crops fell at fairly rapid rates, with wheat, barley and most legumes falling at rates ranging from 6.2 to 9.1 percent per year, on average, between 1965 and 1985. Production of potatoes and dry beans both fell, but at substantially lower rates. Only a few minor fruits and tomatoes experienced increases in production. The Sierra did experience rapid growth in livestock production, especially in dairy cattle, as cropland was shifted into improved pastures (see Section V).

Table 6.3 Crop Production, Annual Averages, 1965-1969 and 1980-1985; and Growth Rates, 1965-1985

Crop	Production (metric tons)			Annual Growth Rates[b] (%)
	1965-69	1980-85 [a]	Change	
Costa Crops				
1. Soybeans	218	42,908	42,690	39.9
2. African oil palm [c]	6,998	336,890	329,892	28.6
3. Manila Hemp	242	11,154	10,912	25.0
4. Tangerines	11,310	32,922	21,612	8.3
5. Watermelon	10,170	28,370	18,200	7.5
6. Oranges	162,372	412,378	250,006	6.2
7. Hard Corn	114,098	250,064	135,966	4.9
8. Plantains	417,708	791,078	373,370	4.4
9. Pineapples	56,986	109,414	52,428	4.0
10. Paddy Rice	227,702	406,772	179,070	3.3
11. Cacao	51,164	89,612	38,448	2.5
12. Coffee	261,440	383,508	122,068	2.0
13. Cotton	16,544	26,722	10,178	1.3
14. Peanuts	8,672	9,080	408	-0.7
15. Lemons	21,364	17,748	-3,616	-0.7
16. Sugarcane	7,921,094	5,993,118	-1,927,976	-1.3
17. Cassava	263,362	223,612	-39,750	-2.2
18. Bananas	2,619,204	1,984,980	-634,224	-2.4
19. Sweet Potatoes	8,418	5,346	-3,072	-3.0
20. Castor Beans	21,826	3,222	-18,604	-13.0
Sierra Crops				
1. Apples	3,056	31,752	28,696	17.4
2. Tomatoes	23,618	49,186	25,568	4.6
3. Avocados	25,778	30,336	4,558	1.8
4. Peaches	2,710	3,108	398	0.9
5. Potatoes	420,808	388,796	-32,012	-1.3
6. Beans	35,870	27,098	-8,772	-2.3
7. Garlic	3,664	2,440	-1,224	-3.9
8. Soft Corn	74,380	48,162	-26,218	-3.9
9. Onions	97,996	44,020	-53,976	-5.3
10. Wheat	76,504	30,940	-45,564	-6.2
11. Cabbage	77,856	26,098	-51,758	-6.8
12. Peas	17,480	6,388	-11,092	-7.2
13. Lentils	1,096	404	-692	-7.3
14. Naranjillas	47,462	12,446	-35,016	-7.3
15. Barley	81,074	27,708	-53,366	-7.5
16. Broad Beans	18,892	4,550	-14,342	-9.1

Source: Appendix Table 6.2.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.
[b] See Note 6.
[c] Palm fruit.

IV. Sources of Growth in Crop Production

Ecuador has been blessed with abundant land resources and it is commonly accepted that most increases in agricultural production during the last few decades have been due to expansion of the land base. As a corollary, it also is widely believed that expansion of the agricultural frontier can serve as the primary means of meeting Ecuador's food and fiber needs well into the 21st century. In fact, only limited potential exists for expanding land area under cultivation as all of the good, arable land now is in use (see Chapter 4). Production is expanding onto more marginal lands in terms of location and quality and increasingly higher social and private costs must be incurred to bring them into production. Expansion of agriculture onto the fragile soils of the Oriente and Northwestern Ecuador is a case in point.

Land under Cultivation

Total land in agricultural production, including harvested cropland and improved pastures, nearly doubled in the last two decades. Such lands grew from an annual average of 3.5 million hectares during 1965-1969 to 5.9 million hectares during 1980-1985, an average annual rate of 3.6 percent per year (Table 6.4, Appendix Table 6.3). Harvested cropland decreased by 187,284 hectares for the same period to 1.6 million hectares, while land in principal crops fell by 192,124 hectares. Thus, all the increase in land in agricultural production was due to

Table 6.4 Harvested Cropland and Pastures, Annual Averages, 1965-1969 and 1980-1985; and Growth Rates, 1965-1985

Class of Land	Area (hectares)			Annual Growth Rates[b] (%)
	1965-69	1980-85[a]	Change	
A. Cropland	1,788,138	1,600,854	-187,284	-0.8
1. Principal Crops	1,737,712	1,545,588	-192,124	-0.9
2. Other Crops	50,426	55,266	4,840	0.4
B. Pastures (Total)	1,718,946	4,292,830	2,573,884	6.2
C. Total Agricultural Land	3,507,084	5,893,684	2,386,600	3.6

Source: Appendix Table 6.3.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.
[b] See Note 6.

increases in pastures, which grew at an annual average rate of 6.2 percent. The aggregate decrease in harvested cropland masks important shifts in land devoted to individual crops (Table 6.5). Costa crops, defined to include those produced in

Table 6.5 Harvested Area of Principal Crops Classified by Region and Direction of Change, Annual Averages, 1965-1969 and 1980-1985 (hectares)

Area/Crop	1965-69	1980-85[a]	Change
A. Total	1,737,712	1,545,588	-192,124
B. Costa Decrease	394,774	215,650	-179,124
1. Bananas	197,000	65,062	-131,938
2. Castor Beans	21,582	3,576	-18,006
3. Sugarcane	108,856	96,084	-12,772
4. Cotton	23,524	17,470	-6,054
5. Cassava	28,942	23,458	-5,484
6. Peanuts	12,142	9,068	-3,074
7. Sweet Potatoes	2,728	932	-1,796
C. Costa Increase	771,332	1,095,524	324,192
1. Coffee	199,538	340,546	141,008
2. Rice	106,096	135,718	29,622
3. Plantains	37,720	67,176	29,456
4. African oil palm	1,642	28,380	26,738
5. Soybeans	252	26,076	25,824
6. Fruits [b]	15,288	36,414	21,126
7. Hard Corn	153,800	172,786	18,986
8. Cacao	256,672	273,742	17,070
9. Manila Hemp	324	14,686	14,362
D. Net Costa	1,166,106	1,311,174	145,068
E. Sierra Decrease	566,234	225,166	-341,068
1. Barley	140,996	29,658	-111,338
2. Soft Corn	143,406	57,156	-86,250
3. Legumes	143,316	65,810	-77,506
4. Wheat	78,618	28,992	-49,626
5. Potatoes	45,522	33,430	-12,092
6. Vegetables [c]	10,458	6,930	-3,528
7. Fruits [d]	3,918	3,190	-728
F. Sierra Increase	5,372	9,248	3,876
1. Fruits [e]	3,490	6,124	2,634
2. Tomatoes	1,882	3,124	1,242
G. Net Sierra	571,606	234,414	-337,192

Source: Appendix Table 6.3.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.
[b] Includes citrus, pineapple and watermelon.
[c] Includes garlic, onions and cabbage.
[d] Includes peaches and naranjillas.
[e] Includes avocados and apples.

the Costa and Oriente, experienced a net increase of 145,068 hectares between the annual average of 1965-1969 and 1980-1985. There was a decline of 179,124 hectares in seven costa crops, led by a fall in bananas of 131,938 hectares and a major reduction of area in castor beans. Concomitantly, there was an increase of 324,192 hectares in nine other costa crops, with coffee accounting for 43 percent of the increase and rice, plantains, African oil palm and soybeans accounting for another 34 percent. Most of the increased area in coffee, cacao and rice was new lands, while increases in area in soybeans, hard corn, plantains, African oil palm and manila hemp were primarily on land previously in bananas and cotton. The balance of the land taken out of bananas, cotton and sugarcane was converted to improved pastures, roughly estimated at about 30,000 hectares.

The harvested area in Sierra crops decreased on net by 337,192 hectares between 1965-1969 and 1980-1985, a decrease of 59 percent in two decades. Seven major crops or crop groups experienced decreases in land area totaling 341,068 hectares. Over one-third of the total was due to decreases in barley, one-fourth each was due to decreases in soft corn and legumes, and most of the balance was due to decreases in wheat and potatoes. A small amount (3,876 hectares) of the lands taken out of the seven crop groups was shifted to the production of tomatoes and fruits. The balance of 337,192 hectares was converted to improved pastures primarily for dairy production, was abandoned or used for seasonal grazing.

Area in pastures more than doubled during the last two decades, increasing from an annual average of 1.7 million hectares in 1965-1969 to 4.3 million hectares in 1980-1985 (Table 6.6). Data for pastures are less reliable than those for crops and the indicated changes should be interpreted more as general trends and magnitudes than as precise measures. Pastures in Sierra Provinces increased by

Table 6.6 Pasture Lands in Ecuador by Region, Annual Averages, 1965-1969 and 1980-1985 (hectares)

Region/Year	1965-69	1980-85[a]	Change
Ecuador (Total)	1,718,946	4,292,830	2,573,884
Sierra Provinces	955,456	1,838,194	882,738
Costa Provinces	516,500	2,033,630	1,517,130
Oriente Provinces	247,000	421,006	174,006

Source: Appendix Table 6.3.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.

about 900,000 hectares, with almost 40 percent of this from lands taken from Sierra crop production.[8] The balance is new pasture lands in the Western foothills and lowland areas of the Sierra Provinces such as in the Santo Domingo de los Colorados area.[9]

Pasture area in the Costa Provinces increase by 1.5 million hectares, with an estimated 30,000 of this from lands taken out of crop production and the balance from new lands brought into use as pastures. The Sierra Provinces had more than half of Ecuador's pastures during 1965-1969 and almost twice as much land in pastures as the Costa. By 1980-1985, however, Costa pastures had nearly quadrupled and the Costa surpassed the Sierra as the leading pasture region. Oriente pastures increased by about 175,000 hectares and nearly doubled with all of the increases in new lands. Data on Oriente pastures are considered to be less reliable, with large year-to-year fluctuations in data that are difficult to explain.

Crop Yields

Decreases in cropland have had a downward effect on agricultural production but this has been offset to some extent by increases in yields (Table 6.7, Appendix Table 6.4). There is a clear secular trend of increasing yields for all the major Costa crops, excepting coffee and sugarcane. African oil palm, bananas, soybeans and hard corn had annual average increases in yields between 1965 and 1985 of 7.5, 5.3, 3.8, 3.5 percent, respectively, which are very high rates by any standard for a two decade period. Cotton, cacao and rice also had respectable rates of growth in yields, ranging from 2.8 to 1.7 percent per year. Yields of plantains and cassava were stagnant, while yields of sugarcane and castor beans fell modestly. Coffee and hemp were the only Costa crops to experience significant declines in yields of 1.5 percent per year on average. Yields of watermelons increased rapidly, while citrus and pineapple yields fell modestly.

All of the major Sierra crops also experienced increases in yields but the magnitude was less than for Costa crops. Soft corn, barley and lentils had the greatest rates of increase in yields at 3.0, 2.7 and 2.7 percent, respectively, which are relatively high for a two-decade period considering the limited investments in research and extension in Sierra crops. Yields grew for both potatoes and dry beans at the rate of 1.2 percent per year, while yields of wheat and broad beans increased at about .5 percent per year. Only four Sierra crops (peas, onions, cabbage and naranjillas) experienced decreases in yields.

Crop yields are relatively low in comparison to those in neighboring countries and to experiment station yields in Ecuador (see Chapter 12, Table 12.1). The modest successes to date and Ecuador's still relatively low yields and labor productivity, suggest significant opportunities to modernize technologies and thereby increase land and labor productivity, farmers' incomes and agricultural production.

Explaining Changes in Production

Changes in crop production can be conceptualized as resulting from: (a) changes in land area under cultivation; and (b) changes in technology which encompass increased use of modern factors of production, improvements to the land such as irrigation and leveling and use of better quality land. The following analysis demonstrates that technical changes explained an important part of changes in production for many of Ecuador's crops over the last two decades and were more important than changes in land area for several principal crops.

Table 6.7 Crop Yields, Annual Averages, 1965-1969 and 1980-1985; and Growth Rates, 1965-1985

Crop	Yields (kilograms/hectare)			Annual Growth Rates[b] (%)
	1965-69	1980-85[a]	Change	
Costa Crops				
1. African oil palm	4,012	11,750	7,738	7.5
2. Watermelon	6,504	13,664	7,160	6.7
3. Bananas	13,359	30,445	17,087	5.3
4. Sweet Potatoes	3,135	5,745	2,610	4.2
5. Soybeans	870	1,632	763	3.8
6. Hard Corn	774	1,453	679	3.5
7. Cotton	719	1,434	714	2.8
8. Cacao	200	325	125	1.8
9. Paddy Rice	2,179	3,005	826	1.7
10. Peanuts	736	968	232	1.3
11. Plantains	11,116	11,773	657	0.1
12. Cassava	9,049	9,545	496	-0.1
13. Sugarcane	72,670	62,502	-10,168	-0.4
14. Castor Beans	987	911	-75	-0.6
15. Lemons	12,758	10,818	-1,940	-0.7
16. Tangerines	12,311	10,036	-2,275	-0.8
17. Oranges	20,274	17,506	-2,768	-0.9
18. Pineapples	19,179	16,882	-2,296	-1.0
19. Coffee	1,325	1,146	-179	-1.5
20. Manila Hemp	746	742	-4	-1.5
Sierra Crops				
1. Apples	3,879	10,373	6,494	7.9
2. Soft Corn	497	840	344	3.0
3. Barley	576	932	356	2.7
4. Lentils	382	579	197	2.7
5. Peaches	4,236	6,120	1,884	2.6
6. Garlic	3,619	5,106	1,486	2.0
7. Beans	471	575	104	1.2
8. Potatoes	9,260	11,619	2,359	1.2
9. Avocados	9,517	9,959	441	0.9
10. Tomatoes	14,043	15,661	1,618	0.7
11. Broad beans	584	688	104	0.6
12. Wheat	974	1,059	85	0.5
13. Peas	564	586	22	-0.2
14. Onions	14,008	8,840	-5,168	-2.7
15. Cabbage	35,483	17,914	-17,569	-4.1
16. Naranjillas	14,389	4,571	-9,817	-6.0

Source: Appendix Table 6.4.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.
[b] See Note 5.

The sources of change in production of various crops can be measured with a more formal accounting model.[10] This model utilizes data for yields and land area for each crop to explain how changes in factor use have contributed to changes in production. It disaggregates the separate effects of changes in technology and in land area on changes in production.

The basic logic of the model is to determine the changes in production from some base period that would have prevailed when holding yields or land area constant while letting the other vary. For example, the change in production due to changes in technology (as measured by yields) can be determined as follows. Production with land area of an initial period (A_0) and yields of an end period (Y_t) first is calculated as A_0Y_t. Actual production with initial land area (A_0) and initial yields (Y_0) then is subtracted from the hypothetical production to measure the change in production due to changes in technology with land area held constant. The change in production due to changes in land area can be calculated in an analogous manner.

The model permits the calculation of the relative importance of changes in: land area; yields; and the interaction between changes in land area and yields. A more detailed, and formal algebraic specification of the model is presented in Appendix I. The three elements of the model can be easily explained in graphic form (Figure 6.1). The rectangle $0A_0X_0Y_0$ is production in the initial period (P_0), and $0A_tX_tY_t$ is production in the end period (P_t). The rectangle $A_0A_tZX_0$ is the increase in production from an increase in land area with yields held constant at Y_0. The

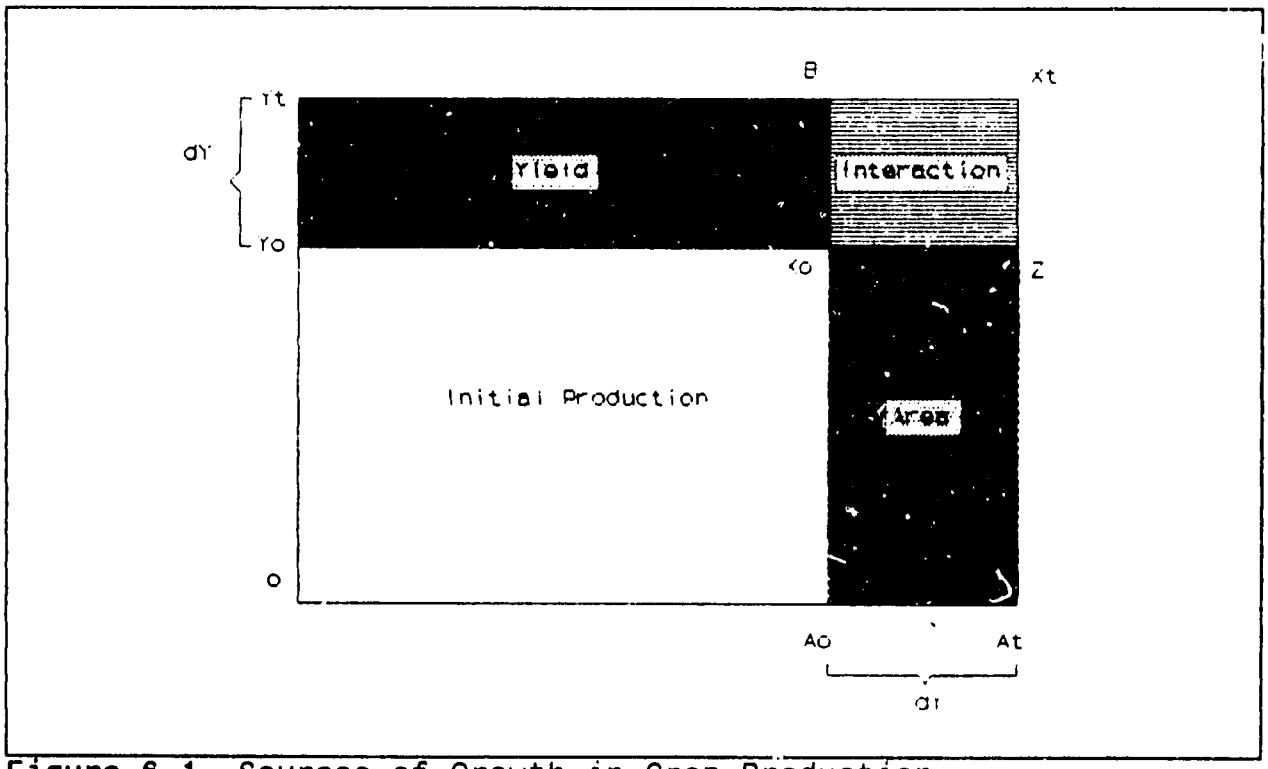

Figure 6.1 Sources of Growth in Crop Production

rectangle $Y_0X_0BY_t$ is the increase in production due to an increase in yields, with land area held constant at A_0. The rectangle X_0ZX_tB is the increase in production due to the interaction of increases in area and yields. Note that the graph illustrates increases in yields and area; any combination of changes in yields and area can be graphed in a similar manner.

Average production, land area and yields for 1965-1969 and 1980-1985 were utilized to measure the relative importance of changes in each of the three components of the accounting model in explaining changes in production.

Results of the Analysis

The results provide strong evidence that technical changes in agriculture have been relatively important for almost all crops. Technical improvements usually either contributed substantially to increases in production or cushioned decreases in production from reductions in land area (Table 6.8, Appendix Table 6.5). Results for three crops, which illustrate three different combinations of changes in yields and area, are explained in detail to facilitate interpretation. Included are: rice, which experienced increases in area and yields; soft corn, with decreases in area and increases in yields; and coffee with increases in area and decreases in yields.

Paddy rice production increased by 176,662 metric tons between the average of 1965-1969 and 1980-1985.[11] Increases in land explained 64,558 metric tons of the total increase in production, with yields held constant in 1965-1969. Increases in yields (technical advances) explained 87,637 metric tons, with land held constant. The interaction of increases in yields and increases in land area explained another 24,468 metric tons.

Production of soft corn decreased by 23,180 metric tons. It would have fallen by 42,823 metric tons from decreased land area with yields held constant but increases in yields helped to cushion the effects of reductions in area. Production would have increased by 49,285 metric tons from increases in yields, with land area held constant in 1965-1969. But land area fell and the interaction of this decrease with increases in yields reduced the potential increase in production from increased yields by 29,642 metric tons. This is the foregone production that would have been realized at the higher yields if land area had not been reduced.

Coffee production increased by 125,884 metric tons due completely to increases in land area as yields declined. Production would have increased by 186,831 metric tons from increases in land area with yields held constant at 1965-1969 levels. Decreases in yields resulted in a decrease in production of 35,711 metric tons with land area held constant. But land area increased so that the interaction of decreases in yields and increases in land area reduced the potential increase in production from increases in land area by another 25,236 metric tons. This is the foregone production from the increased land area that could have been realized if yields had not declined.

Calculating the share of land area, yields and the interaction term in changes in production facilitates interpretation of the results (Table 6.9.) For example, paddy rice production increased by 176,662 metric tons or by 76.4 percent between 1965-1969 and 1980-1985. Increases in land area explained 36.5 percent of the increase in paddy rice production, increases in yields explain 49.6 percent and the balance of 13.9 percent is explained by the interaction term. In the case of soft corn, production fell by 23,180 metric tons, or by 32.6 percent. Decreases in land area explained 184.7 percent of the decrease in soft corn production, increases in yields explained -212.6 percent and 127.9 percent is explained by the interaction

Table 6.8 Source of Changes in Crop Production Between the Annual Average of 1965-1969 and 1980-1985 [a] (metric tons)

Crops	Change in Production	Source of Change: Land Area	Yield	Interaction
Costa Crops				
1. Hard corn	132,033	14,696	104,444	12,893
2. Paddy Rice	176,662	64,558	87,637	24,468
3. Cacao	37,659	3,414	32,109	2,135
4. Plantains	371,550	327,432	24,773	19,345
5. African oil palm	326,876	107,272	12,706	206,898
6. Watermelon	17,937	3,031	11,570	3,336
7. Soybeans	42,345	22,462	192	19,691
8. Manila Hemp	10,653	10,718	-1	-64
9. Tangerines	21,583	29,054	-2,102	-5,369
10. Pineapples	50,531	65,246	-6,903	-7,812
11. Oranges	238,524	302,128	-22,347	-41,256
12. Coffee	125,884	186,831	-35,711	-25,236
13. Cotton	8,123	-4,355	16,803	-4,324
14. Bananas	-650,843	-1,762,526	3,366,041	-2,254,359
15. Cassava	-37,994	-49,626	14,351	-2,719
16. Sweet potatoes	-3,198	-5,630	7,119	-4,687
17. Peanuts	-159	-2,262	2,817	-713
18. Castor beans	-18,040	-17,770	-1,628	1,358
19. Lemons	-3,283	-51	-3,240	8
20. Sugarcane	-1,905,123	-928,141	-1,106,848	129,866
Sierra Crops				
1. Tomatoes	22,496	17,441	3,045	2,010
2. Apples	28,759	8,874	5,026	14,858
3. Avocados	4,644	3,292	1,199	153
4. Peaches	407	-551	1,202	-245
5. Potatoes	-33,101	-111,971	107,399	-28,528
6. Barley	-53,524	-64,087	50,220	-39,657
7. Soft corn	-23,180	-42,823	49,285	-29,642
8. Beans	-9,254	-14,163	8,024	-3,115
9. Wheat	-45,839	-48,316	6,718	-4,241
10. Broad beans	-14,169	-14,858	3,338	-2,649
11. Garlic	-1,717	-2,425	1,704	-996
12. Peas	-10,884	-11,130	680	-434
13. Lentils	-734	-869	585	-450
14. Naranjillas	-34,934	-8,604	-32,200	5,871
15. Onions	-55,646	-29,837	-36,817	11,008
16. Cabbage	-51,482	-25,832	38,440	12,790

Source: Appendix Table 6.5 and accounting model in Appendix I.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.

Table 6.9 Share of Source of Changes in Crop Production Between the Average of 1965-1969 and 1980-1985 [a]

Crops	Change in Production		Source of Change (%)			Total
	Metric Tons	Percent	Land Area	Yield	Interaction	(%)
Costa Crops						
1. Hard corn	132,033	110.9	11.1	79.1	9.8	100
2. Paddy Rice	176,662	76.4	36.5	49.6	13.9	100
3. Cacao	37,659	73.4	9.1	85.3	5.7	100
4. Plantains	371,550	88.6	88.1	6.7	5.2	100
5. African oil palm	326,876	4,961.9	32.8	3.9	63.3	100
6. Watermelon	17,937	170.7	16.9	64.5	18.6	100
7. Soybeans	42,345	19,318.5	53.0	0.5	46.5	100
8. Manila Hemp	10,653	4,405.8	100.6	-0.0	-0.6	100
9. Tangerines	21,583	189.7	134.6	-9.7	-24.9	100
10. Pineapples	50,531	87.7	129.1	-13.7	-15.5	100
11. Oranges	238,524	145.7	126.7	-9.4	-17.3	100
12. Coffee	125,884	47.6	148.4	-28.4	-20.0	100
13. Cotton	8,123	48.0	-53.6	206.8	-53.2	100
14. Bananas	-650,843	-24.7	270.8	-517.2	346.4	100
15. Cassava	-37,994	-14.5	130.6	-37.8	7.2	100
16. Sweet potatoes	-3,198	-37.4	176.1	-222.6	146.6	100
17. Peanuts	-159	-1.8	1,425.9	-1,775.4	449.5	100
18. Castor beans	-18,040	-84.7	98.5	9.0	-7.5	100
19. Lemons	-3,283	-15.4	1.6	98.7	-0.2	100
20. Sugarcane	-1,905,123	-24.1	48.7	58.1	-6.8	100
Sierra Crops						
1. Tomatoes	22,496	85.1	77.5	13.5	8.9	100
2. Apples	28,759	958.0	30.9	17.5	51.7	100
3. Avocados	4,644	18.0	70.9	25.8	3.3	100
4. Peaches	407	15.0	-135.4	295.7	-60.3	100
5. Potatoes	-33,101	-7.9	338.3	-324.5	86.2	100
6. Barley	-53,524	-65.9	119.7	-93.8	74.1	100
7. Soft corn	-23,180	-32.6	184.7	-212.6	127.9	100
8. Beans	-9,254	-25.4	153.0	-86.7	33.7	100
9. Wheat	-45,839	-59.9	105.4	-14.7	9.3	100
10. Broad beans	-14,169	-75.7	104.9	-23.6	18.7	100
11. Garlic	-1,717	-41.4	141.2	-99.2	58.0	100
12. Peas	-10,884	-62.5	102.3	-6.2	4.0	100
13. Lentils	-734	-65.0	118.3	-79.6	61.3	100
14. Naranjillas	-34,934	-74.0	24.6	92.2	-16.8	100
15. Onions	-55,646	-55.8	53.6	66.2	-19.8	100
16. Cabbage	-51,482	-66.3	50.2	74.7	-24.8	100

Source: Table 6.8; Appendix Table 6.5.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.

term. In other words, decreases in soft corn production would have been 84.7 percent greater than they actually were from decreases in land area and 27.9 percent greater from decreases due to the interaction term, if not offset by increases in production of 112.6 percent due to increases in yields.[12]

Increases in yields explained the majority of increases in production of the important Costa crops of rice, hard corn and cacao and all the increase in production of cotton. Yields also were of major importance in cushioning and limiting decreases in the production of bananas as area declined substantially. Yield increases also limited the impact of reduced area on production of cassava, sweet potatoes and peanuts. Increases in land area were more important than increases in yields in explaining increases in production of plantains but yield increases still explained part of the increase. Increases in the production of coffee are explained by relatively large increases in land area, as yields declined. The implication is that production of coffee would have increased much more rapidly if yields could have been sustained. Decreases in yields also contributed to decreased production of castor beans and sugarcane.

Technical improvements also have been important in explaining changes in production in the Sierra. All of the principal Sierra crops experienced decreases in production between the annual average of 1965-1969 and 1980-1985 and most decreases were relatively large. The decreases in production of potatoes, barley, soft corn, beans and lentils would have been significantly greater if not tempered by relatively large increases in yields. Yields of wheat, broad beans and peas increased slightly and dampened somewhat the effects of decreases in land area.

The effects of technical change on production also are captured in the interaction term, which generally reflects a significant role for technical change. For example, African oil palm and soybean production increased from large increases in both area and in yields, with an important share of the effect of such changes on production measured by the interaction term. Examination of the effects of yields alone would lead to the conclusion that increases in yields were not very important in explaining increases in either African oil palm or soybean production when, in fact, their production would be much lower in the absence of technical change.

The interaction term is relatively large for almost all crops that experienced increases in area and yields (principally Costa crops) and clearly measures the joint effects of technical change and changes in land area. The interaction term also is relatively large for crops that experienced decreases in land area and increases in yields (mainly Sierra crops). The interaction term is measuring, in these cases, the foregone production that could have been realized at the higher yields, if land area had not declined. In both cases, the magnitude of the interaction term generally reflects the effects of important levels of technical progress.

The general conclusion that technical changes have been relatively important in explaining changes in crop production must be tempered by a possible measurement problem. It may be that increases in yields, especially in the Sierra, measured concentration of traditional Sierra crops on better quality land, as croplands were shifted to pastures, abandoned or left fallow, as well as improvements in technology. Rapid expansion of crop production onto new, more marginal lands in the Costa would tend to lower yields. The negative effect of decreasing coffee yields on production could be measuring decreases in the quality of land, as well as any retrogression in technical practices. Thus, the yield variable measures changes in the quality of land, as well as technical improvements, with no way to distinguish the separate effects of each.

Data are not available for aggregating the role of technical changes for the crop subsector. It is likely that 30-40 percent of changes in crop production are due to technical changes, on the basis of the important if not dominant role of technical changes for most of the principal crops of Ecuador.

Data also are not available for carrying out a similar analysis for improved pastures in the Sierra, which increased rapidly during the period as land was taken out of traditional crops. The Sierra livestock sector received subsidized credit and technical assistance during the 1970s and 1980s and imported improved breeds, semen, improved pasture seeds and other modern inputs. This suggests that at least some part of the fairly rapid increases in forage and livestock production in the Sierra has been due to technical advances. However, more marginal lands were abandoned and converted to seasonal pastures which would tend to decrease productivity. Livestock production also increased rapidly in the Costa and in the Oriente, but primarily on new lands. Consequently, it is hypothesized that technical changes were less important in explaining increases in livestock production in the Costa and in the Oriente, than in the Sierra.

V. Livestock, Poultry and Shrimp

The livestock subsector became an increasingly important component of the agricultural economy and now is nearly as important as the combined export crops (bananas, coffee and cacao) and traditional crops subsectors (as defined in the national accounts). These latter two subsectors comprised 65.2 percent of agricultural GDP during 1965-1967 compared to only 29.2 percent for livestock (see Chapter 3). During 1986-1988 the share of the two crops subsectors had fallen to 45.9 percent of GDP, while the share of the livestock sector had increased to 33.5 percent. The increase in the relative importance of the livestock subsector reflects more rapid growth rates in livestock than in crops. The hunting and fishing subsector also grew rapidly from 2.3 to 14.0 percent for the same period mainly because of the rapid increase in the production of pond-raised shrimp. Shrimp are discussed along with livestock and poultry in this section because they are raised in captivity in a maricultural process completely analogous to agricultural production. The other products of the hunting and fishing subsector and the forestry subsector are not discussed here because they are harvested from naturally occurring populations and because of data limitations.

It is well known that livestock and poultry production increased rapidly during the past three decades. It is more difficult to measure the magnitude of change because of inadequate data. As Sarhan (p. 6) has noted, official data lack consistency. For this reason the data on livestock numbers utilized in this analysis are from the 1954 and 1974 censuses and from INEC/SEAN for 1988 as reported in a recent statistical bulletin by MAG's Livestock Development Project (PROFOGAN). The PROFOGAN bulletin, prepared with technical assistance from the Federal Republic of Germany, is the most recent and consistent set of data on livestock numbers, production and technical information. This data set is the primary reference for this section. Data on shrimp production are from unpublished sources from the Ministry of Industry, Commerce and Integration (MICEI).

Location and Numbers

Principal livestock in Ecuador include dairy cattle, beef cattle, dual-purpose cattle, chickens, swine and sheep, with shrimp being the only major aquatic species raised in captivity. Minor livestock include goats, rabbits, guinea pigs (*cuyes*),

turkeys, ducks and geese, burros, horses, mules and llamas.
The minor animals generally are kept as barnyard animals, to provide subsistence consumption or to serve as beasts of burden and as a store of wealth for unanticipated expenditures. In contrast, the principal livestock and shrimp are produced mainly for market, usually on larger production units. These two sets are not mutually exclusive with some minor animals, such as turkeys, produced mainly for commercial purposes, while an important share of some of the principal livestock, such as sheep and hogs, are raised for subsistence consumption. Lack of data for the minor livestock constrain the following discussion to principal livestock.

The principal livestock are located throughout the country but with important regional concentrations. Dairy cattle, mainly Holstein and some Brown Swiss, are concentrated in the Northern and Central Sierra, with a small but increasing number in the Baeza area of the Oriente. Beef cattle, usually a mix of criollo and imported Zebu, are produced mainly in the dryer areas of the Costa, as are the more limited number of dual-purpose cattle. Production of beef cattle has become increasingly important in the Oriente during the last two decades but transportation is a major constraint to increased production. Commercial production of chickens is located mainly in Manabí to serve the Guayaquil market and in the area around Santo Domingo de los Colorados in Pichincha province to serve the Quito market. Chickens are kept as barnyard animals by almost all rural families throughout Ecuador and by a surprisingly large number of urban families as well. Sheep production is concentrated in Cotopaxi, Chimborazo and Azuay provinces but is spread throughout the Sierra. Limited numbers of tropical breeds of sheep are found in the Costa and Oriente. Commercial swine production is spread throughout the country with Manabí in the Costa being the most important province, followed by the Sierra provinces of Pichincha, Loja, Azuay and Chimborazo. Pigs also are kept by most rural families for subsistence consumption and by some urban dwellers on the margins of the cities. Shrimp are raised in maturation ponds in the Costa with wild shrimp fisheries accounting for only a small share of total production. Guayas is by far the most important province in shrimp production, followed by El Oro and Manabí.

Livestock numbers have increased at relatively rapid rates between the 1954 and 1974 agricultural censuses and especially between the 1974 census and the 1988 INEC/SEAN survey (Table 6.10). There were a reported 3.9 million dairy, dual-purpose and beef cattle in 1988. Cattle numbers increased at an annual rate of 3.2 percent between 1974 and 1987, somewhat slower than the 3.5 percent growth rate between 1954 and 1974. The slower growth rate in the latter period reflects much higher rates of slaughter in the late 1970s because of greatly increased demand for meat, prolonged drought and controlled milk prices which favored urban consumers and reduced producer incentives. Subsidized credit for importation of breeding stock, higher prices for milk and meat and technical assistance have since led to increased cattle numbers.

The INEC/SEAN data summarized by PROFOGAN do not distinguish clearly between dairy cattle, dual-purpose cattle and beef cattle and estimates of milk cows appear to be too small. PROFOGAN (p. 65) reported 522,000 milk cows in production in 1987 but this number is inconsistent with reported production of 1,130 million liters of milk (p. 62) and it does not distinguish between dairy and dual-purpose breeds. Given national production of 1,130 million liters, average production per cow of 3.8 liters per day and assuming an average lactation of 310 days would imply nearly 1,000,000 milk cows in lactation during 1987. The total dairy and dual-purpose herd would be about 1.5 million or more head when accounting for dry

Table 6.10 Cattle, Swine, Sheep and Goat Populations by Region, 1954 1974 and 1987 (1,000 head)

Region/Year	1954	1974	1987	Annual Growth[a] (%) 1954-74	Annual Growth[a] (%) 1974-87
Cattle	1,215.9	2,494.0	3,884.1	3.5	3.2
Sierra	786.3	1,170.6	1,847.6	1.9	3.3
Costa	429.6	1,136.4	1,669.6	4.7	2.8
Oriente	---	187.0	366.9	---	4.9
Swine	683.1	1,038.3	1,620.1	2.0	3.2
Sierra	429.8	536.2	925.5	1.1	4.0
Costa	253.3	474.9	596.8	3.0	1.7
Oriente	---	27.2	97.8	---	9.6
Sheep	1,350.6	1,033.3	1,293.0	-1.3	1.6
Sierra	1,338.0	1,022.4	1,274.6	-1.3	1.6
Costa	12.6	7.0	15.5	-2.8	5.8
Oriente	---	3.9	2.9	---	-2.1
Goats	136.7	218.2	261.9	2.3	1.3
Sierra	107.3	166.4	188.2	2.1	0.9
Costa	29.4	51.4	73.0	2.7	2.5
Oriente	---	0.4	0.7	---	4.1

Source: PROFOGAN pp. 48-53.

[a] Compound, average annual growth rates between each of the years.

cows and those nursing calves. Earlier MAG data reported 1,000,000 dairy cattle in 1986, but did not indicate if dual-purpose cattle were included (Sarhan p. 2).

The Sierra is the most important dairy area, producing an estimated 75 percent of the milk from 60 percent of the milk cows, which are largely dairy breeds (PROGOFAN pp. 64-65). The balance of the dairy and dual-purpose herd is located in lowland areas, primarily in the Costa, and is comprised mainly of dual-purpose tropical breeds, although some Holstein herds are located near Guayaquil. Most of the dual-purpose breeds are located in the lowlands areas of Pichincha province near Santo Domingo de los Colorados and are probably no more than 20-25 percent of the total of dairy and dual-purpose cattle. Dairy breeds are kept for production of meat, as well as milk, and an important share of meat in the Sierra is from culled dairy cattle.

The balance of the 3.9 million cattle in 1987 are beef cattle, estimated to be about 2.4 million head not including the dual-purpose cattle. According to the above estimates, there are probably 300,000 to 400,000 dual-purpose cattle, for a total beef and dual purpose herd of about 2.9 million head.

Swine numbers grew at 3.2 percent between 1974 and 1987, a faster rate than during the earlier inter-census period and stood at 1.6 million head in 1987. There were 1.3 million head of sheep in 1987 and the sheep population grew at 1.6 percent during 1974-1987, after declining during 1954-1974. The decrease in numbers during the earlier period reflects the effects of the land reform and the expropriation of the large farms of the National Association of Sheep Growers (ANCO). The return of these lands and the reestablishment of ANCO in 1985 have

resulted in a resurgence of interest in commercial sheep production.

Chicken numbers have increased more dramatically than any other class of livestock, growing at an average of 12.0 percent per year between 1970 and 1987 (Table 6.11). There were a total of 49.9 million chickens in 1988 up from only 6.1 million in 1970. This dramatic increase resulted from surging demand during the

Table 6.11 Chicken Population, 1970-1988 (1,000 birds)

Year	Layers	Broilers	Roosters	Total
1970	1,615	2,744	1,780	6,139
1971	1,851	3,704	2,014	7,569
1972	2,433	5,649	2,818	10,900
1973	2,283	6,670	2,547	11,500
1974	2,426	6,914	2,790	12,130
1975	2,600	7,670	2,729	12,999
1976	3,010	8,956	3,085	15,051
1977	4,034	12,001	4,135	20,170
1978	4,309	16,301	4,172	24,782
1979	4,868	18,100	4,529	27,497
1980	5,577	21,647	5,400	32,624
1981	5,619	26,733	5,152	37,504
1982	6,148	29,662	5,547	41,357
1983	4,569	18,075	4,612	27,256
1984	4,980	23,324	4,782	33,086
1985	5,356	30,300	5,096	40,752
1986	6,414	37,208	5,918	49,540
1987	5,635	38,550	4,846	49,031
1988	5,496	39,853	4,548	49,897
Annual Growth[a] (%)	7.4	15.1	5.8	12.0

Source: PROFOGAN p.55 for 1970-1987; Unpublished data from the National Directorate of Livestock, MAG for 1988.

[a] Continuous growth rate calculated by fitting an exponential curve: $Y = ae^{bx}$, where $a>0$ and $Y>0$.

1970s fueled by increased income from the oil boom and from rapid growth of the population. Production of feed grains has expanded rapidly in the Costa to support expansion of the poultry industry.

The area in shrimp ponds also has expanded rapidly, with nearly 118,000 hectares in 1987, according to a study by the Center for the Survey of Natural Resources by Remote Sensing (CLIRSEN), up from zero in 1969. Approximately 25 percent of the shrimp ponds were constructed from mangrove swamps and 33 percent from *salinas* (flat, salty areas flooded by tides) with the balance (42 percent) of the area from other higher-altitude agricultural land inward from the seacoast. The expansion of shrimp farms into mangrove swamps has caused increasing environmental damage according to a 1989 study by the Agricultural Policy Institute (IDEA) (also see Chapter 4). The situation is especially serious in Manabí province where shrimp ponds have resulted in destruction of half the

original mangrove swamps and in El Oro where 30 percent of the mangroves have been destroyed (CLIRSEN). Indirect effects from shrimp production are damaging the ecosystems of the remaining mangrove swamps through pollution of water and overfishing of native shrimp for larvae in the shallow coastal waters. Wild shrimp utilize the mangrove swamps during part of their life cycle and its destruction and pollution are reducing their numbers. Also, use of wild larvae for stocking ponds is very inefficient with an estimated loss of 83 percent between the larvae and adult shrimp (IDEA). The long-term consequences of destruction of mangroves, mining wild larvae and of pollution of remaining mangroves for the ecosystem are yet undetermined. Such environmental degradation certainly will reduce the number of wild shrimp and constrain production.

Livestock Products

Production of livestock products has grown at about the same rate as livestock numbers. Red meat production grew at an average of 3.8 percent between 1974 and 1988 led by growth in beef production of 4.4 percent per year (Table 6.12). Pork production grew at 2.7 percent while sheep and goat meat production declined. The annual slaughter in 1988 included 620,300 head of cattle, 611,600 head

Table 6.12 Livestock Slaughter and Production of Red Meat, 1974-1988 (1,000 head and 1,000 metric tons)

Year	Cattle		Swine		Sheep/Goats		Total Meat
	Slaughter	Meat	Slaughter	Meat	Slaughter	Meat	
1971	---	56.0	---	34.0	---	11.0	101.0
1974	346.7	54.5	466.0	18.3	206.1	4.0	76.8
1975	357.1	57.1	417.8	15.4	209.4	3.7	76.2
1976	369.6	59.1	434.1	16.7	251.9	4.4	80.2
1977	388.4	62.1	425.2	17.8	244.9	4.0	83.9
1978	402.5	64.4	448.8	20.0	229.3	3.9	88.3
1979	419.6	68.4	463.2	22.0	247.3	4.1	94.5
1980	440.4	72.3	484.9	22.9	256.4	4.2	99.4
1981	453.2	72.2	489.9	23.4	256.1	4.4	100.0
1982	468.3	79.3	513.5	24.8	244.9	4.4	108.5
1983	485.1	79.6	464.8	22.8	253.6	4.7	107.1
1984	505.9	83.0	427.2	21.4	239.6	4.4	108.8
1985	536.6	88.5	418.8	20.1	220.0	4.0	112.6
1986	546.3	89.6	448.7	22.6	210.0	3.8	116.0
1987	563.5	92.4	450.0	22.7	200.0	3.6	118.7
1988	620.3	102.3	611.6	27.5	129.0	1.7	131.5
Annual Growth[a] (%)	4.0	4.4	0.9	2.7	-1.7	-2.2	3.8

Source: PROFOGAN pp. 71-72 for 1974-1987; Unpublished data from the Department of Agricultural statistics, MAG, for 1971; Unpublished data from the National Directorate of Livestock, MAG for 1988.

[a] Continuous growth rate for 1974-1988 calculated by fitting an exponential curve: $Y = ae^{bt}$, where $a>0$ and $Y>0$.

of swine and 129,000 head of sheep and goats. Milk production increased by 3.6 percent per year and was 1,388 million liters in 1988 (Table 6.13). About 33 percent of the milk is used on the farm for human consumption and rearing calves, 14

Table 6.13 Milk Production and Utilization, 1973-1988 (1,000,000 liters)

Year	Production	Utilization				
		Pasteurized	Raw	Home Processed	Industry Processed	Farm Use
1971	695	---	---	---	---	---
1973	717	178	142	136	32	229
1974	743	182	148	142	33	238
1975	769	171	162	155	35	246
1976	785	168	167	161	38	251
1977	823	127	201	193	39	263
1978	871	125	218	209	40	279
1979	878	117	222	213	44	281
1980	897	110	232	223	44	287
1981	916	120	233	224	47	293
1982	955	125	239	230	55	306
1983	970	107	254	244	55	310
1984	989	108	248	251	65	316
1985	1,040	132	238	259	78	333
1986	1,092	149	246	263	85	349
1987	1,130	160	252	266	90	362
1988	1,388	---	---	---	---	---
Annual Growth[a] (%)	3.6	-1.9	4.2	5.0	7.7	3.1

Source: PROFOGAN p. 62 for 1973-1987; Unpublished data from Department of Livestock Marketing, MAG, for 1971; Unpublished data from the National Directorate of Livestock, MAG for 1988.

[a] Continuous growth rate for 1973-1987 (1973-1988 for Production) calculated by fitting an exponential curve: $Y = ae^{bX}$, where $a>0$ and $Y>0$.

percent is pasteurized, 22 percent is consumed raw, 24 percent is processed in cottage industries (mainly into cheese) and 7 percent is used for industrial processing.

Production of chicken meat grew at the very rapid annual rate of 11.6 percent between 1970 and 1988 led by growth in broiler production of 15.2 percent per year (Table 6.14). Egg production grew at 7.6 percent.

Production of shrimp has grown at very high annual rates since the mid-1970s and was 82,580 metric tons (whole shrimp) in 1988, with 52,500 metric tons (shrimp tails) being exported, almost exclusively to the United States.[13] The majority of the production in early years was from wild shrimp while an estimated 80 percent of production in 1988 was from cultivated shrimp.

Degradation of the mangroves is beginning to negatively affect shrimp production according to the IDEA study. Only 51 percent of installed capacity was in production in 1988, the share has been declining for nearly a decade and is expected to decline further during 1989 (IDEA p. 135). The amount of area in

Table 6.14 Chicken and Shrimp Production, 1970-1988 (metric tons)

Year	Eggs	Broilers	Layers	Roosters	Total Chicken	Shrimp [a]
1970	12,986	2,881	2,018	2,226	7,125	---
1971	12,884	3,889	2,314	2,518	8,721	5,650
1972	19,564	5,393	3,042	3,522	11,957	---
1973	18,357	7,004	2,854	3,184	13,042	---
1974	19,507	7,260	3,032	3,488	13,780	---
1975	20,906	8,054	3,250	3,412	14,716	5,548
1976	24,203	9,404	3,762	3,856	17,022	9,000
1977	32,437	12,601	5,042	5,168	22,811	8,600
1978	34,698	17,116	5,386	5,216	27,718	9,200
1979	39,143	19,005	6,086	5,667	30,758	11,419
1980	44,844	22,729	6,972	6,750	36,451	17,500
1981	45,182	28,070	7,024	6,440	41,534	20,000
1982	49,436	31,145	7,686	6,934	45,765	29,500
1983	36,739	18,980	5,711	5,765	30,456	36,600
1984	39,561	24,491	6,179	6,006	36,676	39,900
1985	43,065	31,815	5,355	6,695	43,865	36,228
1986	51,573	39,068	8,017	7,397	54,482	52,794
1987	45,314	40,477	7,044	4,798	52,319	77,134
1988	44,197	41,846	6,870	5,684	54,400	82,580
Annual Growth[b] (%)	7.6	15.2	7.2	5.5	11.6	22.8 [c]

Source: PROFOGAN p. 74 for chicken for 1970-1987; Unpublished data from the Subsecretary of Fisheries, MICEI for shrimp; Unpublished data from the National Directorate of Livestock, MAG for 1988 for chicken.

[a] Whole Shrimp.
[b] Continuous growth rate calculated by fitting an exponential curve: $Y = ae^{bt}$, where $a>0$ and $Y>0$.
[c] Based on 1975-1988 data.

production is increasingly constrained by reduced availability of wild larvae. The first laboratory for larval production was not installed until 1980 and expansion of laboratories did not occur until 1984 when there was a major shortage of wild larvae. Laboratories now produce about one-fourth of the total requirement but have greater capacity and their output is increasing. Other factors which constrain production to less than installed capacity include high-cost production relative to world prices and production credit.

Consumption patterns of livestock products changed substantially during the 1970s and 1980s as production of animal proteins increased in response to growing demand. Meat consumption per capita increased from 12.2 kgs. in 1970 to 17.2 kgs. in 1987, a 41 percent increase (PROFOGAN p. 75). The increase of 5.0 kgs. per capita was comprised of increases in consumption of about 1.9 kgs. of beef and 4.0 kgs. of chicken, with decrease of about .4 kgs. of pork and .5 kgs. of sheep and goat. In 1970, 61 percent of meat consumption was from beef, 29 percent from pork,

sheep and goats and 10 percent from poultry. By 1987 poultry had increased to 31 percent of meat consumption, while pork, sheep and goat meat had fallen to only 15 percent and beef declined slightly to 54 percent. Egg consumption increased by 113 percent from 39 to 83 eggs per capita. No official consumption data for shrimp are available, but there was apparent consumption of .75 kilograms of shrimp tails per capita in 1988.

VI. Modern Inputs

Use of modern technologies and associated industrial inputs generally is limited. Most of the major crops are produced with traditional or semi-modern technologies. Only a small proportion of most crops is produced with a fully modern technological package including improved seeds and fertilizer, although there is significant variation among crops. The lack of a comprehensive data base makes measurement of the nature and extent of technical practices by crop and region difficult. There are several studies of individual inputs and crops which permit general inferences to be made.

Levels of Technology

The levels of technology vary substantially within and among crops, with a wide range of technical practices employed (Table 6.15). Potatoes, for example, are mainly produced with modern technologies, while coffee and cassava are produced

Table 6.15 Technology Classes for Principal Crops

Crop	Technology Class (%)		
	Modern	Semi-Modern	Traditional
Potatoes	62	26	12
Tomatoes	59	40	1
Bananas (Export)	48	52	0
Onions	40	57	3
Soybeans	29	71	0
Sugarcane	21	76	3
Wheat	14	68	18
Rice	14	67	19
Barley	12	66	22
Dry Beans	11	69	20
Soft Corn	2	78	20
Hard Corn	2	66	32
Cacao	2	59	39
Coffee	2	26	72
Cassava	0	24	76
Citrus	0	17	83

Source: Adapted from Economic Perspectives, Inc., 1987a1, Appendix Table 1.

largely with traditional, low-productivity techniques. Most crops are produced primarily with semi-modern technologies which incorporate some modern inputs, such as improved seeds, fertilizers, pesticides and herbicides but stop short of a complete package of modern technical practices. Traditional and modern technologies each are used to produce a relatively small proportion of most crops. These data suggest that a majority of producers and crops have shifted from traditional to semi-modern technologies and a smaller proportion have moved all the way to modern technologies. They also are consistent with the trends of increasing yields for most crops and with the relative importance of technical changes in explaining increases in production.

The three classes of technical change set forth in Table 6.15 are gross abstractions of the range of technical practices which exist for each of the crops. For example, IDEA and Grupo Consultores Asociados (pp. 14-16) identified five major technologies utilized in rice production, including: traditional winter upland rice (direct-seeded, rainfed); traditional summer rice (transplanted in standing water, sometimes supplemented by irrigation); semi-modern, direct-seeded rice (winter and summer crops, labor-intensive, irrigated); semi-modern, transplanted rice (winter and summer crops, labor intensive, irrigated); and modern, mechanized rice (winter and summer, direct-seeded and transplanted, irrigated). The range of technical practices varies widely within each of these classes. Similar variations in technical practices are found among all the crops of Ecuador, although technical advances have occurred more rapidly in some crops than others.

Fertilizer Use[14]

Fertilizer use is much below the recommended levels for the principal crops, on average. Hammond and Hill estimated that fertilizer use for 16 crops averaged 44.7 kilograms per hectare in 1982, which was only 24.1 percent of requirements for all nutrients, based on soil analyses for the 16 crops (p. 45). Use relative to requirements for the three principal nutrients was 24.7 percent for nitrogen, 30.1 percent for phosphorous, and 17.6 percent for potassium. A similar analysis for 14 major crops in 1986 by Economic Perspectives, Inc. (1987a) found nitrogen use at 32 percent of recommended levels, phosphorous at 24 percent and potassium at 21 percent, at an average of 61.2 kilograms per hectare.

The relative price of fertilizer has fallen, especially in the post-1981 austerity period. The price of fertilizer and other inputs was implicitly subsidized by the overvalued exchange rate during the import-substitution era and especially during the oil boom in the 1970s. The price of agricultural products was simultaneously constrained to artificially low levels by the overvalued exchange rate and other macroeconomic policies. Adjustments and structural reforms during the 1980s removed most of the exchange rate subsidies to agricultural inputs and simultaneously allowed the price of agricultural products to increase. The net effect was a fall in the price of fertilizers relative to product prices between 1980 and 1986 (Economic Perspectives, Inc. 1987a, p. 11). For example, it required eight kilos of bananas to purchase one kilo of urea in 1980; this had fallen to 1.6 kilos of bananas by 1986.

These favorable price relationships resulted in increased levels of fertilizer use with an annual growth rate of 14.9 percent between 1976 and 1986.[15] It is estimated that fertilizer use will double by the year 2000 (Economic Perspectives, Inc. 1987a p. i).

The gap between average fertilizer use and recommended levels still is relatively large, even after discounting the recommended levels technical levels to

an economic optimum.[16] The large gap is indicative of the relatively low levels of technology being utilized. Major constraints to increased rates of fertilizer use include: limited support for reliable soil testing, lack of studies on economically optimum rates of fertilization, an extremely weak applied research and technology transfer system, uncertainty about government price policy for products and inputs, unreliable supplies of fertilizer with spot shortages of various nutrients, structural deficiencies in the fertilizer industry, and a general lack of farm management research (Hammond and Hill pp. 1-5; Economic Perspectives, Inc. 1987a, pp. i-iii).

The fertilizer industry is dominated by the Ecuadorian Fertilizer Company (FERTISA) a quasi-private enterprise owned mainly by the public sector. All nutrients are imported and then mixed and bagged. FERTISA had about 50 percent of the market prior to 1986 when prices and imports were tightly controlled. In 1986 the government allowed unrestricted importation of fertilizers and FERTISA suddenly was faced with intense competition. Prices fell substantially which contributed to the increased use of fertilizers and resulted in an operating loss for FERTISA given its high cost structure. The Borja government reimposed import controls in 1988 but is considering relaxing trade restrictions for fertilizers. Given relatively large world supplies of urea and attractive prices, the government can facilitate increased fertilizer use and greater productivity if it eliminates trade barriers for this important input.

Improved Seeds[17]

Use of improved seeds is relatively limited, although comprehensive data are not available for a detailed analysis. Production of certified seed is confined to wheat, barley, rice, hard corn, soybeans, cacao, African oil palm and a few minor crops (Flores p. 43). There is a National Seed Program, with the National Institute of Agricultural Research (INIAP) and the National Seed Company (EMSEMILLAS) as principal participants. INIAP is responsible for developing promising new lines and for quality control in the production of basic, registered and certified seeds. It tests improved genetic material, then produces foundation seed, basic seed and registered seed (first, second and third generations). It then contracts with private growers to produce certified seed (fourth generation) which is processed and sold by EMSEMILLAS. Several private firms also are engaged in the production of improved rice, corn and barley seeds and have processing facilities, as does the National Cotton Program which produces certified cotton seed.

Data for the principal crops that utilize seed from Ecuador's certified seed program suggest relatively high levels of use for Costa crops and low levels for Sierra crops (Table 6.16). Improved seeds for the other major crops must be imported and data are not available for estimating the share of cropland sown with improved varieties. Use of improved legume seeds is nil and almost all pasture, grass and vegetable seeds are imported. Use of improved varieties must be relatively high for some of the vegetable crops, which require fresh seed for germination. This is reflected in the relatively high share of tomatoes and onions that are produced with modern or semi-modern technologies (Table 6.15 above).

There are several problems which have constrained expanded use of improved seeds (Flores; Economic Perspectives, Inc. 1987c). Principal among these has been the government policy of setting low prices for improved seeds and overvalued exchange rates, which have simultaneously subsidized seed imports. These two factors have combined to substantially reduce incentives to develop and strengthen domestic production of improved seeds, although the subsidized price has tended

Table 6.16 Share of Principal Crops Planted With Certified Seed

Costa		Sierra	
Crop	Share (%)	Crop	Share (%)
Hard Corn	58	Wheat	9
Rice	65	Barley	7
Soybeans	95	Soft Corn	3
Cotton	100	Potatoes	3

Source: Economic Perspectives, Inc., 1987b Table 1.

to encourage increased use of improved seeds. A second major problem is limited accessibility to improved seed. The distribution system is highly centralized and there is almost no retail distribution in production areas, thus significantly increasing the transactions costs associated with use of improved seeds. A third problem has been the policy of the National Seed Council to deny import permits until proposed parent varieties can be tested by INIAP. INIAP has limited capacity to respond quickly to such requests, thus delaying import of improved seeds.

Perhaps the most serious constraint to increased use of improved seeds is the extremely limited science base serving agriculture, the limited amount of proven technical information and the low level of education and experience in the use of improved seeds and other modern technical practices. Closely related to this is the tendency to promote and sell modern inputs independently (e.g. fertilizer via FERTISA and seeds via EMSEMILLAS). What is needed are increased efforts to validate and extend packages of improved technologies, rather than selling just seeds, or fertilizer.

Other Modern Inputs

Use of other modern inputs also is relatively limited, although definitive data again are not available. One study of the agricultural chemicals in Ecuador found their use quite limited (Economic Perspectives, Inc. 1987d). They tend to be used mainly in the production of Costa cereals where they are a larger cost item than fertilizers. Application rates per hectare have been relatively stable. All pesticides are imported with three firms controlling 82 percent of the total sales. There is little reliable applied research on optimal application rates by crop and region and farmers are generally ignorant about proper handling and use of pesticides. There is evidence of serious environmental contamination from use of farm chemicals (see Chapter 4).

Machinery use increased fairly rapidly between 1975 and 1984, with tractors increasing at 4.6 percent per year and harvesting equipment at 2.9 percent (Economic Perspectives, Inc. 1987b, p.6). There was an estimated inventory of 7,600 tractors and 650 combines in 1984. The fairly rapid increase in machinery during this period is related to the rapid rural to urban migration and the absolute decline in agricultural employment during the same period.

The degree of mechanization is relatively limited. Assuming the average tractor was able to cover 75 hectares, the 7,600 tractors would cover 570,000

hectares or 36 percent of harvested cropland in 1984. This provides a rough index of the degree of mechanization in Ecuadorian agriculture.

The government provides mechanization services through the National Program for Agricultural Mechanization (PRONAMEC) of MAG. This agency rents machinery services to farmers who can not afford their own equipment. Other agencies such as the Ecuadorian Institute of Water Resources (INERHI) also have machinery pools which tend to duplicate MAG services. Such programs are notoriously inefficient and provide services at highly subsidized prices. While ostensibly focused on resource-poor farmers, there is evidence that much of the subsidy may be going to larger farmers who use their influence to obtain the subsidized services.

Technological Improvements in the Longer Term

The above discussion of modern inputs for agriculture has focused on the need to shift from a traditional technology to a modern, high-input technology. The traditional technology utilizes mainly inputs produced within agriculture while the modern technology is based on high-yielding varieties, which require high levels of industrial inputs and human capital (fertilizers, chemicals, irrigation equipment, tractors, harvesters and other equipment, scientists and technicians and better-educated farmers).

The degree to which the modern technology is sustainable has been the subject of concern by ecologists for more than a decade (Cox and Atkins). The high social costs associated with use of chemicals and intensive irrigation are well documented and widely understood. The principal question concerns the economic sustainability of these high-input systems relative to other systems which are less productive, but are more profitable and sustainable because of substantially lower private and social costs. For the immediate future in Ecuador, it appears that the modern, high-input system offers higher social returns given the relative prices of products and factors. Moreover, it will generate substantially higher growth rates necessary to fuel more rapid economic development consistent with Ecuador's high rate of population growth. Research should be designed to address the question of sustainable agriculture and public and private sector entities should clearly consider the alternatives to high-input technologies as they formulate investment plans and public policy.

VII. Understanding Changes in Agricultural Production

Several interrelated factors help explain the changes in the crop production, land use and yields described above. Included are the macroeconomic policy matrix, the petroleum boom and sectoral policies intended to accelerate agricultural development. These three factors collectively generated substantial shifts in relative prices and incomes which, in turn, induced changes in land use and yields among crops and regions and caused the structure of agricultural production to be altered substantially.

Macroeconomic Policies and the Petroleum Boom

The government's economic development policy since the mid-1950s has been import-substitution industrialization and internally-oriented growth. The macroeconomic policy matrix included maintenance of a highly overvalued official

exchange rate; industrial protection through tariff and non-tariff trade barriers; tax exemptions, subsidized credit and other direct subsidies to industry and other related sectors; and taxes on exports (see Chapter 2 for a detailed analysis). The net result was to shift the internal terms of trade strongly in favor of industry and urban development and against agriculture. In essence, the macroeconomic policy matrix subsidized urban-based economic growth at the expense of agriculture and rural people.

The petroleum boom, which began in 1973, resulted in greatly increased demand for better-quality food because of higher incomes. It generated huge windfall gains which were used to finance the substantial subsidies inherent in the import-substitution model of development and which were spread widely throughout the economy. Economic growth accelerated in real terms and averaged over 8 percent for the economy as a whole during 1965-1981, with rates approaching 10 percent in the urban-based economic sectors (Chapter 3). One immediate result was a rapid increase in real per capita incomes during the 1970s, especially in urban areas. As incomes increased, demand for higher-quality foods and especially for animal proteins grew. Since the income elasticity of demand for such products is relatively high, especially among lower income groups, the demand for such foods increased rapidly.

A second major result of the oil boom was greatly reduced demand for traditional subsistence crops as rural population growth fell sharply. Import-substitution industrialization and the petroleum boom precipitated even more rapid rural to urban migration during the 1970s than in the 1960s because of greatly increased demand for unskilled labor in urban areas (see Chapter 5). Consequently, the rate of growth of the rural population fell rapidly from 2.61 to about .26 percent in the Costa and from 2.12 to .81 percent in the Sierra between the 1960s and the 1970s, with some provinces experiencing absolute decreases in the rural population. The relatively large decreases in rural population growth caused sharp decreases in the demand for traditional subsistence crops in rural areas.

One policy of the government was to provide cheap food to the burgeoning urban population. This policy stance initially took the form of the 1964 agrarian reform as a complement to the import-substitution industrialization policy (see below). In the early 1970s the government provided subsidies and controlled prices in order to hold down food costs for the rapidly growing urban population. Wheat imports were heavily and directly subsidized from large windfall dollars from petroleum exports and both wheat and barley imports were authorized at the highly overvalued official exchange rate. Consumer acceptance of the imported hard wheat, which had superior milling and baking qualities compared to domestic soft wheat, was quick and pervasive. These subsidies and the consumer acceptance of wheat substantially reduced the profitability of producing wheat and barley. Maximum prices were set at the consumer level for most basic foods to protect urban consumers and the government embarked on programs to stimulate the production of other basic food crops and feed grains.

The net effect of the macroeconomic policy matrix and the petroleum boom was to greatly increase demand for higher-quality food and animal proteins, while substantially reducing demand for subsistence crops. At the same time, subsidies on imported wheat and barley reduced the relative profitability of producing these crops domestically. The government responded with sectoral policies designed to increase the production of products in greatest demand.

Sectoral Policies

Four major government initiatives for agriculture directly affected and conditioned changes in production of crops and livestock between the mid-1960s and the present. First, the government embarked on an ambitious program of Costa crop diversification in the mid-1960s toward food crops, feed grains and pastures for livestock production in the face of a secular decline in the prices of export crops in the 1950s and 1960s. Second, the rehabilitation and rejuvenation of export crops were emphasized in the 1970s when export prices recuperated. Third, the government simultaneously implemented an agrarian reform program in 1964 as a complement to its import substitution program in an attempt to produce cheaper wage goods for the growing urban population. Finally, the government devoted significant resources to improving livestock production in the Sierra during the 1970s and 1980s, with more modest amounts allocated to Sierra cereals. The major share of public resources (subsidies) for agricultural development during the 1970s and 1980s appears to have been directed toward Costa crops and livestock.

Costa Crop Diversification The government initiated a major effort in the 1960s and early 1970s to diversify Costa crop production and shift lands out of bananas, coffee and cacao, and to reduce excess supply. Banana production increased rapidly during the 1950s, based on expansion of land area, in response to favorable world prices and growing markets. By the early 1960s output substantially exceeded demand, resulting in gluts and declining world prices not only for bananas but also for coffee and cacao.

Principal government policy instruments to induce diversification to Costa food crops, feed grains and pastures were: (a) subsidized credit; (b) guaranteed minimum prices; (c) focused technical assistance; and (d) irrigation projects. Subsidized credit was provided through the National Development Bank (BNF) for expansion of rice, hard corn, African oil palm, soybeans, cotton, castor beans, manila hemp and livestock (see Chapter 9). The National Marketing Board (ENAC) was established to buy and sell selected crops in order to support prices. Minimum prices were set for rice, cotton, hard corn, manila hemp, soybeans and African oil palm fruit and were maintained generally above world market levels, although ENAC bought only rice, corn and soybeans (see Chapter 8). Technical assistance was provided through INIAP and significant progress was made in testing and releasing improved varieties (see Chapter 12). Heavily subsidized irrigation projects were designed and constructed and others were planned by various national and local government agencies led by INERHI (see Chapter 7). The main recipients of subsidized credit, guaranteed minimum prices, technical assistance and subsidized irrigation water were the politically influential farmers with larger holdings.

The provision of subsidies appears has become institutionalized in an interrelated process of raising minimum prices and granting new credit lines each year for the principal food crops and feed grains in the Costa and for cattle in the Sierra and the Costa. Farmers appear to prefer this system, which assures the maintenance of profit margins at acceptable levels, to the establishment of market prices and interest rates and exposure to greater risks.

Export Crop Rehabilitation World prices of coffee and cacao rose to unprecedented levels in the mid-1970s, after a period of sharp price declines in the 1960s. The government responded by implementing renovation programs for coffee and cacao, while continuing with policies which encouraged production of food and feed crops and livestock. The export crop programs provided subsidized credit for rehabilitation of plantations, through replacement of older trees with higher yielding varieties supplied mainly from INIAP's Pichilingue experiment

station. The program also focused on improved technical practices including control of insects and diseases.

Agrarian Reform Sierra agriculture was just emerging from centuries of a *Latifundio* tradition at the onset of the petroleum boom, through the implementation of a land reform law passed in 1964. The agrarian reform constituted one element of the broader strategy of import-substitution in an attempt to increase productivity and the production of food for the growing urban population. The land reform affected crop production and factor use in several fundamental ways. It resulted in the fairly rapid incorporation of idle or underutilized land into production because of the threat of expropriation and farms of all sizes generally became more commercial (Colyer). This permitted farmers, especially small farmers, to shift quickly from production of subsistence crops to commercial crops as demand rose in urban areas during the oil boom. Agrarian reform also resulted in the fragmentation of crop areas, especially for wheat and barley, as large farms were broken up. Continued population growth resulted in further subdivision of agricultural land. As a result, the economies of scale necessary for efficient small-grains production were rapidly eroded. Also, property rights of many of the smaller parcels of land were never properly established. Consequently, many Sierra farmers were denied access to the limited production credit that was available, because they were unable to provide the necessary collateral.

Sierra Livestock Government policies for the Sierra during the 1970s and 1980s were directed mainly at increasing livestock production, especially dairy cattle, with some emphasis on wheat and barley. These programs provided subsidized credit, guaranteed minimum prices and technical assistance. There also was some limited technical assistance for other crops, especially potatoes and soft corn, and some investment in irrigation infrastructure, which was relatively small compared to the large Costa irrigation projects.

The agricultural potential of the Sierra was inherently more limited than the Costa at the beginning of the petroleum era. Nearly all agricultural land was in production, with little capacity to increase production through expansion of cultivated area. Hence, any increases in production had to come from improved yields, or from reducing the area in other crops.

Most Sierra crops were subject to market prices in both the factor and product markets and were not shielded from the negative effects of the macroeconomic policy matrix. In contrast, subsidized credit and minimum prices at least partially counteracted the restrictive effects of macroeconomic policies for the dairy sector, wheat and barley and for most Costa crops.

Effects on Crop Production and Factor Use

The combination of macroeconomic and sectoral policies resulted in a decline in the producer prices of Sierra crops relative to livestock and Costa crops. As a consequence, several shifts in land use and crop production occurred during the 1970s and 1980s.

In the Sierra provinces, larger farmers converted cropland to pastures from traditional crops, while the small farm sector shifted from production of subsistence crops to higher-value crops in response to burgeoning urban markets (see Chapter 5). New lands were brought into pasture production in the Costa and the lowlands areas of the Sierra provinces for dairy and beef production, and for rice, oilseeds, African oil palm, cacao and coffee. Moreover, land was shifted out of bananas and into feed grains and oilseeds production in the Costa to support a broiler industry and pork production and to augment vegetable oil production.

There was a concomitant, significant reduction land area in the Sierra in leguminous crops, potatoes, barley, wheat and soft corn. The legumes, which contain complex amino acids, were consumed along with the cereals as part of a principally vegetarian, subsistence diet of rural people prior to the petroleum boom and provided a complete protein. The Ecuadorian diet changed substantially and rapidly in the aftermath of the petroleum boom. Animal products, which also are a source of complex amino acids, apparently were substituted for the legumes. At the same time imported wheat, costal cereals and plantains were substituted for the Sierra cereals and tubers.

There also were major changes in factor use. The total area devoted to principal crops decreased by 192,124 hectares, or by 11 percent. There was a massive emigration from rural areas and employment in agriculture declined absolutely between 1974 and 1982 (Chapter 5). Modern factors of production were substituted for land and labor. Agriculture became more capital-intensive as tractors and other machinery increased. Improved varieties of plants which required complementary fertilization and controlled water also were increasingly adopted. As a consequence, use of chemical fertilizers and other chemical inputs intensified, although use still is limited. The livestock sector imported pure-blooded livestock and semen. Finally, irrigation of cropland grew rapidly with an estimated 25 percent being irrigated in 1990, mostly from private systems. Machinery, improved seeds and livestock, chemical inputs and irrigation have substituted for limited land and labor which sustained production through increased yields as land area and labor inputs decreased.

VIII. Implications for the Future

Increases in crop yields from whatever source either have increased production or offset, to some extent, decreases in production for crops that experienced decreases in land area. All good and most marginal agricultural land is in production, and the remaining poorer-quality land entails increasingly higher costs of production. Improvements in yields likely are to be the most cost-efficient way to expand agricultural production. The gap between average yields in Ecuador and the average for the rest of South America, or those obtained by Ecuador's most progressive farmers still is relatively large for most crops and livestock. Thus, it is fully within the realm of possibility to significantly increase yields with proven technologies.

The science base for agriculture will have to be substantially improved, however, if Ecuador is to realize this potential (Chapter 12). Extant capacity for applied and adaptive research, technology transfer and agricultural education is practically nil. Greatly increased investments in research, education and extension institutions; scientists and technicians; and in improved linkages to the international network of agricultural science will be needed. Finally, incentives to invest in more modern technologies and industrial inputs which incorporate and complement the improved technologies will have to be provided through an appropriate macroeconomic and sectoral policy matrix.

It is significant that average yields have increased at relatively rapid rates during the two-decade period in which macro-economic and many sectoral policies discriminated against agriculture. Despite these pervasive constraints, substantial technical changes also were taking place, which augurs well for future investments in research, education and extension, even in a less-than-optimal policy environment.

NOTES

1. Agriculture is divided into five subsectors in the national accounts: export crops (bananas, coffee and cacao); other crops; livestock; forestry; and fishing and hunting (Chapter 3). Production agriculture in this chapter is defined to include the principal commodities from the first three subsectors, plus shrimp from the hunting and fishing subsector. These products all are produced in an agricultural process where the particular crop, livestock, poultry or shrimp is raised in captivity, with various nutrients and other inputs utilized to enhance output. In contrast, the products of the forestry subsector and the rest of the hunting and fishing subsector are harvested from naturally occurring populations rather than produced in an agricultural production process. Moreover, consistent data series on production, prices and yields of the principal products of these latter sectors are unavailable. Consequently they are not considered in this chapter.

2. Livestock products could not be apportioned between the Sierra and Costa and are not included in Table 6.2.

3. This is not to suggest that the SEAN data for 1986-1988 are not accurate, only that they are based on a different methodology, and therefore are not comparable with the earlier data series. In fact, the SEAN data likely are more accurate since they are based on a more objective methodology. However, without a complete census they can not be effectively evaluated.

4. Data for 1983 are excluded from the average for 1980-1985 in all the analyses in this chapter because of the extremely bad weather caused by the *El Niño* phenomenon and the resulting very low levels of production.

5. Crops are classified as "Costa" or "Sierra" according to where they are generally grown. In several cases, a crop was grown in both areas but data were not available to make this distinction and the crop was classified in the region where production is concentrated.

6. All growth rates presented in this chapter were calculated with an exponential curve fit of the form $Y = ae^{bx}$, where $a>0$ and $Y>0$, and thus are continuous growth rates. Consequently, the direction of growth along the trend line may be different than that indicated by comparing the data for a beginning year (1965-1969 average) with an end year (1980-1985 average) especially where the magnitude of change is small and the trend is weak. See, for example, the case of peanuts in Table 6.3, or cassava and peas in Table 6.7. All observations were used in fitting the trend line, including 1983 data.

7. The following analysis considers changes in the area harvested of the principal crops listed in Appendix Table 6.3. "Other Crops" are excluded because the composition of this category changes over time as crops are added to or dropped from the list of official production statistics.

8. The Ministry of Agriculture (MAG) classifies as pasture the abandoned croplands that are used only for seasonal grazing as well as improved pastures.

9. The reader should keep in mind that the descriptive terms of Sierra, Costa and Oriente refer both to major geographical regions and to aggregations of Provinces for presentation of official statistics such as censuses, agricultural production, etc.(see Chapter 4 and Chapter 5, Note 3). While the geographical and geo-political regions are roughly homogeneous this is not always the case. Inferring that all Sierra pastures are highland pastures, or that there are no virgin lowland areas in the Sierra provinces is a case in point.

10. The model used here is adapted from that reported in Pray, with assistance from Hugo Ramos, senior author of Chapter 9.

11. The changes in production presented in Table 6.8 are slightly different than those presented in Table 6.3. This is because the averages in Table 6.3 are calculated directly from the production data in Appendix Table 6.2, while production data in Table 6.8 are calculated from the averages of yields and land area from Appendix Tables 6.3 and 6.4 and presented in Appendix Table 6.5. The two methods of calculating the average are not mathematically equivalent.

12. Care must be taken to properly interpret the signs on the percentage shares of the three variables. The signs must be related to the direction of change in total production. If total production increased, the sign is directly related to the change in production (a positive sign indicates that the variable explains an increase in production of the magnitude indicated, while a negative sign means the variable reduced the increase in production by the magnitude indicated). If total production decreased the signs are inversely related to the change in production.

13. Whole shrimp yield about 73 percent tails when the heads are removed.

14. See Economic Perspectives, Inc. (1987a); and Hammond and Hill for excellent reviews of the fertilizer industry in Ecuador.

15. Continuous growth rate calculated from FERTISA data presented in Economic Perspectives, Inc. (1987a p. 11) by fitting an exponential curve.

16. Recommended fertilization rates in Ecuador generally are based on technical optimums that maximize production and are greater than the economic optimum where profits are maximized. The economic optimum is less than the technical optimum because of the law of diminishing returns to increased applications of fertilizer. The rate of fertilizer application should be increased as long as the additional revenue from increased production exceeds the additional cost of the fertilizer. The economic optimum is attained when the added revenue from one additional unit of fertilizer is equal to the cost of the fertilizer.

17. See Economic Perspectives, Inc. (1987c); and Flores for excellent reviews of the improved seed situation in Ecuador.

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APPENDIX I

ACCOUNTING MODEL

The logic of the model utilized to account for sources of change in agricultural production can be set forth algebraically as follows:

1. $DP = P_t - P_0$, or

2. $DP = A_t Y_t - A_0 Y_0$, the change in production

where,

P_0 = Crop production in 1965-1969
P_t = Crop production in 1980-1985
A_0 = Land Area in 1965-1969
A_t = Land Area in 1980-1985
Y_0 = Yields in 1965-1969
Y_t = Yields in 1980-1985,

with all data as averages for the years indicated, and 1983 excluded from the 1980-1985 average, because of abnormal weather.

Note that:

3. $A_t = A_0 + dA$, and

4. $Y_t = Y_0 + dY$,

where dA and dY are the changes in acreage and in yields, respectively, between 1965-1969 and 1980-1985.

Substituting (3) and (4) into (2) reduces to:

5. $DP = A_0 dY + Y_0 dA + dY dA$

Also note from (3) and (4) that:

6. $dA = A_t - A_0$, and

7. $dY = Y_t - Y_0$

Substituting (6) and (7) into (5) results in:

8. $DP = A_0(Y_t - Y_0) + Y_0(A_t - A_0) + (A_t - A_0)(Y_t - Y_0)$

The three elements of equation (8) are the three principal components of the change in production between 0 and t (1965-1969 and 1980-1985) referred to in the text. Each are discussed briefly:

8.a $dP/dY = A_0(Y_t - Y_0)$. This is the change in production due to a change

in yields with area held constant in year 0;

8.b $dP/dA = Y_0(A_t - A_0)$. This is the change in production due to a change in area with yields held constant; and

8.c $dP/(dA)(dY) = (A_t - A_0)(Y_t - Y_0)$. This is the change in production due to the interaction of the changes in yields and area.

The sum of these three components is the total change in production from changes in yields and land area. The data for accounting for the relative importance of each of these three components in explaining changes in production are presented in Appendix Table 6.5.

CHAPTER

7

IRRIGATION AND AGRICULTURAL DEVELOPMENT

MORRIS D. WHITAKER AND JAIME ALZAMORA

I. Introduction

The status of irrigation and its role in the development of Ecuadorian agriculture is reviewed and analyzed in this chapter. The primary focus is on the economic viability of relatively large investments in public irrigation works. Such investments include the study, design, construction, operation and maintenance of irrigation systems. They also encompass complementary services such as technical assistance, machinery pools, demonstration farms and subsidized inputs. A secondary focus is on the distribution of benefits from irrigation projects. Such projects are intended to increase the productivity and incomes of resource-poor farmers and project benefits are supposed to be widely distributed.

The rest of the chapter is organized as follows. Section II reviews the water resources of the country and the need for irrigation. Section III describes the principal public agencies involved in irrigation, while Section IV analyzes the extent and general effectiveness of public and private irrigation systems now in operation. Section V describes and analyzes plans for new public irrigation projects including those under construction and design and study. Section VI considers the process for financing public irrigation projects, while Section VII analyzes the costs of irrigation relative to the foreign debt. Section VIII presents an analysis of the subsidies to public irrigation inherent in the water tariff and Section IX examines the economic viability of public projects. Section X presents an analysis of the size and distribution of economic benefits while Section XI presents conclusions and recommendations of the study.

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II. Water Resources and Irrigation

Ecuador has been endowed with abundant water resources that are reasonably well distributed throughout the country. There are eighty-four river basins, the majority of which flow into the Pacific Ocean (Keller, et al. p. 91). The total annual discharge of these rivers ranges between 210 and 370 billion cubic meters (m^3) toward the Atlantic Ocean and between 80 and 140 billion m^3 toward the Pacific Ocean (Delavaud, et al. pp. 12-13). The smaller of these amounts of water would provide Ecuador's 1.6 million hectares of cropland with 183,500 m^3 of water per hectare, or a depth of 18.4 meters. In comparison, the 52,004 hectares of land irrigated from the Ecuadorian Institute of Water Resources (INERHI) systems in 1987 required an average of 19,129 m^3 per hectare, or a depth of 1.9 meters. Thus, there is enough surface water to irrigate about ten times Ecuador's current total cropland. Less is known about the amount of subterranean water but there are several aquifers that have consistently provided significant quantities of water. Several irrigation systems in the Sierra and Costa have been developed utilizing subterranean water.

The demand for irrigation water is determined generally by the distribution and level of rainfall relative to the location of agricultural land. Other variables besides rainfall, which affect the need for irrigation are temperature, gradient, elevation, the kind of plants and soil characteristics. There is great variability among each of these factors across Ecuador and consequently a large number of agro-ecologic zones. This suggests that the need for irrigation varies considerably from zone to zone.

Eight major climatic zones have been identified based on distribution of rainfall, temperatures and level of rainfall (Delavaud, et al. pp. 17-20). These zones suggest the need for irrigation is greatest in the Sierra and the Central and Southern Costa.

Rainfall in the Sierra generally is equatorial with a bimodal distribution, peaking in April and again in November. The rainy season starts in October and continues through May with reduced precipitation during July through September. The principal agricultural season (winter) corresponds with the beginning of the rains in October. The secondary season (summer) follows the heavy April rains. The amount of rainfall varies considerably from less than 500 mm to 2000 mm throughout the Sierra. The primary demand for irrigation water during the winter season is for supplementary irrigation. The demand for irrigation water rises significantly during the summer season, especially in areas of low average precipitation and in dry years. Almost all irrigation infrastructure in the Sierra is designed for supplementary irrigation, with no storage for irrigation during the dry season. This reflects the bimodal distribution of rainfall and the generally lower temperatures which limit summer crops.

In contrast, the Central and Southern Costa have a tropical pattern of rainfall characterized by a single peak, usually in March. Rainfall begins in December, increases through March and falls off sharply in May. There is a pronounced dry season from June through mid-December, with little rainfall. River flows drop substantially during the dry season. Demand for irrigation during the winter season is small unless December and early January rains are late. If so, some supplementary irrigation may be required especially in rice. Demand for irrigation in the Costa is primarily for producing a second or third crop in the dry season. As a consequence, irrigation projects in the Costa, especially the newer ones, have storage facilities. Those that do not are severely limited in the area they can irrigate.

III. Public Agencies[2]

There are six principal public agencies involved in irrigation: INERHI, the Study Commission for the Development of the Guayas River Basin (CEDEGE); the Center for the Rehabilitation of Manabí (CRM); the Center for the Economic Recovery of Azuay, Cañar and Morona Santiago (CREA); the Regional Program for the Development of Southern Ecuador (PREDESUR); and the National Institute of Meteorology and Hydrology (INAMHI). In addition several other entities, including provinces, municipalities and national government agencies are engaged in irrigation programs. Each of these institutions is briefly described.

INERHI

INERHI was created on November 10, 1966 from the National Bureau of Irrigation and the Directorate of Hydrologic Resources of the Ministry of Agriculture and Livestock (MAG). It is a semi-autonomous, public institution with its own budget and administrative unit. It is attached to MAG and the Minister appoints the director, serves as chair of the Board of Directors and has some influence through the budgetary process. It has the greatest area under irrigation of any of the public institutions.

INERHI assumed the responsibilities of its two predecessors as it was created in 1966. A new Water Law, issued in 1972, substantially expanded INERHI's responsibilities. The new law nationalized all water resources clearly stating that all water that had been considered private property was now a public resource. However, previous owners could continue to use the water under terms of the new law. These terms included efficient use of the water and the concession of a water-use permit issued by INERHI which was not transferable by the user. Under the previous Water Law of 1936 water rights were held privately and could be freely bought and sold or rented separately from the land. Modifications in this law between 1936 and 1972 moved toward the radical reform inherent in the 1972 law. In the euphoria of the oil boom, the new law also provided substantial subsidies to users of irrigation water.

INERHI has three primary functions which were defined in the law creating it and in the Water Law of 1972. First, it was to plan, administer and regulate, as ultimate authority for the Government, the use of all the water resources of the country for all purposes, public and private, rural and urban. Specifically it was to: (a) issue, regulate and control water-use permits; (b) locate water and evaluate water quality and quantity; (c) protect water resources; (d) inventory and evaluate use of water; and (e) plan for the use and protection of water.

Second, INERHI was to plan and administer, as maximum authority, all irrigation, drainage and flood control activities for the country. Its specific functions in this area were to: (a) prepare and execute a national plan for irrigation, drainage and flood control; (b) inventory and evaluate irrigation works and water use for irrigation; (c) regulate, control and approve all irrigation, drainage and flood control programs and projects; and (d) promote and support the development of irrigation and drainage by the private sector and other public sector entities.

Third, INERHI was to study, construct and operate irrigation systems. Specifically it was to: (a) carry out requisite pre-feasibility and feasibility studies including technical, economic and social aspects; (b) construct irrigation works and take all actions necessary to achieve complete implementation of the projects; (c) operate and maintain infrastructure; and (d) promote economic and social

development in areas of irrigation.

INERHI has been given a very comprehensive, complex and difficult assignment. It has broad responsibility for planning, granting, monitoring and adjudicating all water use in the country for whatever purpose. It also has nationwide responsibility for all irrigation, drainage and flood control. Finally, it constructs and operates irrigation, drainage and flood control systems throughout Ecuador.

INERHI's efforts, as measured by its budget allocations since 1985, have been concentrated mainly on its third function, the development of irrigation, drainage and flood control systems (Table 7.1, Appendix Tables 7.1 and 7.2). Nearly 87 percent of its budget was devoted to construction and operation of irrigation

Table 7.1 INERHI Expenses by Programs and Activities, Annual Average 1985-1988 (millions of 1988 sucres)

Activity	INERHI Functions					Total by Activity
	Central Management	Water Management	Irrigation Management	Construction & Operation	Institutional Planning	
Studies	0.71	6.09	0.30	186.21	1.45	194.76
Construction	19.55			4,331.32		4,350.87
Operation				75.89		75.89
Maintenance	8.20			108.33		116.53
Ag. Development				52.30		52.30
Administration	415.77	60.09	9.06	1,040.67	32.17	1,557.77
Fixed Assets	75.02	4.03	0.06	332.85	0.86	412.82
Public Debt	150.77					150.77
Water Agencies		160.60				160.60
Total by Function	670.02	230.81	9.42	6,127.58	34.47	7,072.30
Share (%)	9.47	3.26	0.13	86.64	0.49	100.00

Source: Appendix Tables 7.1 and 7.2.

systems on average during 1985-1988. Only 3.3 percent of its budget was spent on its first function of planning, administering and regulating the use of water resources. Almost nothing has been done to carry out the second function of irrigation management, with only .1 percent of its budget devoted to this task.

IHERHI's organizational structure may be impeding its ability to play a more vigorous role in carrying out its first two mandates. The Directorate of Administration of Water which is responsible for planning, administering and regulating Ecuador's water resources, is attached administratively to the Technical Directorate. The Technical Directorate studies, designs, builds and operates INERHI's irrigation systems. At the field level, the Water Agencies, which process water concessions, are subordinate to the Chief of the Irrigation District. Thus, the administrative unit of INERHI with responsibility to allocate water among all its competing uses is administratively subordinate to a unit of INERHI which develops water for irrigation. The Department for the National Irrigation Plan is part of the Directorate of Planning which serves as a staff office to the Executive Directorate. There is no line office responsible for carrying out the second function of planning and administering all irrigation and drainage at the national level. This reflects

the low priority of this function and the small budget allocations to it.

INERHI also has labor problems which also may be constraining its performance. Salaries for its 811 professional staff (civil servants) have declined in real terms in every year since 1985 and are low compared to private sector alternatives (Appendix Table 7.3). Consequently, it is difficult to develop and maintain a critical mass of experienced staff. Its 1,357 laborers work under a collective labor contract. This union paralyzed INERHI during the peak of the dry season in 1988 by declaring a national strike and closing the Pisque irrigation project for nearly 90 days. The unionization of INERHI's laborers clearly limited its ability to provide basic irrigation services. Finally, INERHI has suffered from a high turnover of senior staff with four Executive Directors during 1985-90. The politization of INERHI has resulted in instability and discontinuity of leadership in an agency that is largely technical in nature.

CEDEGE

CEDEGE was created in 1965 and is a semi-autonomous public agency attached to MAG and to the Office of the President (Orquera p. 22). It is headquartered in Guayaquil, has its own endowment and is governed by a Board of Directors. It was created to carry out studies of ways to develop the region covered by the Guayas River Basin. In 1970 CEDEGE's jurisdiction was expanded to include the Santa Elena Peninsula and in 1972 it was given authority to design and implement projects as well as carry out analyses and studies. In 1979 CEDEGE was given responsibilities of implementing the multipurpose Jaime Roldos Aguilera project (known popularly as the Daule-Peripa project) which strengthened its function of regional planning and improving interinstitutional coordination.

CEDEGE will have over 100,000 irrigable hectares when the Daule-Peripa and closely related Santa Elena projects are fully implemented. These projects are being implemented in stages, however, and only 17,000 hectares are programmed to be irrigable in the first phase starting in 1990. The balance of the 100,000 hectares is planned to be ready in three other later phases.

CRM

CRM was created in 1962 in response to a severe drought that resulted in emergency conditions in the Province of Manabí. It a semi-autonomous public agency attached to the MAG. It has its own budget, is located in Portoviejo and has jurisdiction only in the Province of Manabí.

CRM has focused primarily on potable water systems with some limited involvement in irrigation. It plans to greatly expand its involvement in irrigation with construction of the multiple-use Carrizal-Chone project in the near future and rehabilitation of its multi-purpose Poza Honda project. These and several smaller projects will add about 31,000 additional hectares under irrigation. CRM also plans to bring water from the Daule-Peripa reservoir to the La Esperanza reservoir (as part of the Carrizal-Chone project) and thence to the Poza Honda reservoir. This additional water will meet increasing urban demands for potable water in the Portoviejo area and resolve a growing conflict between agricultural and urban water users.

CREA

CREA was created in 1958 and also is a semi-autonomous public agency

attached to the MAG. It is a legal entity with its own budget and is located in Cuenca. CREA has some very small irrigation projects which it has developed but no data are available. It is working with INERHI to improve the management of watersheds and better utilize water resources. It has no plans to implement new irrigation projects.

PREDESUR

PREDESUR does not exist as a separate legal entity; it is an element of the Executive Directorate of the Ecuadorian Subcommission for the Development of the Puyango-Túmbez and Catamayo-Chira River Basins. The Executive Directorate was created in 1972 with its own budget in accord with a 1971 bilateral agreement with Peru. The bilateral agreement called for the establishment of subcommissions by Peru and Ecuador to exploit the binational water resources of the two river basins. The Executive Directorate of the Subcommission established PREDESUR in 1975 and is legally responsible for it.

PREDESUR's principal involvement in irrigation has been the Puyango-Túmbez project which includes the Tahuín dam. The Tahuín dam project was transferred to INERHI after the dam was about 60 percent complete. When the Puyango-Túmbez project is completed (including two more dams) it will irrigate about 70,000 hectares in Ecuador. Another smaller project of 6,000 hectares (Zapatillo Alto) also is under study.

INAMHI

INAMHI is a semi-autonomous public agency created in 1979 and attached to the Ministry of Natural Resources and Energy. Its primary function is to gather, analyze and provide, in coordination with other agencies, meteorologic, climatic and hydrologic data and information. INAHMI has very limited resources for carrying out its important assignment. The number and level of training of its staff are inadequate to the task at hand. Its meteorologic stations are antiquated and many probably give inaccurate measurements. Several other institutions also have substantial networks of meteorologic stations, including the Ecudorian Electrification Institute (INECEL), the National Institute of Agricultural Research (INIAP), CEDEGE, CRM and CREA. While the Board of Directors of INAMHI is comprised of representatives from some of these agencies, the data from their stations are not ratified by INAMHI nor incorporated into a national data system. The data generated by INAMHI are fundamental to rational allocation of water concessions by INERHI but the two agencies tend to work very independently.

Other Public Agencies

There are several other public national and regional entities that are engaged in the operation of irrigation systems. Included are provincial and municipal governments, MAG, INIAP and the Military (CAME). The most important of these in terms of irrigated area is the Provincial Council of El Oro with approximately 12,000 hectares in four irrigation systems. The provincial councils of Loja and Cotopaxi also have irrigation systems. Fifteen municipal governments, mainly in the Sierra, collectively irrigate 6,600 hectares mainly from small and simple irrigation systems. MAG irrigates 1,000 hectares and INIAP and CAME each about 250 hectares on their farms.

IV. Extent and Effectiveness of Irrigation

There were approximately 418,000 hectares of land irrigated in 1987 (Table 7.2, Appendix Tables 7.4 and 7.5). This includes land irrigated from both public and private projects throughout the year and does not account for irrigation of

Table 7.2 Irrigation Projects in Operation, 1989

Entity	Command Area [a] (*Superficie Dominada*) (hectares)	Irrigable Area (*Superficie Regable*) (hectares)	Irrigated in 1987 (hectares)	Irrigable as Share of Command (%)	Irrigated as Share of Irrigable (%)
A. GRAND TOTAL	510,735	445,244	417,959	87.2	93.9
B. Private	330,000	330,000	330,000	100.0	100.0
C. Public Total	180,735	115,244	87,959	63.8	76.3
1. INERHI (National)	139,630	79,289	52,004	56.8	65.6
2. CEDEGE (Guayas R. Basin)	9,000	4,700	4,700	52.2	100.0
3. CRM (Manabi)	3,500	2,650	2,650	75.7	100.0
4. CREA (Azuay, Canar, & M. S.)	4,200	4,200	4,200	100.0	100.0
5. Provinces	16,315	16,315	16,315	100.0	100.0
6. Municipalities	6,600	6,600	6,600	100.0	100.0
7. Others (MAG, INIAP, CAME)	1,490	1,490	1,490	100.0	100.0

Source: Appendix Tables 7.4 and 7.5.

[a] Data were not available to distinguish between command area, irrigable rea and irrigated area for most of the regional and local irrigation agencies. It is likely that irrigated area is substantially less than irrigable area and that irrigable area is less than the planned command area, just as is the case for INERHI, CEDEGE and CRM.

multiple crops. Irrigated agriculture is relatively important, accounting for about 27 percent of the cropland of the country.[5]

The extent of private irrigation has been estimated but there are no reliable data and the estimates have to be considered approximations. Keller, et al. (p. 103) estimated the area under private irrigation to be 323,000 hectares in 1981. A more recent estimate by Carrera de la Torre of 330,000 hectares is consistent with the first. It also is cited by Orquera (p. 31) as an accepted estimate. Cox, Cox and Tolosa (p. 20) argue that the 1981 estimate was too high and make a more conservative estimate for 1988 of 231,00 hectares. The estimate of 330,000 hectares is judged to be the most reliable on the basis of consistency with the 1981 estimate. INERHI, with assistance from the Office of Overseas Science and Technology Research of France (ORSTOM) is carrying out a study of irrigation by river basin that will provide more accurate data about the extent and location of private irrigation. The study will not be completed until the early 1990s.

The private sector accounts for nearly 80 percent of all irrigation, accepting the estimate of 330,000 hectares in private irrigation. About 33,000 hectares of private irrigation is in 14 farms, ranging from 1,000 to 5,000 hectares per farm (Orquera p. 32). The balance is in smaller, simpler systems thought to be located primarily in the Sierra.[6] INERHI has been involved since 1985 in a modest program to improve the privately-owned *acequias* (distribution systems--primarily primitive ditches) and shallow wells of small farmers. In 1987 this effort improved irrigation on 23,000 hectares and benefitted 15,300 families (INERHI 1987a).

Public projects irrigated a reported 87,959 hectares in 1987 with 52,004 hectares (59 percent) under auspices of INERHI (Table 7.2). These projects are located throughout the country (Figure 7.1). Seven other regional, provincial and local government agencies collectively irrigated nearly 36,000 hectares. The single most important of these is the Provincial Council of El Oro, which irrigated 12,000 hectares.

INERHI irrigation systems have not realized their planned potential.[7] The area planned at the design stage to be irrigated (command area) was 139,630 hectares. There is only sufficient infrastructure, however, for an irrigable area of 79,289 hectares or 57 percent of the planned command area. More critically, the irrigable area is greatly underutilized with only 52,004 hectares actually under irrigation in 1987 (66 percent of irrigable area).[8]

Inefficient utilization of irrigation water, especially on farms, likely is the main reason that one-third of the irrigable area is not irrigated. Keller, et al. (p. 45-48) found on-farm efficiencies were especially low at only 2-15 percent for earth systems and 20-45 percent for lined systems. The same study noted that almost all Ecuador's irrigation systems are stream diversions and that irrigation must occur 24 hours per day to take full advantage of available water. Night irrigation was found to be very inefficient, especially on steeper slopes in the Sierra. As a result there may be as little as one-half the water effectively available as supplied. These stark realities expose the overly optomistic nature of feasibility studies which assumed much higher rates of efficiency in the main system and in on-farm applications than are being realized.

Efficiencies appear to be relatively lower in on-farm applications than in the main systems in all public projects (Keller, et al. 1982, 47). This suggests that on-farm water management should be the initial focus of technical assistance and training. There clearly is opportunity for substantial improvement in efficiency of on-farm water applications in Ecuador with already proven technologies. If efficiencies were improved by only one-third, there would be sufficient water to irrigate all the land that is currently irrigable in INERHI projects (79,289 hectares).

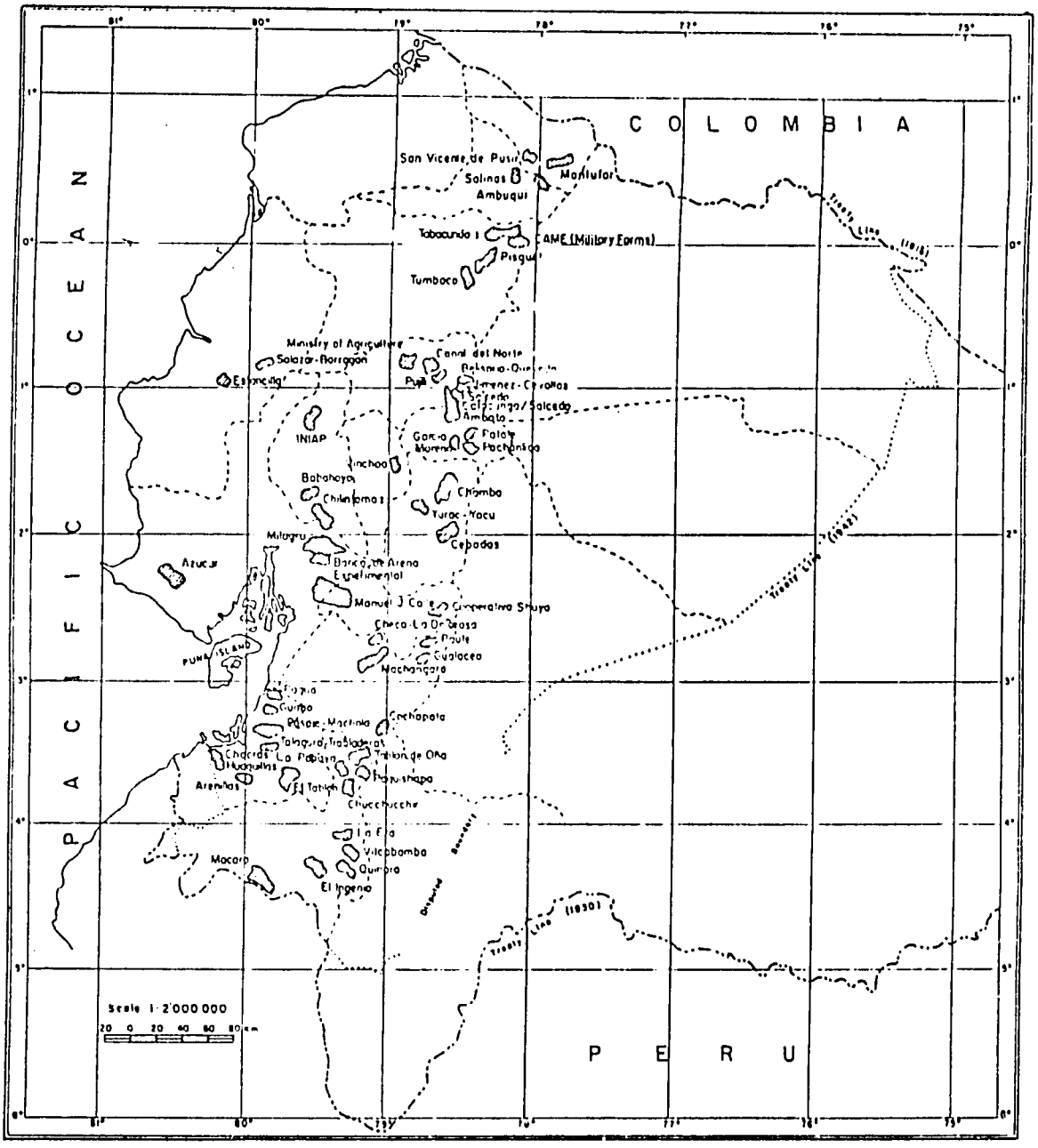

Figure 7.1 Irrigation Projects in Operation
Source: Prepared by authors from data provided by the various irrigation agencies and Appendix Tables 7.4 and 7.5.

Water resources sometimes prove insufficient to fully develop a project, despite initial hydrologic studies which document adequate supplies. The problem appears primarily to be incorrect measurements of available water supply at the feasibility stage of the project. This is due, at least in part, to several institutions being involved in water measurement. There currently is no system for linking these diverse networks into an integral information system. As a result, data on water supplies are less accurate than they might be and overestimations of flows occur. Projects which suffer from overestimation of water flows and also have inefficiencies in on-farm water applications obviously are constrained to much less irrigable area than planned.

Lack of funding also has constrained development of irrigation infrastructure and restricted expansion of the irrigable area toward the contemplated command area. INERHI has expended, on average, for all of its operating irrigation systems, only 79 percent of planned total project costs (Appendix Table 7.4). Only 16 of INERHI's 35 operational systems are 90 percent or more completed, as measured by accumulated expenditures as a share of total project costs. Construction tends to be delayed primarily because of funding shortfalls. Give inefficient on-farm water management and inadequate water supplies, the postponement of further investments in infrastructure has been efficient in an economic sense.

V. Future Irrigation Projects

There are a relatively large number of public irrigation projects either under construction or under serious study or design programmed for completion during the 1990s. If completed as planned these projects will substantially increase irrigated cropland in Ecuador but at very high costs and increased public foreign debt.

Projects under Construction

Projects currently under construction will expand the irrigated area by 108,109 hectares when and if fully implemented (Table 7.3, Figure 7.2, Appendix Tables 7.6 and 7.7). INERHI is the most important agency in terms of numbers and magnitude of new projects. It has 25 projects under construction with a planned command area of 62,318 hectares. The most important of these is Phase I of the Jubones Project of 15,600 hectares located in El Oro province. Other important projects include the Ambato-Huachi-Pelileo and Píllaro projects in Tungurahua province and the Tahuín project in El Oro province. The latter was part of PREDESUR's Puyango-Túmbez project but has been transferred to INERHI. The other 21 INERHI projects are much smaller, ranging from 170 to 3,100 hectares and are located throughout the country.

CEDEGE is the next most important irrigation agency in terms of new projects. It will add 32,691 hectares when three projects currently under construction are completed and fully implemented. The most important of these is the first phase of the Daule-Peripa multipurpose project.[9] It includes the dam on the Daule River which was completed and placed in operation in 1988. Infrastructure for irrigation of 17,000 hectares on the right bank of the Daule has been completed but will not be operational until 1991. The second phase will add generation of electricity and the third will provide infrastructure to irrigate 33,000 hectares on the left bank of the Daule River.[10]

CEDEGE's second most important construction project is the first phase of its Santa Elena project.[11] The Santa Elena project utilizes water stored in the

Table 7.3 Irrigation Projects under Construction, January 1989

Entity/Project	Province	Planned Command Area (*Area Neta*) (hectares)	Expected Termination Date (year)
A. GRAND TOTAL		108,109	---
B. INERHI		62,318	---
1. Ambato-Huachi-Pelileo	Tungurahua	9,885	1990
2. Píllaro	Tungurahua	8,870	1995
3. Tahuín	El Oro	7,400	1994
4. Jubones Phase I	El Oro	15,600	1995
5. Others (21 Projects)	Various	20,583	---
C. CEDEGE		32,691	
1. Daule-Peripa Phase I	Guayas	17,000	1990
2. Santa Elena Phase I	Guayas	15,691	1990
3. Samborondón (Drainage)	Guayas	—	1991
D. CRM		13,100	
1. Poza Honda Rehabilitation	Manabi	6,500	1990
1. Jama	Manabi	2,000	1990
2. Briceño	Manabi	1,000	1990
3. Small Dams (9 Projects)	Manabi	3,600	---

Source: Appendix Tables 7.6 and 7.7.

Daule-Peripa Reservoir for both irrigation and potable water throughout the Santa Elena Peninsula. The first phase of the project will pump water from the lower Daule River, near La Toma in Guayas Province, up 75 meters to an aqueduct which will carry it to the Chongon dam and distribution system for irrigation of 15,691 hectares in the Chongon-Playas area and potable water for Playas. The second phase of the project, which is under study and design, will irrigate another 27,192 hectares and provide potable water for Salinas and La Libertad. Water will be pumped uphill another 73 meters from the Chongon Reservoir and distributed via aqueducts and canals to various sites in the Western Santa Elena Peninsula.

CRM has three principal projects under construction, rehabilitation of the Poza Honda and Briceño projects and construction of the Jama project, which will irrigate 9,500 hectares in total. CRM has nearly completed rehabilitation of the Poza Honda project, which was severely damaged by flooding, and plans to add a net of 6,500 hectares to the 2,650 hectares that are now irrigable. The Jama project will add 2,000 hectares. The Briceño project is being rehabilitated and a net of 1,000 hectares will be added. CRM also is constructing nine other small dams which will irrigate 3,600 hectares.

The actual increase in the area under irrigation from projects currently under construction probably will be smaller and slower than implied by their planned command area of 108,109 hectares. Financial and other constraints likely will slow down the completion of infrastructure. The result will be smaller irrigable

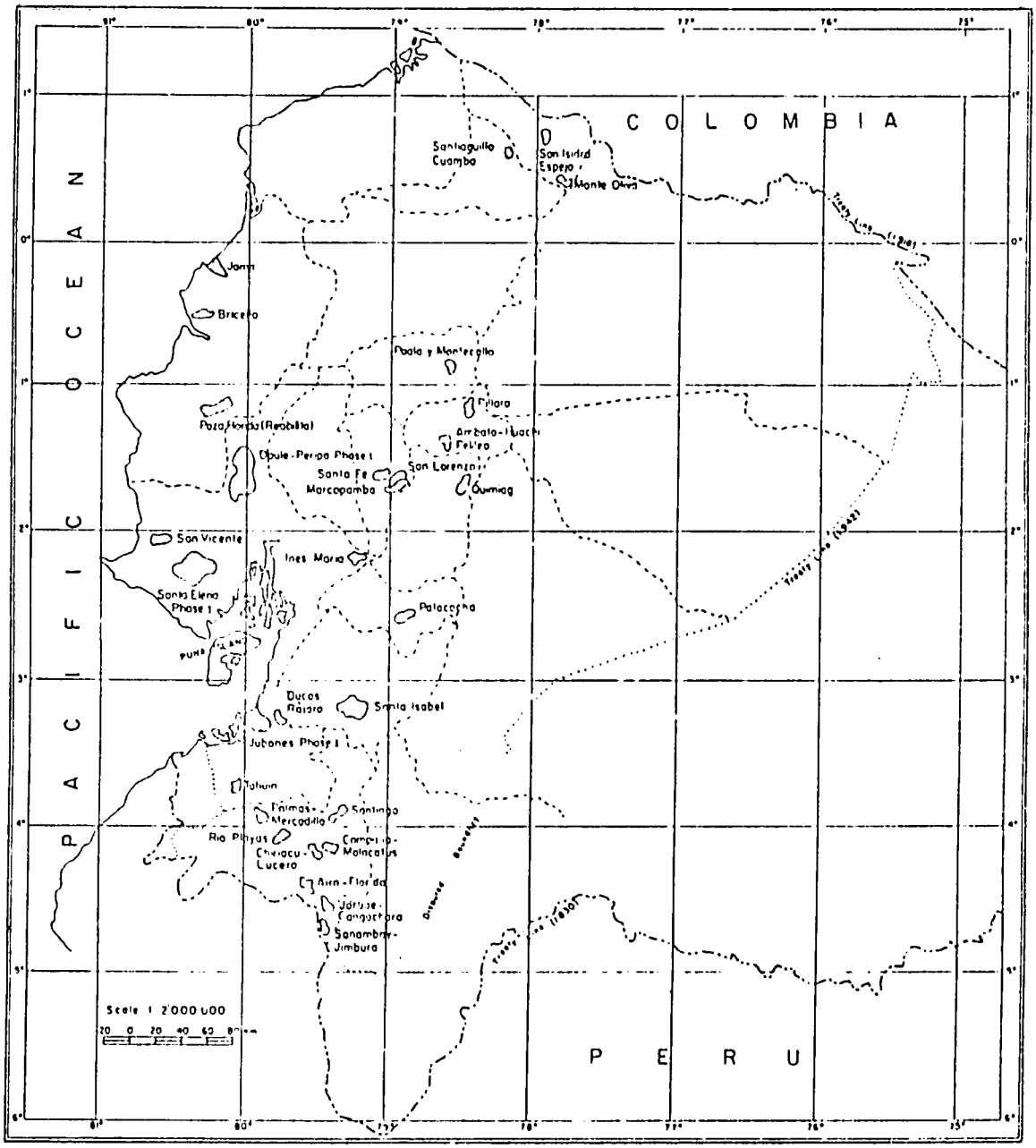

Figure 7.2 Irrigation Projects under Construction
Source : Prepared by authors from data provided by the various irrigation agencies and Appendix Tables 7.6 and 7.7.

areas than the planned command areas, even several years after planned completion dates in the early 1990s. Moreover, inefficient use of water at both the system and farm levels probably will limit the area actually irrigated to less than the irrigable area. Lack of complementary resources such as improved technological packages and associated modern factors of production (improved seeds, pesticides and fertilizers) will limit the profitability of irrigation and further constrain full utilization of the irrigable areas. These realities already have been demonstrated in the experience of INERHI's many operating irrigation systems. There is no reason to expect a greatly improved pattern in INERHI's new projects, or that CEDEGE or CRM, with much less institutional capacity than INERHI, will fare any better.

Projects under Design or Study

There are a number of irrigation projects under design or serious study which have a planned command area of 294,308 hectares (Table 7.4, Figure 7.3, Appendix Tables 7.8 and 7.9). These projects include only those which are in the design phase or under feasibility study. In addition to these, there are a large number of other projects that are at the preliminary stages of identification and study which are not treated in this section. For example, INERHI alone has 36 other projects (besides those listed in Table 7.4) which are under preliminary study that would irrigate another 152,058 hectares.[12]

INERHI is the most important public irrigation agency in terms of projects now under design or in serious study, with 132,116 hectares, followed by CEDEGE with 68,192, PREDESUR with 76,000 and CRM with 18,000. Several are second and third stages of projects currently under construction and they likely will advance to the construction stage by the early to mid-1990s. They will be subject to the same funding and operational constraints discussed above for projects now under construction. It is unlikely that projects now under design or study will be completed before the late 1990s or increase the area irrigated in any significant way until after 2000.

INERHI's most important project is Phase II of the Jubones project with an additional 38,400 hectares of planned command area, which is at the design stage and is expected to move to construction in the early 1990s. The Tabacundo II project (8,889 hectares) also is designed and construction will begin when financing can be arranged. Other important projects include Artezon-Mira-El Angel in Carchi province, Chalupas and Chaupi Palama in Cotopaxi province and Catarama and Banco de Arena in Guayas and Los Rios provinces, respectively. INERHI also has 13 other projects at design or feasibility stage totaling 27,927 hectares.

INERHI is planning the rehabilitation of five of its older irrigation systems at a cost of US$17.3 million. The most important of these is the Chambo system which was designed with too small a diversion dam to irrigate the planned command area. The cost of this modification is projected to be US$12.0 million, which seems very high for the benefits expected. Other systems planned for renovation include Salinas, Pisque, Tumbaco and Manuel J. Calle. The latter is afflicted with serious drainage problems which, if not resolved, may obviate the utility of recent improvements in the distribution system. INERHI also is continuing its program to repair and improve the acequias and shallow wells of small farmers. While INERHI had planned to continue its flood control program in the Lower Guayas River Basin, this activity was transferred to CEDEGE early in 1989, along with responsibility for the Catarama irrigation project. Moreover, it is possible that INERHI's three large irrigation projects in the region (Milagro, Chillintomo and Manuel J. Calle), which are

Table 7.4 Irrigation Projects under Design or Serious Study, January 1989

Entity/Project	Province	Stage of Study or Design	Planned Command Area (*Area Neta*) (hectares)
A. GRAND TOTAL			294,308
B. INERHI			132,116
1. Artezon-Mira-El Angel	Carchi	Feas.	9,000
2. Tabacundo II (Tunnel)	Pichincha	Design	8,889
3. Chaupi Paloma	Cotopaxi	Feas.	10,700
4. Chalupas	Cotopaxi	Feas.	18,600
5. Banco de Arena	Guayas	Feas.	12,800
6. Catarama	Los Rios	Feas.	5,800
7. Jubones Phase II	El Oro	Design	38,400
8. Others (13 Projects)	Various	Des.-Feas	27,927
C. CEDEGE			68,192
1. Daule-Peripa Phase III	Guayas	Design	33,000
2. Santa Elena Phase II	Guayas	Design	27,192
3. Pedro Carbo	Guayas	Pre-Feas.	8,000
D. CRM			18,000
1. Carrizal-Chone	Manabi	Design	18,000
F. PREDESUR			76,000
1. Puyango-Túmbez	Loja	Feas.	70,000
2. Zapotillo Alto	Loja	Design	6,000

Source: Appendix Tables 7.8 and 7.9.

an integral part of flood control infrastructure, also could be transferred to CEDEGE.

CEDEGE has two major projects in the design stage and is seeking financing for them. One is the Phase III of the Daule-Peripa project which will construct infrastructure to irrigate 33,000 hectares on the right bank of the Daule river. The second is Phase II of the Santa Elena project which will provide irrigation water for an additional 27,192 hectares in the Santa Elena Peninsula and potable water for Salinas and La Libertad. Each of these sub-projects is closely related to investments made in the first phases and the economic viability of the Daule-Peripa and Santa Elena projects depends on completion of all the phases of both projects. It is expected that funding will be secured and construction on these two sub-projects will start in the early 1990s. CEDEGE also is in process of final design of the Pedro Carbo project of 8,000 hectares.

PREDESUR is just letting contracts for the feasibility studies of the Puyango-Túmbez project which will irrigate an estimated 70,000 hectares in Loja when it is

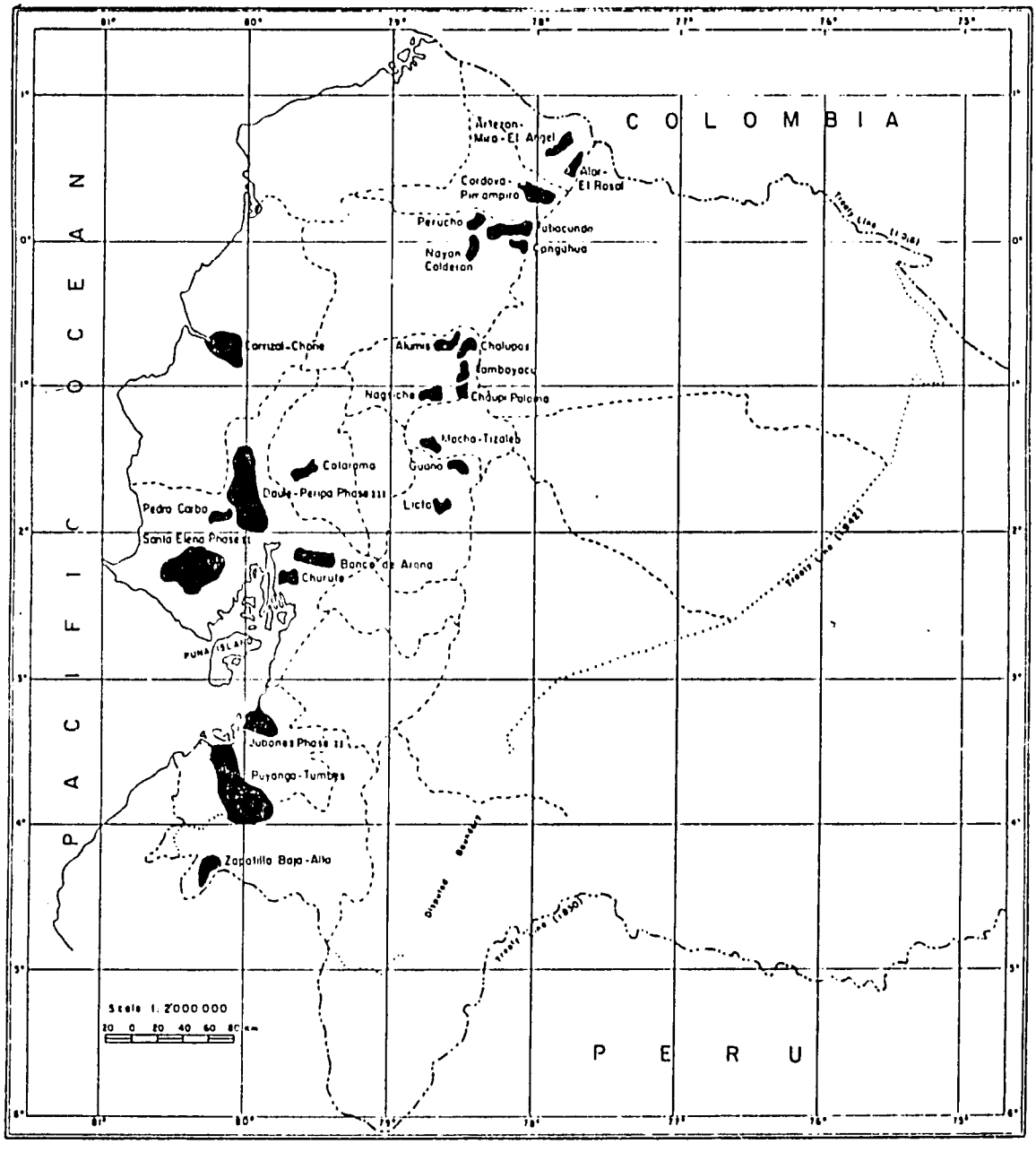

Figure 7.3 Irrigation Projects under Design or Serious Study
Source : Prepared by authors from data provided by the various irrigation agencies and Appendix Tables 7.8 and 7.9.

completed (PREDESUR). The initiation of construction is likely several years away,since financing still has to be secured.

CRM has one major project which has been designed and shortly will be under construction. The Carrizal-Chone project has a planned command area of 18,000 hectares. The project includes construction of the La Esperanza dam on the Carrizal river and the Grande dam on the Chone river for irrigation and flood control. It also includes an aqueduct for inter-basin transfer of water from the Daule-Peripa reservoir to the La Esperanza reservoir and from there to the Poza Honda reservoir to augment the supply of potable water for Portoviejo. The contract has already been awarded for construction of the La Esperanza dam, which is expected to begin in late 1990.

INERHI will continue to be the dominant irrigation agency in terms of area irrigated for well into the first two decades of the 21st century, even if all the projects under construction and study by other agencies are fully implemented (Table 7.5). CEDEGE and CRM both will become more important but the irrigable area under their collective jurisdiction will not reach that managed by INERHI. CEDEGE will be the second most important irrigation agency both when current construction is completed and when projects under design or study are completed, but it will not reach one-half the area covered by INERHI projects.

Nothing is known about the status of any current construction or plans for

Table 7.5 Irrigation Projects in Operation, under Construction and under Design or Serious Study, 1989 (hectares)

Entity	Irrigated in 1987	Under Construction 1989	Under Design or Study 1989	Total Irrigated and under Construction (a+b)	Total under Construction and Study (b+c)	Grand Total (a+b+c)
	(a)	(b)	(c)	(d)	(e)	(f)
A. Total	417,959	108,109	294,308	196,068	402,417	820,376
B. Private	330,000				0	330,000
C. Public	87,959	108,109	294,308	196,068	402,417	490,376
1. INERHI(National)	52,004	62,318	132,116	114,322	194,434	246,438
2. CEDEGE (Guayas R. Basin)	4,700	32,691	68,192	37,391	100,883	105,583
3. CRM (Manabí)	2,650	13,100	18,000	15,750	31,100	33,750
4. CREA (Azuay, Cañar, & M. S.)	4,200			4,200	0	4,200
5. PREDESUR (South Ecuador)			76,000	0	76,000	76,000
6. Other Public	24,405			24,405	0	24,405

Source: Tables 7.2, 7.3 and 7.4.

private irrigation. Even after completion of public projects currently under construction, private irrigation at the current level of 330,000 hectares will substantially exceed public irrigation of 196,068 hectares. The actual gap will probably be even greater as the planned command areas of public projects will not be realized.

The total area under public and private irrigation if all public projects in construction and under design and study were completed and fully implemented would be 820,376 hectares, nearly doubling the area currently under irrigation.[13] Because of the constraints discussed above, the irrigable area from new public projects is expected to be much smaller than the planned command areas and the irrigated areas smaller than the irrigable areas. Also, it will require much longer to bring these smaller areas under irrigation than planned in overly ambitious schedules.

VI. Financing Irrigation Projects

The process for approving and financing public irrigation projects in Ecuador is largely decentralized and highly subjective. There is only a limited attempt by the National Devlelopment Council (CONADE) to enforce the application of objective criteria and procedures in setting national priorities for allocation of investment capital (Cox, Cox and Tolosa 64 ff.). This is generally true, not only within the irrigation sector but also among other competing needs in agriculture and among sectors. The result is intense interinstitutional competition for both internal and external financing for irrigation and other development projects.

Funding for irrigation projects for every public entity comes from two principal sources, domestic (primarily government) and external (primarily bilateral and multilateral development agencies). Domestic resources for the public irrigation agencies include funds from taxes earmarked for specific activities, revenues from tariffs and other services, funds from the general budget, internal credits and donations from domestic agencies.

The sources of funds appear to limit flexibility in applying objective criteria to allocation of funds. For example, INERHI receives earmarked tax proceeds from the *Plan Loja* which must be used for irrigation projects in the Loja province. It also receives funds from a tax on Central Bank credits that goes into a National Fund for Irrigation and Drainage (FONARYD), half of which must be used for the Jubones irrigation project. International and domestic credits and donations almost always reflect perspectives and interests of the funding sources. The flexibility represented by income from water tariffs and direct budget support is relatively small. Tariffs have averaged about 3-4 percent of INERHI's income in recent years and much smaller shares for CEDEGE and CRM (Cox, Cox and Tolosa p. 64). Direct budget support has averaged about 25-30 percent.

The decentralized and politicized system for financing irrigation projects has several undesirable effects. An unhealthy competition has ensued between the principal irrigation agencies. This was confined to INERHI and CEDEGE until recently when both CRM and PREDESUR entered more actively into the fray, successfully seeking funding for the Carrizal-Chone and Zapotillo Alto projects. This has tended to pit these institutions against each other, especially the regional institutions against INERHI. The recent transfers of the flood control program of the lower Guayas River basin and the Catarama irrigation project from INERHI to CEDEGE has heightened tensions in INERHI. The ad hoc system for approving and financing irrigation projects further limits INERHI's capacity to serve its legally mandated role in managing water and irrigation resources for the country.

Another undesirable effect of decentralized project development and financing is the failure to complete projects. INERHI's failure to complete its operational irrigation systems, in many cases years after they were placed in operation, has already been noted. In the meantime, other projects continue to be identified, studied, designed and built by INERHI (and the regional entities) as if the uncompleted operating systems did not exist.

Another manifestation of problems with the decentralized approval and financing system is the tendency to construct interrelated elements of projects out of sequence. One example is the decision to proceed with financing and construction of Stage 2 of Phase I of the Santa Elena project before securing funding for Stage 1. Stage 2 is a dam and distribution system at Chongon for irrigation of 15,691 hectares and potable water for Playas. Stage 1 comprises a pumping station near La Toma and an aqueduct that takes water from the Daule river that carries it to the second stage at Chongon. Stage 2 obviously can not operate until Stage 1 is completed. The financing for Stage 2 of Phase I of Santa Elena (US$187 million) was obtained from Brazil with no assurance that funding could be obtained for Stage 1. While funding for Stage 1 since has been arranged from the same source, the inherent danger in funding and starting Stage 2 first is obvious.

VII. Costs and Public Debt

Expenditures on public sector irrigation and water resources have averaged nearly 40 percent of the public sector budget for agriculture for nearly two decades (see Chapter 11 Table 11.3). In contrast, the area actually irrigated by public sector projects in 1987 of 87,959 hectares is about 6 percent of average cropland during 1980-85 (see Chapter 6). The share of agriculture's GDP derived from publicly-irrigated agriculture is not known but probably is not much different than 6 percent. Thus, public expenditures to operate irrigation systems seem disproportionately large relative to the importance of irrigated cropland.

The cost of infrastructure for INERHI's 35 operating irrigation systems through 1988 is estimated to be S/.75,313.1 million in 1988 constant prices, or US$172.7 million, at the free market exchange rate of S/.436.19/US$ in 1988 (Table 7.6, Appendix Table 7.10).[14] The value in 1988 prices of other public irrigation infrastructure is estimated at S/.34,152.0 million or US$78.3 million.[15] The total value of all public irrigation systems now in operation is S/.109,465.1 million or US$251.0 million, on the basis of these estimates. These estimates do not include the costs of operations and maintenance; services; institutional development; central administration; national level water and irrigation and drainage management; nor water measurement by INAMHI.

The costs of INERHI's infrastructure per irrigable hectare averaged S/.949,855 (US$2,177.62) in 1988 but varied considerably among operational irrigation systems. Such costs range from a low of S/.127,300 per irrigable hectare in Jiménez-Cevallos to S/.2,674,663 in Machangara. The great variability in costs suggests some projects may be viable with much lower benefits relative to higher-cost projects.

As noted above, more than half of INERHI's 35 operational irrigation systems are less than 90 percent complete and average only 79 percent complete based on accumulated costs as a share of total costs. The total cost in 1988 prices of these projects is estimated at S/.94,839.8 million or US$217.4 million.[16] Thus, INERHI needs another US$44.7 million just to finish the partially-completed projects that are in operation but has financing to complete only a few of them.

Table 7.6 INERHI Investments in Infrastructure in its Operational Irrigation Systems, through 1988

Irrigation System (name)	Share Completed (%)	Costs to Date (1988 sucres) Total (millions)	Per Irrigable hectare	Inferred Total Costs (millions)
INERHI Total	79.4	75,313.1	949,855	94,839.8
1. Montufar	96.8	6,845.0	2,444,632	7,073.8
2. San Vicente de P.	100.0	337.9	844,625	337.9
3. Ambuquí	81.5	1,307.0	986,415	1,603.1
4. Salinas	96.8	3,243.0	1,544,281	3,351.4
5. Tabacundo I(Wells)	100.0	425.5	236,635	425.5
6. Pisque	93.8	13,145.3	2,094,873	14,012.0
7. Tumbaco	72.5	2,574.2	1,336,563	3,552.1
8. Lat./Sal./Ambato	98.0	6,017.7	716,389	6,138.7
9. Jiménez-Cevallos	100.0	89.1	127,300	89.1
10. Canal del Norte	67.0	158.0	158,020	235.9
11. Pujilí		147.4	733,483	
12. Pachanlica	89.0	354.2	590,250	397.9
13. Garcia Moreno	90.2	325.5	325,530	360.9
14. Patate	66.7	116.7	166,743	175.1
15. Chambo	56.7	13,809.1	2,191,913	24,354.2
16. Cebadas	100.0	384.9	641,533	384.9
17. Yurac-Yacu	96.2	57.3	190,967	59.5
18. Vinchoa	79.8	54.1	135,325	67.9
19. Machángara	73.8	2,225.3	2,674,663	3,016.4
20. Tablón de Oña	86.4	266.9	266,870	308.9
21. Macará	86.1	3,327.2	1,848,428	3,866.0
22. La Papaya	83.0	333.5	476,400	401.7
23. La Era	100.0	169.8	424,575	169.8
24. El Ingenio	90.7	241.6	604,050	266.4
25. Paquishapa	88.6	225.0	562,475	253.9
26. Chucchucchir	100.0	77.7	310,960	77.7
27. Quinara	100.0	504.9	1,262,200	504.9
28. Vilcabamba	100.0	168.3	561,133	168.3
29. Milagro	89.8	11,992.5	1,050,135	13,354.3
30. Chilintomo I	51.9	184.1	167,355	.0
31. Manuel J. Calle	58.1	5,785.9	262,993	9,959.6
32. Azúcar	80.5	185.8	764,403	230.6
33. Banco de Arena	28.6	35.5	132,045	124.3
34. Chacras-Huaqui.	61.9	92.5	370,000	149.5
35. El Tablón	100.0	104.7	149,600	104.7

Source: Appendix Tables 7.4 and 7.10.

The proposed cost of new irrigation and multipurpose projects under construction is US$ 1.1 billion and those under design and study another US$1.1 billion, or a total of US$2.2 billion (Table 7.7, Appendix Tables 7.7 and 7.9). This estimate includes only those projects currently under construction and those under design or study that are under serious consideration for implementation. It does not include a large number of projects that are under preliminary review and that currently are low priority.

Table 7.7 Cost of New, Public Irrigation and Multipurpose Projects (millions, 1988 prices)

Entity	Under Construction		Under Design and Study		Total	
	(sucres)	(dollars)	(sucres)	(dollars)	(sucres)	(dollars)
1. TOTAL	480,867.0	1,102.4	489,370.6	1,121.9	970,237.6	2,224.3
2. INERHI	72,446.8	166.1	201,563.5	462.1	274,010.3	628.2
3. CEDEGE	384,375.0	881.2	205,323.6	470.7	589,698.6	1,351.9
4. CRM	24,045.2	55.1	28,788.5	66.0	52,833.7	121.1
5. PREDESUR	0.0	0.0	53,695.0	123.1	53,695.0	123.1

Source: Appendix Tables 7.7 and 7.9.

Financing of these projects has contributed significantly to Ecuador's foreign debt (Table 7.8). The debt from irrigation and multipurpose projects in operation and under construction is estimated to be US$1.1 billion or 11.6 percent of the foreign debt. When only the irrigation component is considered the amount is US$312.3 million and 3.3 percent of the foreign debt, still significant levels. If multipurpose and irrigation projects currently under design and study are implemented, the magnitude of the debt burden will increase by US$1.0 billion, to US$2.1 billion or to 20.0 percent of the foreign debt. Moreover, projects under design and study are much more irrigation intensive than projects under construction, with irrigation components accounting for 57 percent of total costs for the former and only 21 percent for the latter. As a result, the share of the public debt from irrigation components of projects will rise sharply to 8.5 percent of foreign debt when projects under design and study are implemented.

VIII. Subsidies and the Water Tariff

Public irrigation projects in Ecuador are heavily subsidized. Ecuadorian law stipulates that such subsidies be given through the water tariff. Thus, irrigation water is priced much lower than the cost of providing it. The irrigation subsidy is one of the largest provided by the GOE and has contributed substantially to

Table 7.8 Importance of Irrigation and Multipurpose Projects in the Foreign Debt (millions of 1988 dollars)

Item	Operating Systems	Under Construction	Subtotal (a+b)	Under Design/ and Study	Total (a+b+d)
	(a)	(b)	(c)	(d)	(e)
Total Cost of All Components	251.0	1,102.4	1,353.4	1,121.9	2,475.3
Estimated Cost of Irrigation Component [a]	251.0	235.4	486.4	640.9	1,127.3
Irrigation Component as Share of Total Cost (%)	100	21	36	57	46
Estimated Amount Financed Abroad [a] (All Components)	100.4	992.2	1,092.6	1,009.7	2,102.3
Estimated Amount Financed Abroad [b] (Irrigation Component)	100.4	211.9	312.3	576.8	889.1
Foreign Debt (1988 Year-end) [c]	9,395.0	9,395.0	9,395.0	10,516.9	10,516.9
All Components Financed Abroad as Share of Debt	1.1%	10.6%	11.6%	9.6%	20.0%
Irrigation Component Fincanced abroad as Share of Debt	1.1%	2.3%	3.3%	5.5%	8.5%

Source: Tables 7.6 and 7.7; BCE 1989, pp. 85-86 for data on the foreign debt.

[a] The cost of the irrigation component was estimated from the cost of the infrastructure per hectare for INERHI projects (US$2,177.62 at the 1988 free market exchange rate of S/.436.19/US$1) multiplied by the command area of projects under construction, or under design and study from Table 7.5.

[b] See Note 18 for assumptions.

[c] The cost of projects under design and study is added to the 1988 debt for calculation of the debt share for such projects.

recent budget deficits.

INERHI is responsible legally for establishing water tariffs for all public irrigation projects. The water tariff has two components, the basic tariff which recovers some capital costs and the volumetric tariff which is supposed to recover all the costs of operation and maintenance.

The basic tariff is for "...amortizing the capital invested by INERHI in constructing infrastructure in its irrigation systems..." (INERHI n.d., p. 2, translation by authors). The total cost of the infrastructure is updated annually to account for new investments but is not adjusted for inflation. The law stipulates that 25 percent of the cost of infrastructure and all of the interest on capital be given as subsidies to water users. The period of time over which the reduced capital costs are to be recovered is 75 years for surface irrigation and 12 years for wells. The cost per year then is divided by the number of irrigable hectares to determine the basic tariff per hectare. A single, average tariff is calculated each year for all surface systems and individual tariffs for each subterranean system.[19] The basic tariff in equation form for surface systems is:

$$\text{Basic Tariff} = \frac{(\text{Total Investment})(.75)}{(\text{Irrigable Area})(75)}$$

The second component is the volumetric tariff. The Water Tariff Regulation specifies that it is to be calculated by dividing the operation and maintenance costs for all projects by the volume (cubic meters) of water used to calculate a uniform tariff (INERHI n.d., p. 4). INERHI converts the volumetric tariff to a per hectare basis because measurement of water supplied to individual farmers is not widespread. This is done by using standard water requirements for each crop, by soil and climate and then applying these requirements to the crop mix for each irrigation project to determine the water requirement per hectare. The cost per hectare is obtained by multiplying the cost per cubic meter of water by the requirement per hectare. The volumetric tariff charged to each farmer then is determined by multiplying the per hectare water requirement by the number of hectares irrigated.

The magnitude of the subsidy inherent in the basic tariff can be estimated by comparing it with the annual cost of amortizing the irrigation infrastructure. The basic tariff for 1989 for INERHI's 35 operating irrigation systems is calculated to be S/.686 per irrigable hectare. This estimate is based on the sum, in current prices of each year (S/.5,436.5 million) of all past capital investments using the above formula (Table 7.9, Appendix Tables 7.4 and 7.10).[20] INERHI investments in the same systems through December 1988 in 1988 prices were S/.75,313.1 million.[21] The cost to amortize this amount over 40 years (a usual term for a loan for irrigation infrastructure) using an interest rate of 6 percent is S/.63,129 per hectare per year. The difference (S/.62,443) between this and the basic tariff is the per hectare subsidy paid by the government to construct irrigation infrastructure. Thus, the government is subsidizing 99 percent of the costs of irrigation infrastructure in the 35 INERHI systems currently in operation. This subsidy will have to be paid every year for 40 years, under the assumptions of this example, to pay all the interest and capital costs.

The volumetric tariff also is subsidized. It is estimated that S/.1,861.1 million (constant 1988 prices) on average per year during 1985-88 related closely to the operation and maintenance of irrigation systems but were not accounted for in the volumetric tariff.[22] These costs were one-fourth of INERHI's average annual budget during 1985-88 and nearly fifteen times the 1987 operations and maintenance costs

Table 7.9 INERHI: Capital, and Operation & Maintenance Costs, the Water Tariff and the State Subsidy in 1988, per Irrigable Hectare (1988 sucres)

Item	Costs			
	Capital	Operations & Maintenance	Total	Share (%)
1. Actual Cost	63,129	26,534	89,663	100.0
2. Water Tariff	686	3,062	3,748	4.2
3. Subsidy	62,443	23,472	85,915	95.8

Source: Summarized from Section VIII.

of S/.98.0 million included in the calculation of the 1988 volumetric tariff (S/.126.8 million in 1988 prices). This is an additional subsidy of S/.23,472 per irrigable hectare (79,289 hectares). The average volumetric tariff for potatoes, which demand substantial water, was S/.3,062 per hectare in 1988. This upper-limit tariff is assumed to represent the average volumetric tariff for all INERHI water users in 1988 (INERHI 1987b, p. 11). Thus, the volumetric tariff is much lower than it would be if all relevant costs were included.

The total subsidy is estimated to be S/.85,915 per irrigable hectare for INERHI projects comprised of the subsidy to capital of S/.62,443 and to operations and maintenance of S/.23,472 (Table 7.9). This amounts to 96 percent of the total costs of providing the water and is a major drain on government resources.

Other regional irrigation agencies are supposed to charge a water tariff based on the same criteria as INERHI and under INERHI's supervision. In fact, CEDEGE, CRM, CREA and PREDESUR have established their own criteria for water tariffs with generally greater subsidies than INERHI (Cox, Cox and Tolosa p. 102).

The magnitude of the annual government subsidy to all operational public irrigation systems as of December 1988 is estimated to be S/.9,901.2 million, or US$22.7 million based on the INERHI subsid per hectare of S/.85,915, the irrigable area of 115,244 hectares in all operational projects and the 1988 free market exchange rate of S/.436.19/US$ (see Appendix Table 7.11). Government subsidies to irrigation will increase by another US$21.3 million in the next few years to a total of US$44.0 million as large new projects now under construction are completed, assuming the same subsidy per hectare and a command area of 108,109 hectares. A similar calculation reveals that the subsidy will increase by another US$58.0 million to US$102.0 million when high-priority projects under design or study with a command area of 294,308 hectares become operational.

The very large current subsidies and the likelihood that they will double in size when projects now under construction are completed is cause for serious concern. Such subsidies increase the debt burden, contribute to fiscal stress and greater budget deficits, reduce foreign exchange reserves and make it more difficult to contain inflationary pressures. The large subsidies also result in waste of water resources. When water is so substantially underpriced, farmers use more

than is needed. Greatly underpriced water explains, in large part, the very low levels of efficiency in on-farm applications of water and why public irrigation projects generally yield low economic returns to relatively large public investments.

IX. The Economic Viability of Public Irrigation Projects

There is evidence that irrigation systems in Ecuador generate much smaller economic returns than estimated in the economic analyses of feasibility studies, which tend to be unduly optimistic. *Ex ante* economic evaluations of proposed irrigation projects likely have overestimated the internal rate of return or benefit-cost ratio. A review of 34 feasibility studies by INERHI revealed that 31 of the 34 had estimated ex ante internal rates of return ranging from 12 to 40 percent and all were positive.[23] These studies generally assumed that: (a) all infrastructure for the planned command area would be constructed and in an unrealistically short time; (b) all the planned command area would be irrigated also in an unrealistically short time; (c) water would be used at relatively high levels of efficiency both at the system levels and in on-farm applications; (d) the water flow was sufficient for the planned command area; (e) farmers would be able to significantly increase productivity and yields; (f) water tariffs and fees would be collected fully; and (g) costs of project construction and operation would not increase.

There are only two ex post facto economic evaluations of the actual performance of irrigation projects in Ecuador in contrast to the large numbers of ex ante feasibility studies. These are evaluations of the Montufar and Milagro projects by IDB and the World Bank, respectively. Thus, there has been almost no attempt by INERHI or other regional or planning agencies in Ecuador to measure the actual performance of irrigation systems, relative to what was predicted.

The results of these two studies and other evidence indicate that actual economic returns to public investments in irrigation are much lower than they are estimated to be in feasibility studies. The IDB evaluation of Montufar found that the harvested area was only 29 percent of project design and the increase in profits per hectare was only 43 percent of project design. The net result was that profits had increased by only 17 percent of what was planned in project design, five years after completion of infrastructure and with lined tertiary canals. The project had 3,500 hectares of irrigable land but was irrigating only 1,800 hectares. It experienced a cost overrun of 64 percent with a total cost of US$6.9 million, or US$3,833 per irrigated hectare. The internal rate of return was only 5 percent compared to an estimated rate of return of 26 percent in the feasibility study. Even today the Montufar project shows signs of low returns, with a reduced irrigable area of only 2,800 hectares and an irrigated area of 2,238 hectares. It is likely that a current analysis would show even lower economic returns.

Similar results were obtained by the World Bank in a 1982 review and evaluation of the Milagro project. Milagro is clearly one of INERHI's most inefficient projects. There had been only a modest increase in the irrigated area of the project since 1973. Even today, only 3,150 hectares are irrigated out of an irrigable area of 11,420 hectares. There are large investments in a machinery pool and other complementary inputs which are relatively unproductive. The mix of crops has changed very little and increases in profits per hectare are very small.

Other more general evidence also suggests relatively low returns, on average, to public irrigation projects. First, projects usually begin operation only partially completed because of cost overruns and slowdowns in construction. Second, technical efficiency of water use is much lower than assumed which limits the area

that can be irrigated. Third, complementary inputs and improved technical practices are not adopted on the irrigated land as quickly or as widely as was planned. Thus, yields and net increases in income (profits) from irrigation remain relatively low.

The ex post facto evaluations of specific projects and the general evidence lead to the conclusion that expected project benefits do not begin as soon nor in nearly as large a magnitude as projected in feasibility studies. The major portion of costs, however, tend to occur before the irrigation system is operational and well before any substantial flow of benefits. Costs also tend to be greater than those planned at the design stage. It is well known that the internal rate of return, or benefit-cost ratio is very sensitive to the timing of the flow of project benefits relative to costs. If benefits are not realized for several years later than projected, the internal rate of return will be substantially smaller. And if the benefits not only are postponed but are smaller than expected, the internal rate of return will be even smaller. If costs are incurred on schedule but are greater than planned, the rate will be smaller still.

X. The Size and Distribution of Benefits

Irrigation projects permit farmers who begin to irrigate their land to realize increased profits (project benefits), with the better farmers producing relatively greater benefits. These benefits are produced because irrigation and complementary inputs allow farmers to increase productivity, production and profits. Project benefits are defined as the increase in profits per unit of irrigation water utilized, after paying for all the additional inputs required to adopt irrigation and associated technological packages.

Project benefits from irrigation generally continue year after year. They tend to be capitalized into the value of the land when the right to use the water is tied to the land because they are perceived as permanent increases in profits due to adoption of irrigation. Thus, the original owners of the land receive all the economic rents as a lump sum (present value of future net project benefits) from irrigation projects when they sell the land. Private benefits from irrigation are in direct proportion to original land ownership. Consequently, land values will tend to fall for all owners if the government raises the water tariff in an attempt to pass on more of the cost to farmers. Second owners will be decapitalized when user fees are raised because they paid the original owners a higher price of land reflecting the lower water tariff.[7]

Private investments to utilize irrigation water from public projects in Ecuador will realize higher rates of return than the public investments in the project, because of the large government subsidy to irrigation water. Utilization of irrigation water from public projects (instead of relying of rainfall) entails additional private costs for the water tariff and other complementary inputs (such as infrastructure for on-farm irrigation, improved seeds, fertilizers, etc.). Once these costs have been covered by the value of increased production, the farmer realizes an increase in profits and private investments to utilize irrigation water from the public system are profitable.

However, the water tariff covers only about 5 percent of the total costs of delivering water to the farm, with a government subsidy in 1988 of S/.85,915/irrigable hectare/year. The increase in private profits must be sufficient to pay for all of the subsidy in order for public investments in irrigation projects to become socially profitable. When the increase in profits exceeds the subsidy the social benefit-cost ratio is greater than one and the internal rate of return is

positive.[illegible] The size of project benefits is of critical concern, both in terms of measuring the degree to which farmers capture government subsidies and of determining if public investments are socially profitable.

One method for estimating the magnitude of project benefits is to determine the increase in the value of land due to irrigation. As noted above, the annual net benefits from irrigation projects which accrue to farmers, tend to be capitalized into the value of farmers' land. Informal surveys of knowledgeable people (farmers, real estate agents and officials of the Chambers of Agriculture) during January-May 1989 revealed substantial differences between the value of irrigated land and the value of unirrigated land of similar quality near the irrigation project in question (Table 7.10, Appendix Table 7.12). The survey included 25 observations in all the major irrigated areas of the country and covered projects that account

Table 7.10 Weighted Average of the Differences in the Value of Irrigated and Unirrigated Land of Similar Quality for Operational Irrigation Projects. January - May, 1989

System	Number of Observations	Mean Difference in Value of Land (1.000 sucres)	Irrigable Area (hectares)	Total Value (1.000 sucres)
INERHI				
1. Montufar	6	450	2,800	1,260,000
2. San Vicente de P.	1	1,350	400	540,000
3. Ambuqui	1	1,350	1,325	1,788,750
4. Salinas	1	650	2,100	1,365,000
5. Tabacundo I(Wells)	1	250	1,789	447,250
6. Pisque	1	200	6,275	1,255,000
7. Lat./Sal./Ambato	3	700	8,400	5,880,000
8. Chambo	2	1,125	6,300	7,087,500
9. Cebadas	1	650	600	390,000
10. Milagro	3	370	11,420	4,225,400
11. Manuel J. Calle	2	325	22,000	7,150,000
CRM				
1. Poza Honda	2	410	2,650	1,086,500
CEDEGE				
1. Babahoyo	1	250	4,700	1,175,000
TOTAL	25	476[a]	70,759	33,650,400

Source: Informal survey conducted during January-May of 1989 (See Appendix Table 7.12).

[a] Weighted Average.

for 61 percent of the irrigable area of all public projects currently in operation. Differences in the value of irrigated and unirrigated land are highly variable, ranging from S/.160,000 to S/.1,700,000 per hectare and reflect the present value of the stream of expected benefits produced by the irrigation project.

The difference between the value of unirrigated and irrigated land necessary to reflect a benefit stream sufficiently large to pay the irrigation subsidy is S/.1,292,703/hectare. This "break-even" value is easily calculated as the present value of a benefit stream equal to the irrigation subsidy of S/.85,915 per hectare, given some time period over which the annual benefits flow and a discount rate. Utilizing the same parameters as in the estimate of the subsidy to public projects (40 years and 6 percent interest) permits comparison of the estimated average subsidy with the benefit stream implicit in the difference in land values.[26] The observed differences in land values indicate that most irrigation projects produce net benefit streams that are substantially less than the average subsidy, although a few projects are socially profitable. Farmers reap some or all of the public irrigation subsidy in the form of increased profits that are reflected in higher land values. In those projects where benefits are not sufficient to pay for all the costs of water, part of the subsidy is wasted. All projects which have a difference in land values less than the break-even of S/.1,292,703 are socially unprofitable and part of the subsidy is lost.

The amount of the subsidy that is wasted can be roughly approximated from the survey data on land values. The weighted average of the differences in the value of irrigated and unirrigated land of S/.476,000 is an estimate of the average increase in the value of land due to irrigation. The average annual benefit stream from public irrigation projects reflected in this average of increased land values due to irrigation is S/.31,636, assuming the same parameters of 40 years and a discount rate of 6 percent. Farmers actually receive, on average, only 37 percent of the subsidy of S/.85,915 and the balance is completely wasted. Project benefits are substantially less than predicted and planned and are not sufficient to cover the costs of providing the water. This analysis suggests that public irrigation projects are socially unprofitable on average, with a benefit-cost ratio of less than one.

The allocation of subsidies and benefits is summarized for operating irrigation systems and for those under construction (Table 7.11). The estimated annual subsidy to public irrigation systems in operation was US$22.7 million. Farmers capture US$8.4 million of this subsidy each year in the form of increased profits, which tends to be capitalized into the value of their land. The value of land is increased by an estimated S/.54,857.3 million or US$125.8 million, which is received as a windfall gain when the land is sold.[27]

The balance of the annual subsidy, amounting to US$14.3 million is lost and wasted in the form of unproductive irrigation infrastructure. Given the limited demand for used dams and lined canals, there is little likelihood that such losses ever will be recovered without significant complementary investments to make existing projects more efficient and productive. When projects under construction are completed the amount of the annual subsidy will nearly double to US$44.0 million, with US$16.2 million being captured by farmers and the balance of US$27.8 million being lost.

The distribution of benefits from irrigation is directly proportional to the distribution of land ownership. Unfortunately, data on land ownership in public irrigation projects is extremely limited. The only data available were for the Pisque project for 1981 (S.A. AGRER N.V. and INERHI Annexes, p. 286). These data, based on a sample of about one-third of 2,569 water users, indicate that land ownership

Table 7.11 Allocation of Subsidies and Benefits of Public Irrigation Projects in Ecuador, 1989 (millions of sucres, and millions of dollars, 1988 prices[a])

Item		Subsidy	Benefit	Difference (Loss)
Per Hectare(sucres)	S/.	85,915	31,636	54,279
Present INERHI	S/.	6,812.1	2,508.4	4,303.7
(79,289 hectares)	US$	15.6	5.8	9.9
Present Public	S/.	9,901.2	3,645.9	6,255.3
(115,244 hectares)	US$	22.7	8.4	14.3
Under Construction	S/.	9,288.2	3,420.1	5,868.0
(108,109 hectares)	US$	21.3	7.8	13.5
Total (Current &	S/.	19,189.4	7,066.0	12,123.4
Under Construction)	US$	44.0	16.2	27.8
(223,353 hectares)				

Source: Summarized from Section X, and Tables 7.2 and 7.3.

[a] Sucres converted to dollars at the average free market rate for 1988 of S/.436.19 per dollar.

is highly concentrated. Since project benefits are directly proportional to land ownership, this means that benefits from the Pisque project are distributed very unequally with a relatively small number of landowners receiving the bulk of the benefits as a government subsidy. The 53 largest land owners constituted only 5.5 percent of all farmers but owned 45.2 percent of the land amounting to 1,478 hectares or 27.89 hectares each. In contrast, the 1,521 farmers with the smallest holdings were 52.9 percent of all farmers but had only 720 hectares among them (13.7 percent of the land) or an average of .47 hectares. The informal survey of land values indicated an increase in land values in Pisque due to irrigation of S/.200,000 per hectare. If this were the average for Pisque, it amounts to S/.5,578,000 which can be obtained on average by each of the largest farmers when the land is sold.[28] The small farmers each would receive S/.94,000 upon sale of their land or less than two percent of benefits received on average by the largest land owners.

Thus, farmers with large land holdings are the principal beneficiaries of public irrigation projects. The conventional wisdom that such projects benefit primarily small farmers is a myth. Moreover, relatively few farmers utilize public irrigation with only an estimated 64,200 doing so in 1988. Justification of irrigation projects on social grounds (i.e., improving the wellbeing of poor farmers with small holdings) is as poorly founded as the ex ante attempts to rationalize such projects on the basis of economic (efficiency) criteria.

XI. Conclusions and Recommendations

There are several results from this study which indicate that public resources dedicated to irrigation are used very inefficiently. These findings suggest the need for substantial reallocation of these scarce development resources if more rapid agricultural development is to be realized. The major conclusions of the study are summarized and recommendations for more productive public investments are made.

A. Conclusions

1. Irrigation is an important aspect of agriculture, with nearly one in four hectares of cropland under irrigation in 1987. There were 417,959 hectares under irrigation, with 330,000 in private systems and the balance in public systems. INERHI is the most important public agency with 52,004 hectares under irrigation. The next most important are Provincial Councils in Loja and Cotopaxi which irrigate a combined 16,315 hectares.

2. Little is known about private sector irrigation. The area irrigated by private systems is an estimate that is widely accepted but with little data to confirm it. Private users have organized themselves into water users' associations. Visits to private systems indicate they are much less capital intensive and more carefully managed than public systems. Such visits also indicate higher levels of efficiency in on-farm applications of water and in yields than on farms using public irrigation water. Private investments in irrigation infrastructure are likely profitable, because the area under private irrigation has grown over time. These observations are proffered as hypotheses because detailed, comparative analyses are not available.

3. Projects under construction, and design or serious study would nearly double the irrigated area from 417,959 to 820,376 hectares if they were fully implemented. Projects under construction would add another 108,109 hectares and projects under design or serious study would add another 294,308 hectares. The share of the private sector in the total would decline from around 80 percent to about 40 percent. INERHI would continue to be the dominant public agency in terms of area under irrigation both with respect to projects now under construction and those under design and study.

4. Expansion of the area under irrigation is not likely to materialize nearly as quickly, nor in the magnitudes planned in project designs and studies. On the basis of past INERHI experience, additional area under irrigation from projects now under construction will be about 40,670 hectares, not the 108,109 hectares planned and this would not be in production until the mid-to-late 1990s. Another 110,718 hectares would be brought into irrigation from projects now under design or study by 2000-2010 not the 294,308 hectares planned. This would add 151,388 hectares to that now irrigated (89,959 public and 330,000 private) for a total of 569,347 hectares, compared to a planned total of 820,376 hectares. If this is the actual experience of these projects, then project benefits will be lower than predicted and economic returns will be much smaller. Private irrigation would comprise nearly 60 percent of the total and INERHI still would be the dominant public sector agency.

5. Public irrigation projects are, on average, not economically viable, with

costs that exceed benefits. While ex ante economic studies exude optimism, ex post facto studies present a more sobering picture of cost overruns and of benefits (increased profits) that are much smaller and later than predicted. Annual benefits are estimated to average about 35 percent of the annual subsidy to irrigation water in INERHI systems and are likely no higher in other public projects.

6. Public irrigation projects are highly subsidized, with farmers paying only about 4 percent of the total costs of irrigation water, on average. The balance of the costs are a government subsidy that is estimated at US$23.3 million per year in 1988. Farmers receive about US$8.6 million of the subsidy annually in the form of increased profits (project benefits) from irrigation. The balance of US$14.7 million is wasted in sunk costs of unproductive and unsalable irrigation infrastructure. Profits (project benefits) would have to increase by the amount of the lost subsidy (US$14.7 million) before projects become, on average, socially profitable. And if the increased profits were substantially later than the investments in infrastructure, the projects still could be uneconomic.

7. Financing of public, multipurpose irrigation projects comprises a significant part of the foreign public debt. The value of foreign financing of projects now in operation and under construction is estimated to be US$1.1 billion. This is 11.6 percent of the public foreign debt and imposes a substantial burden on the economy, especially in terms of balance of payments and inflationary pressures. When projects currently under design and study are financed the debt share will increase to 20.0 percent. The negative impact of these debts is magnified because the investments are so unproductive. They represent a continued drain on the economy rather than contributing significantly to economic growth and development. The government will have to pay the relatively large irrigation subsidy for many years to come with little hope of project benefits ever covering all the cost of providing the water.

8. Benefits from irrigation projects are very unequally distributed, with large landowners receiving disproportionately large shares. Annual project benefits tend to be capitalized into the value of the land and accrue to the original owner of the land when it is sold. Thus, project benefits are proportional to the size of land holdings of the original owners. Small farmers with less than one hectare who account for nearly 60 percent of all farmers would receive only 13 percent of the US$8.6 million of increased profits in 1988 or US$31 each (assuming the distribution of land holdings in the Pisque irrigation project in 1982 is representative of the country). In contrast, large landowners comprising 6 percent of all farmers would receive 41 percent of the increased profits, or US$1,096 each.

9. Project benefits are very small and later than expected because of very low levels of efficiency in on-farm applications of water. Levels of efficiency are so low that the area irrigated is nearly one-third less that installed capacity. Benefits also are less than predicted because the installed capacity is less than planned. This is a secondary concern, however, since the existing infrastructure is being utilized at much less than capacity.

10. Yields and profits are much lower than expected because of inadequate public investments in technology development and diffusion. Public irrigation agencies have attempted to address the problem of low productivity through machinery pools, subsidized fertilizer, demonstration farms and technical assistance.

These efforts have been very small, disparate and ad hoc in nature. Moreover, they are attempting to address a major deficiency in Ecuadorian agriculture with grossly inadequate and uncoordinated resources. Lack of complementary support in science and technology related to soil, water and plant relationships and in on-farm use of water has seriously constrained the viability of investments in irrigation infrastructure. These investments have been further constrained by the generally unfavorable macroeconomic policy environment which has depressed the price of agricultural products generally and subsidized industry at the expense of agriculture.

11. The national-level functions of planning, administering and regulating: (a) water use; and (b) irrigation, drainage and flood control have been given very limited budget support and leadership. INERHI, which is assigned these functions by law, has concentrated the major share of its resources on its third function, the construction and operation of irrigation systems. INERHI's organization structure subordinates the first two functions to the third. This likely both partially explains and is a result of the allocation of most resources to building and operating irrigation systems.

12. The process and criteria for setting national priorities for investments in irrigation, drainage and flood control systems is highly and increasingly politicized. There is no procedure which requires public irrigation and water projects be approved, in the context of national priorities, before foreign financing can be obtained, although CONADE does review and attempt to coordinate the financing of such projects. Strong regional interests actively promote their pet projects and vie with each other for external funding support. Objective social and economic criteria often are given only limited weight in the process of deciding whether to proceed with a project and feasibility studies generally are deficient.

13. There is an increase in the degree of inter-regional competition among the principal irrigation agencies. This is manifest in competition for external funding for various projects. It also is apparent in attempts to extend control over more projects. The most recent winner clearly is CEDEGE, which has obtained external credits of nearly US$750 million for its Daule-Peripa and Santa Elena projects and which recently was assigned responsibility for two important projects previously under INERHI jurisdiction. CRM and PREDESUR also have been successful in obtaining relatively large levels of external funding. Tensions in INERHI are heightened and employee morale is low as some view these events as precursors of greater "losses." Also INERHI has been unsuccessful, to date, in obtaining financing for its Tabacundo project.

B. Recommendations

1. Declare a moratorium on all new irrigation projects. Public investments in irrigation are much less socially and economically viable than has been predicted. Serious consideration should be given to declaring a moratorium on all new projects under design and study pending a careful review and analysis. This analysis should set priorities for all future investments in irrigation. It also should establish a uniform process, to which all irrigation agencies would be subject, for deciding which projects would be advanced to design stage and financed after the moratorium was lifted. Projects under construction also should be reviewed to determine how they could be more sharply focused. Only those components with

demonstrated high pay-offs should be continued.

2. Resources should be focused on improving the efficiency of existing irrigation systems. Public irrigation agencies should focus and concentrate their limited budgets on increasing the efficiency of water use both on the farm and at the system level. They should work closely with research and extension agencies to enhance the utilization of higher-yielding varieties and complementary inputs.

3. Significant resources should be allocated to technology generation and transfer for irrigated agriculture. INIAP, FUNDAGRO, PROTECA and the national production programs should work closely with the public irrigation agencies to develop, adapt and disseminate improved technologies focused on soil-plant-water relationships. Productivity must be raised in irrigated agriculture, which affects one in four hectares of cropland. Investments in public irrigation projects will become more profitable as yields increase.

4. A clear division of labor should be implemented between public irrigation agencies and technology transfer institutions and duplication of effort eliminated. Public irrigation agencies should focus on the technical aspects of irrigation systems and on-farm water management. Research and extension agencies should focus on soil-water-plant relationships and on increasing agricultural productivity. The agricultural development component of public irrigation agencies (demonstration farms, machinery pools, subsidized fertilizer and propagation and sale of plants and animals) should be transferred to the appropriate agencies such as INIAP and MAG.

5. The water tariff must be increased as productivity rises and project benefits increase. It seems abundantly clear that Ecuador can not afford to continue to subsidize irrigation water. The 1972 Water Law, which was passed in the euphoria of the oil boom, needs to be changed and the costs of irrigation water shifted substantially to the private users of the resource. The government should carefully reconsider the advisability of maintaining property rights for water as a public good. Changes in the water tariff must be done carefully, however, since large, wholesale increases will tend to decapitalize second and later owners of irrigated land. Increases in the tariff must be closely correlated with increases in productivity. Unfortunately, the current benefits of irrigation appear to be much lower than the costs, on average, so that some part of the investments in infrastructure are being lost. Unless productivity is increased substantially, it will be impossible to pass on all the costs to private users through increased tariffs, who will stop irrigating before they suffer losses.

6. Management of public irrigation projects needs to be turned over to water users' associations, with the State involved primarily in maintaining complex structures. When users have the responsibility to manage the system, they will tend to minimize the costs of operation and routine maintenance. There appears to be a substantial waste of resources by public agencies which are too heavily involved too far down the irrigation system.

7. INERHI should provide increased support to improvement of private irrigation systems, especially maintenance of the primary and secondary canals and water diversion structures. INERHI has the expertise and experience to provide such services, which should be done on a cost basis. The private sector should

make investments in necessary infrastructure with technical assistance from INHERHI.

8. Make INERHI's national-level functions of planning, administration and regulation of: (a) water resources; and (b) irrigation, drainage and flood control autonomous from its dominant function of construction and operation of irrigation systems. These extremely important functions are subordinate administratively to the function of construction and operation of irrigations systems and both have received a disproportionately small budget. These two functions are very important and should be carried out independently from the operation and construction of irrigation systems, with substantially increased budget support. One approach would be to create a new independent water and irrigation board. INERHI would continue with construction and operation of irrigation, drainage and flood control systems and would have the same status as other public irrigation agencies. All entities which construct and operate irrigation, drainage and flood control systems would be subject to the norms and standards set by the proposed national-level water and irrigation board.

9. A uniform and streamlined process for review and approval of all new irrigation projects should be developed by the proposed national-level water use and irrigation board. This process should specify the various steps for approval (project identification, feasibility studies, design, financing and construction). It should specify the criteria for project identification and the review and approval procedures at each step of the process. The national water use and irrigation board should have authority to approve all projects and access to national and foreign financing and credits.

10. Investments to raise the productivity of rainfed agriculture also should be increased substantially. Rainfed crop and pasture lands comprise more area than irrigated land. Productivity on rainfed lands also is very low and more modern technologies can have a major impact on increasing agricultural production and incomes of farm families. Public investments to raise productivity of rainfed and irrigated agriculture are far more likely to meet the future food needs of Ecuador's rapidly growing population, than continued investments in irrigation infrastructure. Ecuador has substantially overinvested in irrigation infrastructure while substantially underinvesting in technology generation and transfer for rainfed agriculture.

NOTES

1. See Chapter 4 for a detailed description of land use and the eight principal agro-ecologic zones.

2. There are several studies which provide much more detail on the legal and institutional aspects of Ecuador's irrigation sector, and that are a partial basis for information provided in this Section. See Cruz, Orquera and Salazar; Orquera; Cox, Cox and Tolosa; and Keller, et al.

3. This anomaly has been noted in other studies. See Orquera; Cox, Cox and Tolosa pp. 24; and Louis Berger International and PROTECVIA Ltd.

4. The same problem affects all of the public agencies serving agriculture. See Chapter 12 for the case of INIAP, Ecuador's public research agency.

5. Average cropland was 1,545,588 hectares during 1980-1985 (Chapter 6 Table 6.5). Part of irrigated land is in improved pastures which are not included in cropland. Data on irrigated pasture lands are not available but such lands are a small proportion of total pastures. If irrigated pastures were 25 percent of all irrigated land, then the share of irrigated land in the total of cropland and irrigated pastures would fall from 27 to 25 percent.

6. According to Anderson (p. 80) there were 250 water user's associations in the Sierra and 1 in the Costa in 1973.

7. It is highly probable that the discussion which follows about INERHI also applies to the other principal irrigation agencies. Unfortunately data are not available for a similar analysis.

8. Care must be exercised in interpretation of public sector data. Data on command area, irrigable area and area irrigated in 1987 were available only for INERHI, CEDEGE and CRM. Data for the other entities were taken from secondary sources and were purported to measure irrigated area. To the extent that these data measure command or irrigable areas and the area actually irrigated was less, the area irrigated in 1987 is overestimated.

9. See Marshall & Associates for a description of the Daule-Peripa project.

10. Design work has been completed as of 1990 for the 33,000 hectares but financing has not yet been secured.

11. The Santa Elena project is closely related to the Daule-Peripa project and is sometimes referred to as if it were part of the Daule-Peripa project. It is, however, a separate project. See CEDEGE/CEDEX.

12. Unpublished data provided by INERHI, Directorate of Planning on a computer print-out, in possession of the authors.

13. This assumes all the planned command areas of projects under construction and in design or study are irrigated and that the area under irrigation in existing public and private systems continues to be irrigated.

14. These estimates are based on INERHI data on the annual value of investments in infrastructure in current prices. INERHI maintains annual data for all its projects since 1966 and the total amount for each project since its inception. The difference between the sum of the annual amounts since 1966 and the total since inception is the sum in current prices of all investments for projects that began prior to 1966. The annual values were converted to constant 1988 Sucres using the Consumer Price Index. The sum of investments prior to 1966 was assumed to have been incurred in 1965. To the extent investments occurred before 1965, the constant value in 1988 prices is underestimated. The dollar value is calculated at the average free market exchange rate for 1988 of S/.436.19 (BCE 1990, p. 46).

15. The average cost of INERHI infrastructure per irrigable hectare (S/.949,855) is multiplied by the number of irrigable hectares in other public irrigation systems of 35,955 hectares (Table 7.2). The result is S/.34,152.0 millions or US$78.3 million.

16. The degree of completion in Table 7.6 (share of accumulated cost in total cost both in current prices) is used to estimate the total cost in 1988 prices of completing the project.

17. For example, INERHI has an additional 36 such projects on its "wish list." These projects would cost another S/.38,357.2 million or US$87.9 million (at the 1988 average free market exchange rate of S/.436.19/US$) according to unpublished INERHI data. All are at the prefeasibility stages of study.

18. This assumes: 50 percent of operating projects have been repaid and 80 percent of the balance is financed abroad, 90 percent of projects under construction are financed abroad, and 90 percent of the projects under design and study will be financed abroad.

19. Charging the average tariff to all water users in surface systems means tha more efficient irrigation systems and water users subsidize the less efficient.

20. The 1989 tariff estimated here is based on the sum of all past investments through December 1988, including those incurred prior to 1966, in the 35 operational irrigation systems considered in this analysis, all in current prices in accordance with current INERHI practice. INERHI does not adjust the value of total investments for inflation when calculating the basic tariff, although doing so has been analyzed by the staff and considered by the Board of Directors during the last two years.

21. The total costs of infrastructure are presented in constant 1988 prices to account for the opportunity costs of investment in irrigation infrastructure. Amortizing the value of past investments in 1988 prices accounts explicitly for the costs society must bear for having invested in irrigation infrastructure. The Consumer Price Index on a 1988 base is used to deflate the current investment in each year. The value of irrigation infrastructure in 1988 likely is underestimated because all investments prior to 1966 are assumed to have been made in 1965 (see Endnote No. 14).

22. The estimate of an annual average subsidy of S/.1,861.1 millions is calculated as follows. First, the costs of studies and construction (S/.4,517.5) and operations and maintenance (S/.184.2 millions) are subtracted from total costs since these are

accounted for in the basic and volumetric tariffs. Then the costs of water management (S/.230.8 millions) and irrigation management (S/.9.4 millions) which are nationwide functions not related to INERHI's irrigation systems, are subtracted from the undistributed balance of S/.2,370.5 millions. Finally, the costs of central management and institutional planning associated with the functions of water management, irrigation management and construction are subtracted from the balance of S/.2,316.5 millions. These costs were estimated at S/.455.4 millions, in proportion to the importance of water management, irrigation management, and construction (65 percent) in total costs. The balance of S/.1,861.1 millions is the part of INERHI's budget that is allocable to operations and maintenance of irrigation systems but not accounted for in the volumetric tariff (see Table 7.1, Appendix Tables 7.1 and 7.2).

23. From an unpublished table, "Estudios de Proyectos de Riego," prepared by the Sección Agro-Socio-Economía of INERHI in possession of the Authors.

24. Original owners are also decapitalized from an increase in the water tariff because the value of their land also falls. Thus, they will suffer a loss in terms of foregone income when the land is sold. But original owners paid a much lower price for the land before the value of irrigation benefits were capitalized into it so they suffer a "paper" loss. Second owners suffer an direct loss since they paid more for the land than it is worth after the increase in the tariff.

25. This conclusion needs to be qualified to accommodate the timing of costs and benefits. A positive net benefit stream at some point in the life of the project is a necessary but not a sufficient condition for an economically viable project. Annual benefits may eventually exceed the annual costs of amortizing the capital investments and paying for operations and maintenance. However, if capital costs are realized primarily in the initial years of the project and project benefits do not begin in a substantial way until several years later, the internal rate of return still may be negative.

26. Note that if a higher interest rate is utilized, the size of the subsidy increases, as does the annual flow of project benefits. The relationship between them remains basically the same, however.

27. The increased value of land is estimated as the present value of the annual benefit streams, amortized over 40 years at 6 percent interest (to be consistent with parameters used throughout this analysis) multiplied by the amount of irrigable land in operational projects.

28. The amount of S/.200,000 is the increase in the value of irrigated land in the area of the Pisque project beyond the influence of the Quito urban area.

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CHAPTER

THE AGRICULTURAL MARKETING SYSTEM

DAVID TSCHIRLEY AND HAROLD RILEY

I. Introduction

The Ecuadorian agricultural marketing system presents a complex set of problems reflecting several basic conditions including the geographic and related agricultural diversity of the country, the export orientation of a major portion of the agricultural sector and the relatively weak infrastructure and institutional support for marketing.

During the past two decades this system has been under substantial pressures associated with rapid urbanization, continued high rates of population growth and a surge in per capita income during the oil boom of the 1970s, followed by a persistent economic recession in the 1980s as oil revenues dropped sharply. The development of national highway and communication networks has supported the growth of a more geographically coordinated marketing system allowing greater regional and farm level specialization in agricultural production. However, the forces of technological and socioeconomic change continue to create opportunities for more efficient, innovative methods of arranging transactions, transporting, storing, processing and distributing agricultural products and delivering farm inputs. Such progress will be critical as the importance of marketing activities continues to increase in relation to farm level production.

The government's principal efforts in agricultural marketing have been to regulate prices and to intervene directly in the purchase, storage and sale of selected basic commodities as a means of supporting farm-level prices while subsidizing retail prices. Parastatals have been formed to encourage the development of a more extensive and efficient agricultural input distribution system. These interventions have been costly to the government and in some instances have served as disincentives to producers and private sector marketing firms. The public sector has provided little direct support to private sector

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marketing agents through credit, information systems, research, technical assistance and training. This serious lack of public sector support stems in large measure from a deeply ingrained bias against private marketing agents, resulting in continued efforts to replace them or strictly control their activities. Such efforts have introduced very significant distortions and inefficiencies into the system.

This chapter first presents a conceptual framework for the analysis of agricultural marketing systems and reviews the changing environment within which agricultural marketing takes place. It then presents a descriptive and diagnostic assessment of the organization and performance of the major commodity and input marketing subsystems. The chapter concludes with an agenda for market system development, focusing on subsidies, price policy, strategic public and private sector investments, market regulations and public sector marketing support services.

II. An Overview

A serious assessment of the Ecuadorian agricultural marketing system should recognize that private enterprises are and will likely continue to be the primary providers of marketing services. Thus, a major policy issue concerns the appropriate role of the public sector in regulating and promoting development within this fundamentally entrepreneurial system.

A Conceptual Perspective

The current problems within the Ecuadorian food system are similar to those in many other countries, especially in Latin America. For this reason the extensive research and technical assistance experience of Michigan State University has been drawn upon by the authors in carrying out this study in Ecuador (Harrison, et al. 1974; Riley, et al. 1970, 1989; Weber, et al.). The conceptual approach places emphasis on the role of dynamic market processes, within the context of "scientific industrialization" of the food and agricultural system (Shaffer 1968). Scientific industrialization involves the creation and adoption of new technologies and new institutional arrangements that lead to greater specialization of labor, increased labor productivity and shifting employment of labor from farm-level production to nonfarm activities, often in small-scale agricultural processing and service functions. Over time, there is substantial migration to towns and cities, shifting patterns of food consumption and a rapid increase in the demand for marketing services. The principal changes in food consumption patterns include a relatively rapid increase in the demand for livestock products, fruits and vegetables and processed foods and decreasing demand for basic grains and starchy tubers.[1] The pattern of change proceeds more rapidly when there are significant and sustained increases in per capita income and this is not likely to occur unless there is a reasonable degree of political and economic stability.

The rapid growth of large urban centers and the general trend to urbanization has been a dominant force in the transformation of Latin American food systems and Ecuado is no exception. Large public and private sector investments are required to expand transport, storage, processing, wholesaling and retailing facilities as urban populations overtake and exceed those in rural areas. Insufficient investment in these facilities can seriously impede the transition from a traditional subsistence agricultural economy to a dynamic, market-oriented one.

The concept of a "food system" provides a framework for describing the changing organization of the marketing system, diagnosing problems and formulating strategies for public and private actions to improve system performance. As shown in Figure 8.1, a food system includes all of the steps of productive activity required to move food from the initial producer to the final consumer. This process includes international as well as domestic markets and marketing agents. Also included are policy and regulatory elements and the

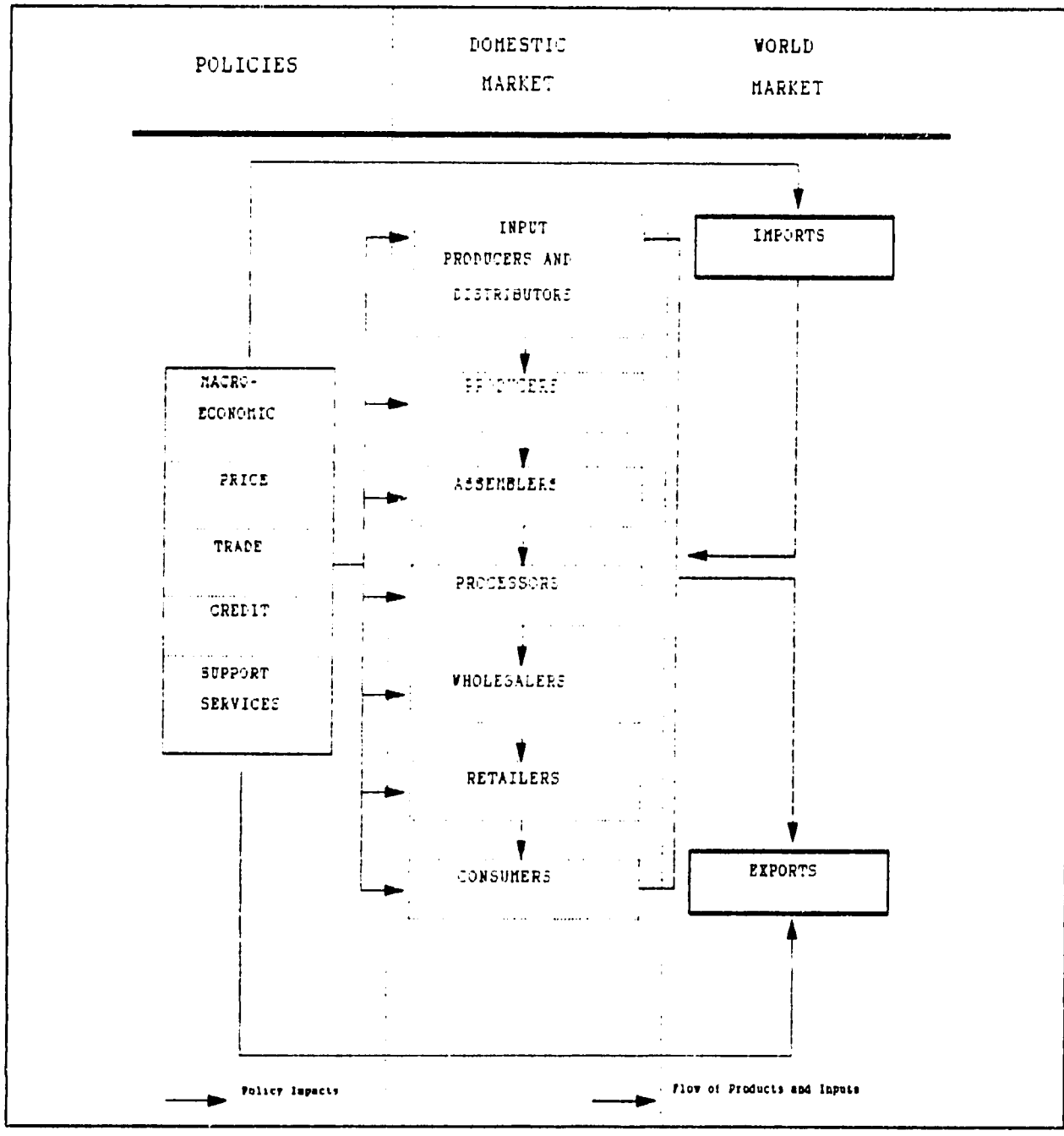

Figure 8.1 Principal Components of a Food System

supporting institutions providing credit, education, research and information. The coordination of these functional activities is achieved largely through market forces, though government intervention can and does have significant impacts on the coordination process.

The advantage of viewing marketing activities as they relate to one another in a food system context is that one is better able to identify constraints and possible opportunities for improving overall system performance. Rather than viewing individual system components in isolation, specific attention is focused on the interdependencies among the sequential steps in the production-distribution process and the dynamic interactions that will occur in response to changes in policies, institutional arrangements and technology.

For diagnostic and prescriptive purposes it is useful to divide the food system into commodity subsystems since each commodity group has unique characteristics that must be accommodated in the marketing process. From a policy perspective the desired attributes of such a subsystem can be described as follows:

a. The matching of supply and demand over space, form and time at each stage in the production-distribution system;

b. Efficiency in the physical transformation, handling and delivery of commodities, as well as in arranging and carrying out transactions;

c. Progressiveness in developing new products and in adopting more productive technologies, management methods and institutional arrangements; and

d. Equity in returns to subsector participants in relation to value added to the final product and costs and risks incurred. Equity also requires widespread access to markets, information and support services, including credit.

There are potential conflicts among these performance goals which must be taken into consideration in designing new policies and programs. For example, equity goals may sometimes conflict with those of progressiveness and efficiency. One of the challenges for marketing analysts is to clarify the trade-offs among goals, so that policy makers can make more informed choices.

Changing Demands for Food and Marketing Services

During the development process, demand for food changes both quantitatively and qualitatively. The principal causes of this changing demand are increasing population and increasing consumer income.

Demographic Trends

Growth in Ecuador's population and rapid urbanization have had significant impacts on the demand for food and marketing services. The total population increased from 4.7 million to 10.2 million between 1962 and 1988 and is projected to reach almost 14 million by the year 2000. Fifty-five percent of the population now resides in urban areas compared with 41 percent as recently as 1974 and 28 percent in 1950 (see Chapter 5 for additional detail about population).

As a consequence of population growth, the demand for food at the national

level has probably increased by nearly 3 percent per year during the past two decades. However, demand for marketing services will have increased at a significantly higher rate reflecting the additional logistical costs of bringing food to families that migrated to the cities.

Consumer Income

Real per capita income grew at an average annual rate of more than 5 percent during the decade of the 1970s. This income growth likely increased per capita demand for basic foodstuffs by approximately 3 percent per year, assuming an income elasticity of demand for food of 0.6. However, rising incomes probably caused per capita retail food expenditures to increase by more than 3 percent annually, since the income elasticity of demand for marketing services has been shown to be much higher than the elasticity of demand for basic foodstuffs.

When the income-induced increase in per capita demand for food and services at retail is combined with the increased demand due to population growth and urbanization, it seems reasonable to conclude that total retail demand for food increased by an average of seven or more percent per year during the decade of the 1970s. This very rapid growth in consumer demand changed dramatically with the onset of the economic crisis during the 1980s. As a result, aggregate per capita demand for food has probably increased very little and may have decreased for lower income groups during the 1980s.

In 1986 urban households spent nearly one half of their total food budget for cereal and livestock products (Table 8.1). Over the past two decades the percent

Table 8.1 Percent of Food Expenditure by Food Groups, Urban Households, Ecuador, 1986

Food Group	Expenditure (%)
Cereals and Derivatives	13.2
Meat and Preparations	18.2
Fish and Seafood	5.2
Milk, Milk Products, and Eggs	14.1
Fats and Oils	4.0
Fresh Vegetables	7.6
Tubers and Derivatives	4.4
Legumes	7.1
Fresh Fruits	5.5
Processed Fruits and Vegetables	0.7
Sugar, Salt, and Condiments	3.9
Coffee, Tea, and Soft Drinks	3.7
Misc. Processed Foods and Beverages	8.6
Food and Bev. Consumed Outside the Home	3.7
	100.0

Source: CEDATOS.

of expenditures going to tubers and cereal products has declined while percentages going to milk and poultry products, fish and seafood and fresh vegetables have increased significantly.

The proportion of total 1986 urban household income spent for food varied from 49 percent for the one-third of the households with the lowest incomes to 33 percent for households with highest incomes. This reflects the wide disparity in household incomes that continues to exist in Ecuador (Table 8.2).

The situation of the poorest third of households has become more precarious since 1986. A recession which began in the early 1980s caused a decline in real per capita GDP in 1982-83 and continued economic stagnation into the late 1980s (Scobie and Jardine 1988a). The economic situation worsened significantly during 1988 and 1989. Though survey data indicates that average protein and caloric intake of the lower income group has not changed significantly since 1986, food and beverage expenditures as a proportion of total expenditures has increased sharply. From 1986 to 1989, this proportion rose in urban areas from 49 percent to nearly 64 percent. In the rural areas near Quito and Guayaquil, the figures for 1989 are 70 percent and 76 percent, respectively (CEDATOS). Any further decrease in these households' purchasing power could soon begin to compromise their nutritional status.

Table 8.2 Income Distribution Among Urban Households, Ecuador, 1986-1987

Monthly Household Income (sucres)	Percent of Households	Percent of Total Income
< 20,000	56.0	23.2
20,000-40,000	28.7	32.3
40,001-100,000	12.8	27.8
> 100,000	2.4	16.6
	100.0	100.0

Source: CEDATOS Urban Household Survey, 1986-1987.

Finally, this grouping of households does not reflect the situation of the poorest segment of Ecuadorian society. Nelson estimates the cost of a minimally adequate "least-cost" diet of rice, sugar and oil for a family of five at S/. 31,400. This cost is slightly greater than the minimum wage and certainly underestimates the cost of actual diets consumed even by the very poor. Nelson concludes that unemployed or marginally employed persons, or low-income families with more than three children would not be able to afford even this minimal diet. Targeted interventions to redress this situation will probably be necessary for some time to come (see Section VIII, Chapter 14).

The Evolving System of Food Marketing

To respond to the changing demands for food and marketing services and to accomodate the changing patterns and increasing volume of agricultural production,

the agricultural marketing system must evolve over time. Regional markets must move toward greater integration and the entire system of infrastructure and institutions that moves food and food products from the farm to final consumers must expand and adapt to these changing conditions.

Geographic Perspective

Mainland Ecuador consists of three distinct geographic regions, the Costa, Sierra and Oriente, that are being drawn into a more integrated national agricultural marketing system. The nature and characteristics of agricultural production in these regions are described in Chapter 6.

The wide range of soil, water and temperature conditions in Ecuador provides opportunities for the production and consumption of a large variety of products (see Chapter 4). This creates the possibility of organizing the production and delivery of perishable products over most of the year, thus reducing seasonal supply fluctuations and the need for processing and storage activities. But to achieve this potential requires increasingly better informed and technically progressive enterprise managers in the private sector.

The two largest cities, Quito and Guayaquil, are the dominant trading centers that link the two principal regional market areas into a growing national agricultural marketing network. Secondary cities that play important roles in the Sierra are Loja, Cuenca, Riobamba, Ambato, Latacunga and Ibarra. In the Costa, the major secondary market cities include Machala, Manta, Esmeraldas, Portoviejo, Milagro, Daule and Quevedo. Santo Domingo is an important market city located between the two regional networks. Finally, numerous rural assembly centers exist throughout the country. Farm production generally moves first to these rural assembly points. Assemblers then either sell directly to processors (e.g., hard corn to feed manufacturers and soybeans to oilseed crushers) or to wholesalers who move the product to the primary and secondary cities for consumption, or to the secondary cities for transhipment to Quito and Guayaquil.

All-weather highways connect the primary and secondary cities but flooding in the Costa and landslides in the Sierra often create traffic interruptions. The lack of good secondary and farm-to-market roads in rural areas, especially in the Costa, is widely cited as a major transportation problem which contributes to high marketing costs and the inability of many farmers to move products to market during the rainy season. These transportation problems will likely persist for a considerable period of time due to the relatively high cost of constructing and maintaining roads under Ecuadorian conditions. Hence, the development and maintenance of an improved road and highway network should be a high priority in any comprehensive market development program.

Urban Food Distribution

Most food reaches urban consumers through many very small retailers. Within each urban center there are one or more municipal market facilities in which the municipality makes small stalls available to retailers at subsidized rental rates. As urban populations have grown, food retail and wholesale activities have spread into buildings and streets surrounding the municipal markets, creating traffic congestion and product handling difficulties. Concurrently, retailers have established small food stores in various locations within the expanding residential areas. The heavy influx of rural migrants, the lack of employment opportunities and the ease of entry into some form of food retailing contributes to the small-

scale, extremely fragmented system of retail food distribution.

Modern, self-service supermarkets have successfully entered the Quito and Guayaquil markets but as yet handle only a modest percentage of total retail food sales. According to management of the largest chain, Supermaxi, their national market share of retail rice sales is only 2.0 percent to 2.5 percent, while chicken meat is nearly 7 percent. Shares in Quito, their major center of operations, would be significantly higher. Supermaxi has its own wholesale warehouse in Quito, from which it supplies its branch stores with nearly all their product line. It also has a special facility for receiving, cleaning and packaging fresh fruits and vegetables and is vertically integrated to the production level in milk, beef and chicken. The firm currently has 10 stores in Quito, three in Guayaquil and one each in Ambato and Cuenca. It plans to add three to four new stores during 1990, including two in new cities. Although these initiatives do not directly and immediately have a major impact on the retailing of food in low income areas, they will make a long-term contribution to the development of a larger-scale, more technically efficient system of urban food distribution and a related food processing industry. They also contribute to the training of an expanding number of store employees who can undertake new wholesale-retail enterprises. This process should eventually reduce the cost and improve the variety and quality of food products reaching urban consumers. Prices of basic foodstuffs in modern supermarkets are already consistently below those in the large "popular markets" and neighborhood stores frequented by low income consumers (Table 8.3).

Table 8.3 Average Prices of Basic Foodstuffs in Supermarkets, "Popular Markets' and Neighborhood Stores, Quito, 1989

Food	Type of Store		
	Supermarket	"Popular Market"	Neighborhood Store
Rice	125	133	142
Sugar	78	78	89
Oil	500	500	511
Soft Corn	250	255	268

Source: Weekly Price and Market News Bulletin, Marketing Subsecretariat, Ministry of Agriculture.

A modern wholesale market facility was built on the outskirts of Quito in 1980. The project was initiated by the municipality with financial assistance from the Inter-American Development Bank. The cost of this facility, exclusive of land, was S/.140 million (US$5.6 million at the time). The land and buildings are the property of the municipality but the market is operated by a mixed enterprise composed of 30 shareholders, including the provincial chamber of agriculture, the local association of wholesale grocers, two producer cooperatives and a supermarket firm. This new market has become established as a wholesale center for rice, food legumes, dry groceries, potatoes and eggs but has not yet attracted a high volume of fresh fruits and vegetables. These perishable products are still moving directly to traditional municipal markets within the city.

The need for more modern and efficient food wholesaling facilities in the larger cities continues to be assessed by municipal and national planning units. Feasibility studies have been made for improved marketing facilities in Guayaquil and Cuenca. Additional studies should be undertaken as part of a comprehensive market development program. The potential for introducing retailer cooperatives and voluntary wholesale-retail groups should be considered as a new dimension in urban food systems.

Rural Markets

Rural periodic markets continue to be important institutional arrangements for organizing the purchase and sale of agricultural products and the distribution of farm inputs and consumer goods (Bromley 1981). Municipalities provide space, rudimentary facilities and the supervision of market activities. The market day has great social, religious and political as well as commercial significance in the life of the community. With the improvement of transportation and communication services, these markets are increasingly drawn into the regional and national market network. This broadens the variety of products available in local markets and creates additional potential competition among buyers of surplus agricultural commodities that can be transhipped to other markets.

As rural trading centers grow, there is often increased interest in improved market facilities and services. This provides an opportunity for public sector assistance in planning investments and institutional arrangements which could increase the efficiency and effectiveness of rural markets (Weber).

ENPROVIT

The National Company for Basic Products (ENPROVIT) is a government-owned enterprise created in 1971 and attached to the Ministry of Agriculture (MAG). Its mandated function is to regulate prices of basic commodities so as to benefit low income consumers.

During the period 1980-85, ENPROVIT operated 250-275 retail outlets, including 30 "supermarkets." These outlets were located throughout the country but the bulk of the sales took place in the major cities. The main products handled have been rice, pastas, powdered milk, oatmeal, sugar, salt and a few household items and processed foods. However, the supermarkets carried a wider range of food and non-food products. The basic foodstuffs have been sold at official prices and at margins considerably below actual operating costs. The ENPROVIT supermarkets charged higher margins for products not subject to price controls in an attempt to cover the costs of handling low-margin, basic commodities. Nevertheless, ENPROVIT continued to register persistent and sizeable financial

losses even though it had access to subsidized credit.

During the period 1985-88 the political leaders in the Government of Ecuador (GOE) attempted to scale down the ENPROVIT operations as part of a general effort to reduce direct government intervention in the food system. ENPROVIT's share of total retail food sales declined from about 5 percent in the mid-1980s to no more than one percent by 1988. However, operating costs were not reduced proportionally since most of the employees were protected by labor contracts that could not be terminated except at very high cost.

Since the change in government in 1988, the Office of the President has made a major effort to reactivate ENPROVIT and substantially expand the scope of its operations. In addition to their 220 currently existing retail outlets there were three new initiatives during 1989 in an attempt to bring lower-cost food to households adversely affected by the high rates of inflation. The new initiatives included:

1. Free Markets (*Ferias Libres*) These are weekly street markets held in low-income neighborhoods. Farmers bring produce for direct sale to consumers but specialized traders appear to have captured a very large share of the sales volume in these markets. ENPROVIT also assembles and offers products for sale at official prices. There were 33 such markets operating in 24 cities in the fall of 1989. While they have succeeded in reaching some poor households, total volume remains very low. Too, patrons have registered many complaints regarding poor sanitary conditions;

2. Tent Markets (*Carpas Barriales*) These were operated five days a week by ENPROVIT in 40 low-income neighborhoods located in the five largest cities during late 1989. Three different-sized baskets of food products were being sold at fixed prices. The baskets included an assortment of fruits, vegetables and meats, as well as processed basic food items; and

3. Contract Stores (*Tiendas Dirigidas*) These are retail stores operated by consumer groups that agree to buy basic products from ENPROVIT and sell them at fixed prices.

Over the past decade most outside marketing experts have viewed ENPROVIT as a relatively high-cost and ineffective mechanism for the distribution of food and basic consumer goods. Recent efforts to expand and improve its operations have not significantly changed this situation. Recommendations have ranged from closing it down to converting it into a strictly wholesaling operation. Given the Ecuadorian political-economic environment, it is likely to continue operations in some form as a means to demonstrate government concern over food prices and food availability to the poorer segment of the population. However, some critics suggest that the highest priority for food subsidization should be carefully targeted to the poorest segments of the population and the most vulnerable from a nutritional perspective (e.g., pregnant mothers and small children). Such a policy would require active participation by public agencies responsible for health, education and social services.

III. Commodity Marketing Subsystems

The agricultural marketing system in Ecuador has been under severe stress over the past twenty years to adapt to the rapid changes depicted in the previous sections. This section will describe and analyze the organization and performance of the principal commodity marketing subsystems, within the context of this changing economic environment.

Costa Food and Feed Grains

The principal food and feed grains cultivated in the Costa are rice, hard corn and soybeans. Rice is used for human consumption, while by-products of rice milling are used predominantly in the manufacture of poultry and shrimp feed. Soybeans yield oil for human consumption and meal for use in poultry and shrimp feed. Hard corn is used almost entirely in poultry feed. Production trends have been highly positive for each crop. From 1970 to 1988, production of rice and hard corn increased 80 percent and 130 percent, respectively. Soybean production was incipient until 1975 but has increased rapidly since that time (see Chapter 6 for more detail).

Structure of Production and Marketing

All three Costa grains--rice, hard corn and soybeans--share two distinct growing seasons. The rainy season plantings of each crop take place primarily during December and January. The corresponding harvests begin in late April and are largely over by the end of June, though the hard corn harvest is prolonged into early August in some areas.[3] This rainy season harvest accounts, on average, for 80 percent of hard corn production and 60 percent of rice production.[4] Dry season plantings take place primarily during June, with subsequent harvests concentrated in October. This harvest accounts for the vast majority of soybean production.

The three grains show great variety in their structure of production. Hard corn is the most geographically dispersed, the smallest scale in terms of farm size and is served by the poorest transportation infrastructure. Soybean production is the most geographically concentrated and the largest scale and is served by an excellent road system. Rice production lies between these two crops in all three characteristics. Hard corn production takes place dominantly on small and medium-sized farms, relative to rice and soybeans. Fewer than 1 percent of all farms had more than 20 ha of hard corn during the 1987 rainy season harvest. The corresponding figure is nearly 65 percent for soybeans during the 1987 summer harvest and 20 percent for rice during the 1988 winter season harvest (Tschirley 1988a; Ramos 1989a).

Despite the numerical dominance of small and medium-sized hard corn farmers, marketings are clearly dominated by the largest producers.[5] According to Tschirley (1988a) 5 percent of farmers during the 1987 rainy season harvest accounted for 78 percent of all hard corn sales. Nearly 40 percent of all farmers made no sales. Rice production is also quite concentrated. Twenty percent of farmers during 1988 made over three-quarters of all sales. Soybean production, though dominated by large producers, is the least concentrated in marketing. Twenty-four percent of farmers accounted for 70 percent of total sales during the 1987 dry season harvest.

Soybean marketing is the most direct of the three grains, going through an average of 1.3 transactions to reach soybean crushers. During the 1987 dry season harvest, nearly two-thirds of all producer sales were to crushers. Nearly a quarter of these sales were to traders and the remainder were to the National Agricultural Storage and Marketing Company (ENAC) (Tschirley 1988a). Marketing of soybean meal and oil is also quite direct, as indicated by the fact that feed manufacturers purchased 98 percent of their meal directly from crushers in 1987. Also, the largest crushers directly distribute oil under their brand name.

Hard corn goes through an average of 2.2 transactions to reach poultry feed manufacturers. During the 1987 rainy season harvest, nearly 90 percent of the marketed surplus was sold by farmers to rural traders. These traders then sold over one-half of their purchases to feed manufacturers and more than 40 percent to wholesalers (Tschirley 1988a).

Since rice is consumed directly by humans, its marketing requires more transactions than does that of hard corn and soybeans. As shown by Figures 8.2 and 8.3, most rice passes through five marketing agents before reaching its final consumers: an initial sale to rice millers, followed by sales to three levels of wholesalers (national, provincial and urban) and finally a sale to retailers (Ramos 1989a).

Public and Private Sector Participation

As the previous section indicated, the private sector plays the dominant role in the production and marketing of the Costa food and feed grains. Nevertheless, the GOE has significantly influenced these processes through regulation and direct participation. The State has utilized three basic instruments to affect the conduct and performance of rice, hard corn and soybean markets.[6] First, it has controlled imports of all three commodities, as well as those of soybean meal and oil. Second, it has bought and sold in all three markets through ENAC, primarily to defend producer support prices. Finally, price controls enforced by legal sanctions have been periodically applied to defend official consumer prices. Among the basic grains, these latter measures have been applied almost exclusively to rice.

Import Policy Import policy has been based upon complete government control of all imports. This control is expressed both by prohibition of private imports and by strictly enforced quotas when the private sector is permitted to import. In addition to the quotas, MAG and the Ministry of Industry and Commerce (MICIP) must approve each individual importation. Although both private import prohibitions and quotas have been used in all three crops, the former has been most common in rice, while the latter has been more commonly applied to hard corn, soybeans and soybean meal and oil.

Beyond these quantitative controls, import levies or subsidies are applied, in pursuit of two objectives. First, they equalize import and official domestic prices of rice and hard corn. Second, domestic processing of soybeans and unrefined soybean products is encouraged by imposing value-added import taxes of between 70 percent and 80 percent on processed oil and 10 percent on meal. Meanwhile, soybeans and crude soybean oil enter the country tax free (Stewart, Cuesta and Acosta).

Direct State Participation Direct GOE participation in buying and selling of grains is implemented through two marketing parastatals. At the producer level, ENAC purchases rice, hard corn and soybeans from farmers at official support prices, while ENPROVIT sell basic foodstuffs at retail to poorer consumers (ENPROVIT was discussed in an earlier section). ENAC sells a very small proportion

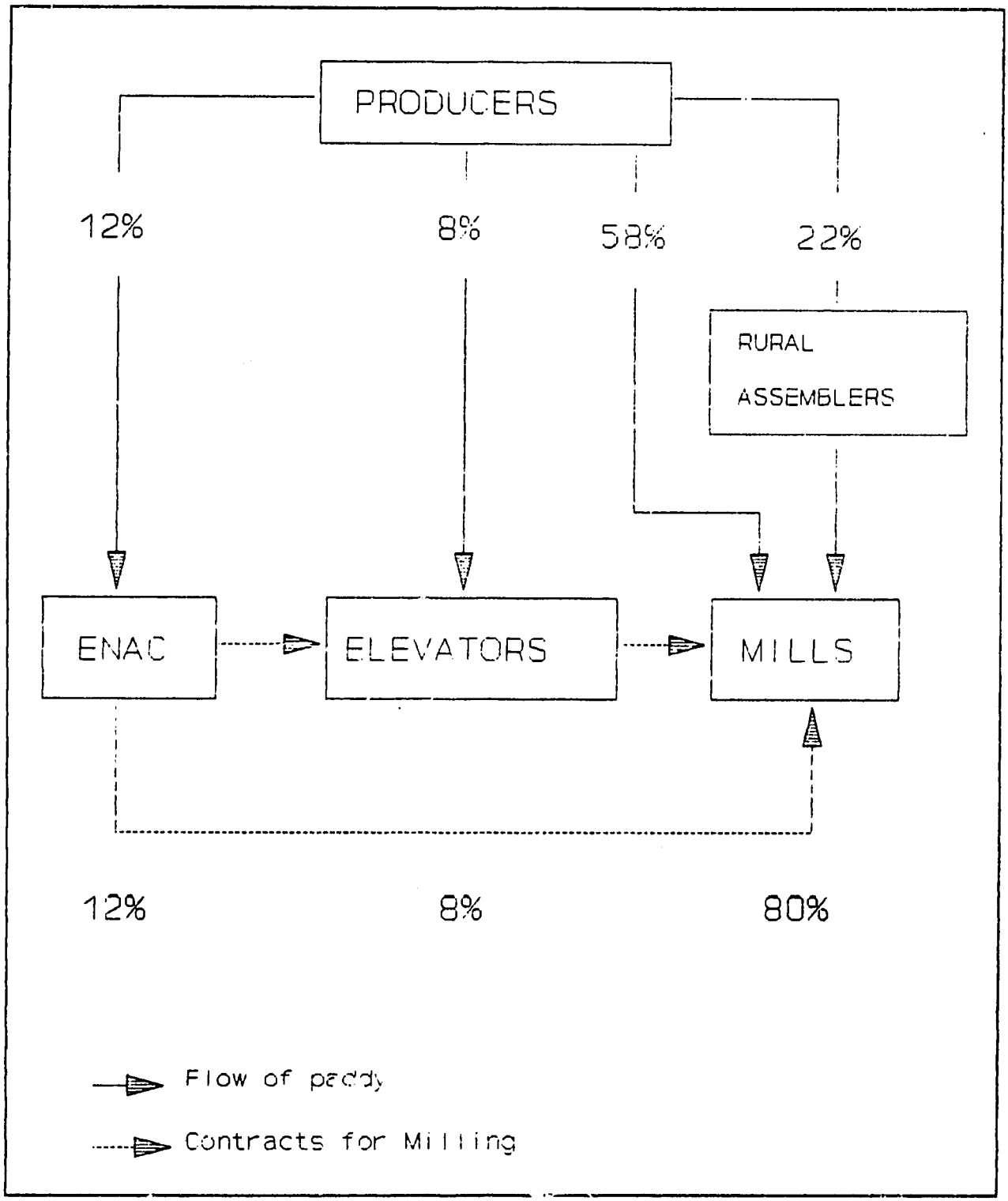

Figure 8.2 Market channels and flows of paddy rice

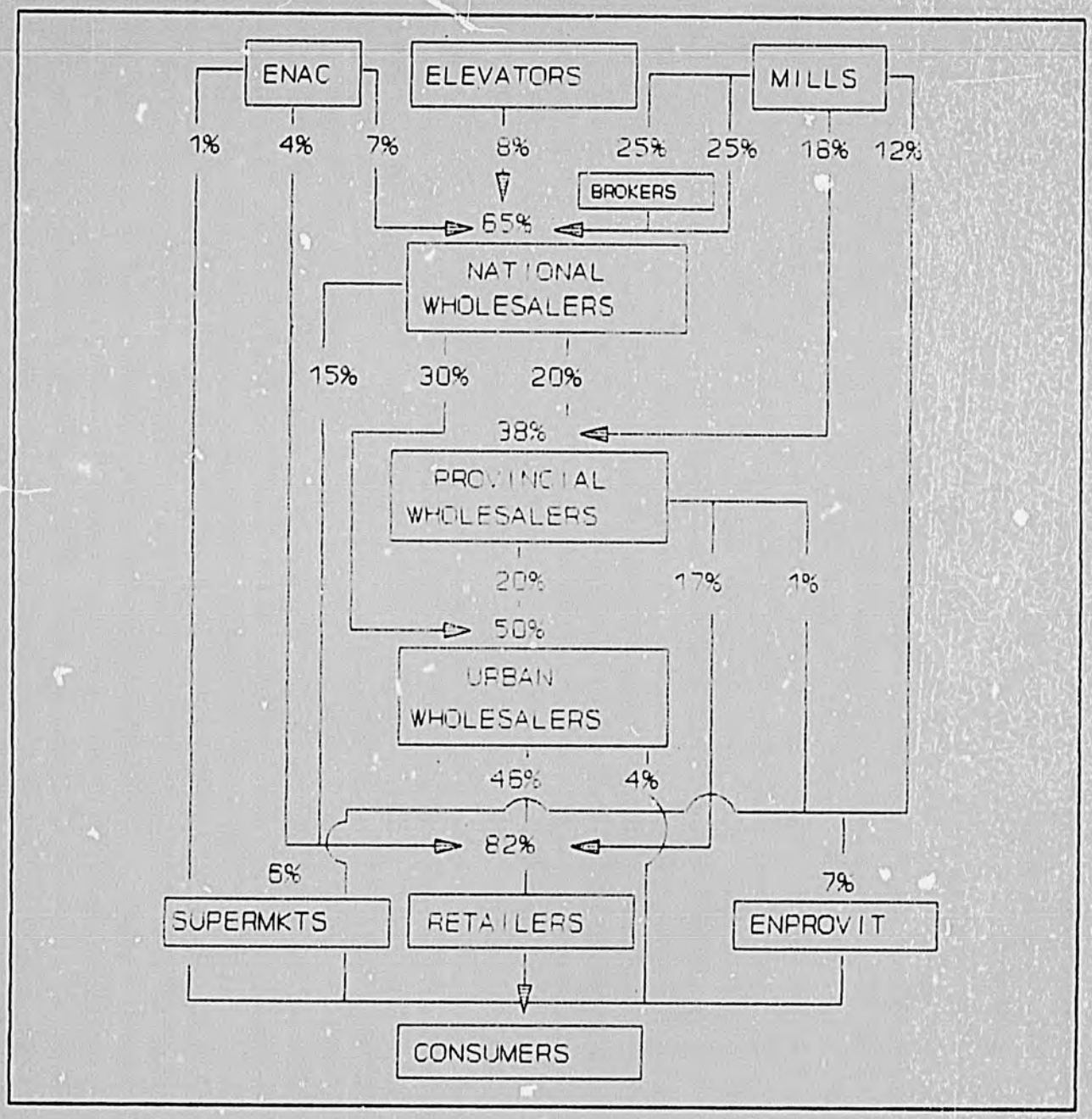

Figure 8.3 Market channels and flows of milled rice

of its rice to ENPROVIT for retail distribution, channelling the largest volume to wholesalers. ENAC sells hard corn and soybeans directly to feed manufacturers or wholesalers (hard corn) and to oilseed processors (soybeans).

Figure 8.4 shows that ENAC purchases of over 20,000 MT in 1989 were insufficient to enforce official hard corn prices. Even in years of larger ENAC purchases, market prices have often been below the official price, sometimes by large margins. This can be attributed in part to the geographical dispersion of production and consumption of this crop, as well as to the inability of ENAC to purchase all it is offered at the official price. In contrast, the concentration of

soybean production and consumption has allowed ENAC, even with minimal intervention, to practically impose official prices during years in which they exceeded domestic equilibrium market prices (Tschirley 1988a). ENAC's influence in the rice market lies between these two extremes. Though farmers are often willing to sell to rice millers and private traders at a discount from the support price, ENAC's presence often causes market prices to closely track official prices.

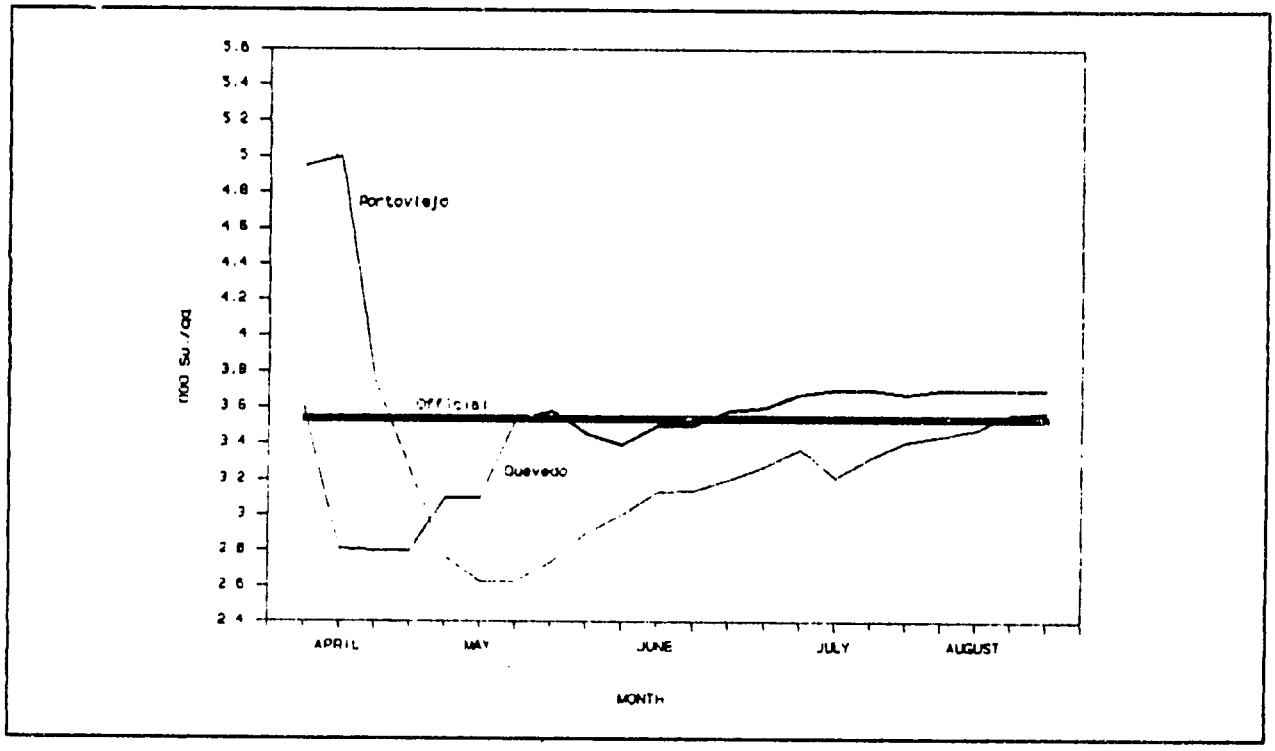

Figure 8.4 Market and Official Hard Corn Prices, April - August, 1989

Table 8.4 shows percent ENAC participation in the rice, hard corn and soybean markets since 1974.[7] Two observations stand out. First, intervention in the rice and hard corn markets has been more stable than in the soybean market. Second, ENAC intervention reached historical highs during the period 1985-1987. The very large purchases of rice and hard corn during these years required extremely high expenditures and led directly to serious financial problems for ENAC between 1987 and 1989.

Price Controls Price controls have been in place since 1973, when prices of a wide number of agricultural goods were frozen. In 1977, the Economic Front begar to fix maximum consumer and minimum producer prices. Producer prices of Costa grains have been defended exclusively through ENAC purchases. In practice, the only grain in which consumer prices have been enforced is rice. This has been attempted through ENAC sales, as well as legal sanctions against traders supposedly hoarding grain, or selling above the official price. Recent legal measures include the seizing (with payment at official prices) of relatively small amounts of rice from warehouses during February through April of 1989, as well as during the 1989 rainy season harvest.[8]

Chicken meat and eggs, whose production depends largely on hard corn and

Table 8.4 Percent ENAC Participation in Rice, Hard maize and Soybean Markets in Ecuador, 1974-1988

Year	ENAC Participation (%)		
	Rice	Hard maize	Soybeans
1974	3.5	0.0	0.0
1975	9.5	0.0	0.0
1976	1.9	2.0	0.0
1977	7.1	4.0	0.0
1978	5.6	18.0	0.0
1979	2.8	15.0	0.0
1980	15.3	18.0	0.0
1981	9.6	36.0	0.0
1982	11.5	11.0	0.0
1983	0.0	0.0	0.0
1984	0.0	10.0	50.0
1985	5.1	42.0	0.0
1986	22.1	20.0	0.0
1987	32.4	1.0	15.0
1988	0.0	0.0	0.0
Average[a]:	8.4	11.8	10.8
Coef. of Var.:	1.04	1.09	1.69

Source: Rice: Stewart and Cuesta; hard corn and soybeans: Tschirley, 1988a; Consultores Asociados, 1988.

Average and coefficient of variation for soybeans are calculated beginning in 1983, the first year that an official producer price was set for this crop.

soybean meal utilized in feed concentrates, have also been subject to periodic price controls. These became especially severe in late 1987 and early 1988. During this time, poultry producers were jailed for selling above official prices and the product was seized by the government.

The pattern of recent price controls for rice and poultry products indicates that enforcement becomes most severe during periods of shortage and consequent high prices. Also, official poultry product prices have been set with very little regard to costs of production. The market disruptions that necessarily result from such a policy have been very severe.

Hard corn marketing at the rural assembly level appears to be very competitive. Nearly three-quarters of all hard corn sold in rural markets was sold in towns with more than five traders. Only 2 percent was sold in towns with one trader. Furthermore, there appears to be no systematic relationship between farm size and price received. Small quantities of corn generally receive the same price as larger quantities if the two are of comparable quality (Tschirley 1988a).

Nearly 1,000 commercial rice mills compete for farmers' grain in the relatively small rice producing area and the fifteen largest millers process only 15 percent of total production (Ramos 1989b). The greatest possibility of insufficient competition at the assembly level occurs in the marketing of soybeans, due to extreme concentration among crushers. Nevertheless, the presence of ENAC is sufficient to practically force crushers to pay the official price. Also, soybean farmers have the option of selling to competitive local traders instead of crushers. These rural traders (of both hard corn and soybeans) and rice millers provide two important services to producers. One is a competitive local market alternative to more distant soybean crushers, feed manufacturers and rice wholesalers. The other is an immediate cash payment, which helps farmers improve their liquidity in preparation for the following crop cycle. The fact that so many farmers choose to sell to these traders, even in the presence of alternatives, attests to the service they provide.[9]

Competition at the wholesale and feed manufacturer level for hard corn also appears to be adequate. Feed manufacturing during 1986 and 1987 had a low concentration level, as measured by the commonly used CR4 ratio.[10] In addition, feed manufacturers in the Costa must compete with Sierra wholesalers for purchases from rural traders. It is highly unlikely, then, that these manufacturers could unilaterally depress the price received by producers or rural traders.

It is possible that rice wholesalers are able to exercise some market power. A large percentage of milled rice eventually passes through the hands of between twelve and twenty large, national wholesalers. These wholesalers have excellent access to commercial bank credit and are the major lenders to rice millers. Most rice stored in rice millers' warehouses is owned by wholesalers, who retrieve it when necessary. The level of excess profits that these traders may extract requires a closer examination. Despite their large scale and access to capital, it remains doubtful that they form a cartel with the ability to unilaterally influence prices.

Finally, existing evidence indicates that spatially separated Costa grain markets are well integrated. This integration extends to neighboring Colombia and Peru (Tschirley 1988a) and provides additional evidence supporting the view that marketing of basic grains in the Costa of Ecuador is generally quite competitive.

Principal Marketing Problems

The principal problems affecting the marketing of rice and corn in Ecuador are supply and resulting price instability. Severe shortages and price increases have affected both markets in 1983/84 and 1988/89. The corn market was severely affected in 1987/88. To differing degrees, both domestic production shortfalls and large unofficial sales to Colombia were the causes of the initial shortages. However, the extreme price shocks were largely a result of great uncertainty regarding the timing and volume of imports to cover the shortages, as well as delays in the arrival of the imports. These delays have two fundamental causes: unreliable data regarding production and stocks and the highly political nature of imports. Inconsistent relative price policy for corn and soybeans also has had important

effects on the corn market.

The official estimates of corn production provided by the National Corn and Soybean Program of MAG are at best "ballpark" figures. Unofficial estimates come from the Association of Feed Manufacturers (AFABA) and from the National Agricultural Products Exchange (*Bolsa de Productos*). AFABA estimates are based primarily on aerial surveys and are consistently the lowest of the three. National Exchange estimates are also somewhat ad hoc and tend to fall between the other two. The uncertainty created by unreliable production data is compounded by a very active unofficial border trade and by the complete absence of reliable stock data. Rice production estimates from MAG's National Rice Program are more accurate than those for corn and the Program also collects relatively reliable stock data from rice millers. Nevertheless, both data series could be significantly improved.

Rice and corn prices are available daily at the Guayaquil and Quito wholesale markets and corn prices are also available at feed manufacturing plants. Border prices with Colombia and Peru are also available at least once a week. Border and domestic price differentials, used in combination with domestic price movements and the available production estimates, might be sufficient to allow adequate import/export decisions, were it not for the highly political nature of these decisions. An overriding policy objective in Ecuador is self-sufficiency in basic food and feed grains. Shortfalls are considered a policy failure and tend to be politically costly for the government. Shortages are therefore often denied until they reach crisis proportions.

Finally, relative official prices of corn and soybeans have contributed to corn supply instability during at least two years. Between 1986 and 1987, the official soybean price nearly doubled relative to the official corn price. As a result, volume marketed may have fallen by more than two months of consumption. In 1989, the relative soybean price ratio remained very high. Farmers planted almost exclusively soybeans during the dry season, resulting in the smallest dry season corn harvest in many years.

A secondary problem affecting both corn and rice marketing is the absence of systematic price incentives for improved grain quality. Prices at each level in the marketing system are only loosely related to quality. As a result, at least 20 percent of corn sold at the rural assembly level exceeds the maximum mold content accepted by the more progressive feed manufacturers (Tschirley 1988a).

ENAC presence in the soybean market appears to have been sufficient to prevent monopoly pricing of the grain by soybean crushers. Nevertheless, soybean meal prices have consistently exceeded soybean prices, reversing the price relationship found in international markets and imposing higher production costs on the poultry industry. This pattern is due to oligopoly market power exercised by the crushers in the absence of competition from imported soybean meal.

Sierra Food Crops

By order of farm-gate value in 1988, the principal food crops produced in the Sierra are potatoes, soft corn, tomatoes, dry beans, onions, barley and wheat (see Chapter 6). Tomatoes and onions will be treated along with other vegetables in a later section.

Wheat, barley and potato production show clear negative trends, with barley and wheat showing the most drastic decreases (Table 8.5). Soft corn and dry bean production have been highly variable but show no clear positive or negative trends.

Sierra food crop production is characterized by very small land holdings.

Table 8.5 Index of Sierra Crop Production, 1975-1987

Year	Wheat	Barley	Soft Maize	Dry Beans	Potatoes
1975	100	100	100	100	100
1976	72	98	117	127	110
1977	62	65	60	100	84
1978	45	35	43	72	69
1979	48	33	202	89	51
1980	48	39	50	101	65
1981	64	43	54	114	78
1982	60	56	61	109	83
1983	42	47	49	78	63
1984	39	40	63	100	78
1985	29	43	68	141	85
1986	51	70	118	104	78
1987	48	48	111	97	71

Source: Consultores Asociados 1989a, 1989b, 1989c, 1989d, 1989e.

The average farm size in many areas of the Sierra is less than two hectares. Consistent with this fragmented structure of production, all five Sierra food crops considered in this section are generally sold in small lots to local assemblers by individual farmers. Marketed surplus (the proportion of total production which is marketed) is generally low, ranging from 43 percent for soft corn to 72 percent for barley and dry beans (Consultores Asociados 1989a, 1989b, 1989d).

Functional distinctions can be made between the marketing of wheat and barley, and potatoes, dry beans and soft corn. Wheat and barley are industrialized, wheat being used primarily for bread and pasta and barley for beer. Marketing channels for domestically produced grain are short, commonly with two transactions for the grain to arrive at millers and brewers. Post-harvest losses are relatively low. Seasonal price movements are modest, due in part to year-round imports of each grain. Wheat imports increased 120 percent between 1973 and 1987 and represented over 95 percent of total supply in 1988. Barley imports tripled between 1976 and 1985 and comprised 31 percent of total supply in 1988. Both millers and brewers prefer imported grain due to its higher quality and more streamlined marketing process. As a result, brewers purchased only 17 percent of national barley production between 1978 and 1988. Millers buy a larger proportion of national wheat production, though this figure probably does not exceed 50-60 percent.

In contrast to wheat and barley, potatoes, beans and soft corn are with few exceptions not industrialized. Except for unofficial border trade, imports play no role in any of these foods. Marketing channels are long and the retail distribution system is extremely fragmented. Sales volumes tend to be small, losses large and margins high. Quality is often poor. Total physical losses of potatoes between the farm and retail levels are estimated to be as high as 22 percent (Consultores Asociados 1989d). Soft corn losses are lower but still high. Without imports to

stabilize supply, seasonal price movements can be extreme, especially in outlying markets. This problem is especially severe in potatoes, where the ratio of the seasonal high price to the seasonal low price at the retail level often exceeds 2.5 in Guayaquil and Quito and reaches as high as 5.0 in outlying markets.

Direct state participation in Sierra food crop markets is almost non-existent. ENAC purchased dry beans only in 1981 and has never purchased any other Sierra crop. Indirect state participation includes the setting of minimum producer and maximum consumer prices for each crop, periodic shutting of borders to stop dry bean sales to Colombia and Peru and direct and indirect subsidies on imported wheat and locally produced wheat flour. No effective system of grades and standards exists. Minimum producer and maximum consumer prices are seldom enforced, so that only the wheat subsidies and periodic border closings have had significant market impacts. Of these, the wheat and wheat flour subsidies were by far the most important government policy affecting Sierra agriculture. Prior to their elimination in late 1988, they had major impacts on domestic wheat production, on dairy production (wheat and pasture compete for much of the same land in the Sierra) and on consumption patterns.

Periodic border closings to impede the flow of dry beans to Colombia have also had significant impacts. These closures have drastically depressed prices received by Ecuadorian producers in certain years. Their justification is not clear. Given the very small internal market for the type of bean sold to Colombia, allowing unimpeded foreign sales would significantly benefit producers, while imposing little or no cost on Ecuadorian consumers.

The principal problems affecting the marketing of Sierra food grains include poor quality, relatively high marketing margins and price instability. Poor quality affects all crops. Physical losses are relatively high in potatoes and soft corn and the quality arriving to the final consumer is often poor. High margins and a fragmented retail distribution process principally affect potatoes, soft corn and beans. Elevated margins are due largely to high marketing costs, which result from the very small scale of production and the fragmented retail process. Marketing margins for barley and wheat appear quite reasonable. Price instability is most severe in potatoes, though soft corn also shows relatively large seasonal and interyear variation.

Poultry and Eggs

The poultry industry in Ecuador has been among the most dynamic in the country since 1970. Growth rates were rapid and real prices fell steadily throughout the 1970s and into the 1980s. These trends, combined with rapidly growing urban populations and per capita income, placed eggs and chicken within the financial reach of a much larger portion of the consuming public.

Nevertheless, this industry has experienced serious difficulties in recent years. According to MAG data from its Poultry Division, per capita consumption of chicken meat has fallen slightly since 1982, while per capita consumption of eggs has shown a very pronounced decline. Currently, chicken meat is moderately more expensive than beef and is considered a luxury good by many consumers. Macroeconomic conditions indicate that renewed real per capita income growth may not emerge for some years. Too, slow productivity growth will likely preclude falling real prices of domestically produced hard corn and soybean meal. Thus, the fundamental challenge facing this industry over the next five to ten years is how to maintain or increase per capita consumption of poultry products in the face of rising or stagnant input prices and falling or stagnant real per capita incomes.

An econometric supply and demand analysis (Tschirley 1988a) indicates that population growth, and to a lesser extent changes in consumer preferences, will cause total chicken and egg demand to continue to increase significantly, even with stagnant real prices and per capita incomes. Expected increases in chicken demand between 1987 and 1996, are 23 percent under a "low" scenario of falling real incomes and increasing real prices, 81 percent under an "intermediate" scenario of constant real prices and incomes and 169 percent under a "high" scenario of falling real prices and increasing real incomes. Based on these results, and on reasonable assumptions about the relationship between demand for chicken and eggs, Table 8.6 shows expected increases in derived demand for hard corn and/or sorghum, and soybean meal.[11]

Table 8.6 Projected Increases in Derived Demand by the Poultry Industry for Hard Corn, Sorghum and Soybean Meal in Ecuador, 1987-1996

Scenario	Increase Over 10 Years (%)	
	Hard Corn and/or Sorghum	Soybean Meal
Low	106	112
Intermediate	49	53
High	8	11

Source: Tschirley 1988.

It appears realistic to expect an increase in corn, sorghum and soybean meal demand at least equal to that in the intermediate scenario. This assumes zero growth in real per capita income, constant real chicken and egg prices and zero growth in feed grain demand by the shrimp, beef, pork and milk industries. Any increase in real per capita income, reduction in real prices, or further development of the shrimp, milk, beef, or pork industries will result in an increase in demand of significantly more than those indicated above.

The challenge faced by the country is illustrated by the fact that hard corn and sorghum production since 1985 (a year of self-sufficient domestic production) would have had to increase at a compound annual rate of 4.1 percent just to assure sufficient domestically produced supplies under the intermediate scenario presented above. In fact, production has fallen since that time and it appears quite unlikely that Ecuador can attain the necessary productivity growth to satisfy its feed grains needs solely through domestic production.[12]

Feed grain price and import policies thus become critical issues for this subsector. It will be necessary for Ecuador to design a comprehensive policy that encourages efficient domestic production, while guaranteeing stable and sufficient domestic and imported supplies to the feed manufacturing industry. This policy must be complemented by aggressive agricultural research to increase the productivity and reduce the prices of feed grains.

Beef

Beef continues to be the main meat consumed in Ecuador. In 1986, per capita consumption was 11.5 kgs compared to 2.3 kgs of pork and 5.6 kgs of poultry (Sarhan). Beef produced in the Sierra comes largely from dairy herds. In the Costa and Oriente the cattle herds generally are comprised of beef animals, usually some combination of native breeds and Cebu, and some dual-purpose cattle. Live cattle are trucked from surplus provinces to the larger cities for slaughter and immediate distribution, most frequently without refrigeration. In 1986 there were 113 slaughterhouses scattered throughout the country, nearly three-fourths of which were municipal enterprises that provide custom services to wholesalers who assemble live cattle and sell dressed beef. The service fees charged by the municipal slaughterhouses are low and usually subsidized by local governments. Although there is a strict law establishing sanitary standards, it is not enforced.

The specialized group of intermediaries called *introductores* are the main coordinators of the beef marketing system. They buy live cattle from producers, assemble truck-load lots and arrange for slaughter and delivery of carcass beef to retailers. This is a closely knit system that provides a reasonably stable meat supply and short-term operating credit to retailers. Most beef is sold to consumers by small retailers in public markets. Meat handling is unsanitary, cutting methods are crude and gross margins are relatively large. A high percentage of the beef carcass and viscera are sold for human consumption.

The beef marketing system has received a great deal of criticism. Producers are believed to be at a disadvantage in selling live animals to the introductores. Buyers are alleged to have an information advantage and to be more skilled than producers at estimating live cattle weights. Assembly market facilities are non-existent or deficient and relatively unregulated. Slaughterhouses are criticized as unsanitary and a threat to human health. Competition among wholesalers has also been questioned.

Amidst these criticisms, initiatives are being taken by both the public and private sectors. Supermaxi and a few hotels have direct supply arrangements with producers. The animals are slaughtered in private abattoirs. Several municipalities are planning new slaughtering facilities. Much remains to be done to facilitate the development of an efficient and adequately sanitary system of beef marketing. Proposals for the consolidation of slaughtering into a few large, regional facilities with refrigerated transport and distribution systems should be approached with caution. This alternative system may prove to be desirable for the long run but in the short run much could be done to improve the functioning of assembly markets and the organization of more competitive and technically adequate slaughtering and retailing channels.

Milk

More than three-fourths of the milk is produced in the Sierra, where agro-ecological conditions favor dairying. Substantial volumes of fresh milk are transported by refrigerated trucks from the Sierra to Guayaquil and other Costa urban markets. Total milk production has trended upward at about three percent per year over the past decade. Annual consumption has held steady near 80 liters per person, including fluid milk and the fluid equivalent of milk products. Approximately one-third of the total milk output is used on farms to feed calves.

A 1977 law authorized the government to set minimum prices for milk at the farm level and maximum prices at the consumer level. The law also provided for the

control of milk quality. The Economic Front reviews and adjusts prices periodically, taking into consideration cost of production studies by a milk producer association and the MAG.

However, it is alleged by producers that the controlled prices do not cover production costs, especially during the recent inflationary surge. As a result, cow herds are being reduced or liquidated (Echeverria). But price controls cause other problems as well. In practice, price controls are easier to monitor on pasteurized, packaged fluid milk than on raw milk. The latter has a reputation of being unsanitary, diluted with water and dispensed with non-standardized ladles from large milk cans. Furthermore, there are no price controls on processed milk products. This creates opportunities for greater profit by diverting milk from fluid use to cheese, butter and other processed products. Clandestine sales to Colombia and Peru have been other means of realizing higher prices for milk and milk products.

The GOE has very limited capacity to enforce the law on sanitary handling of milk. More than two-thirds of the milk used in fluid form is unpasteurized (Table 8.7) and there is little if any control of handling practices from farm to consumer. Likewise, more than three-fourths of the manufactured milk products are produced in small, relatively unsupervised plants.

Table 8.7 Destination of Marketed Milk in Ecuador, 1987

Destination	Percent
Fluid consumption	54
Pasteurized milk	16
Raw Milk	36
Reconstituted imported powder	2
Milk Products (cheese, powder, butter, ice cream, yogurt)	46
Industrial plant production	10
Small plant production	36
Total	100

Source: Echeverria 1989.

Oil Crops

Production and consumption of vegetable oils have grown very rapidly in Ecuador since the early 1970s. Between 1977 and 1987, total availability (domestic production and imports) of these oils increased by nearly 115 percent, while imports fell from 38 percent to 0 percent of total availability (Table 8.8). Though some estimates indicate that as much as 30 percent of this total supply is traded illegally to Colombia and Peru, rapid per capita income growth into the early 1980's clearly boosted per capita consumption. African oil palm and soybeans are the primary sources of edible oils, accounting for nearly 97 percent of total supply in 1987. African palm oil has increased its share over the years and in 1987

Table 8.8 Edible Oil Production, Imports and Total Availability in Ecuador, 1977-1987 (metric tons)

Year	Cotton, Sesame, and Peanuts		Soybeans		African Palm		Total Avail.	% Dom. Prod.
	Domestic Prod	Imports	Domestic Prod	Imports	Domestic Prod	Imports		
1977	4,526	0.8	3,854	10,014	26,110	10,993	55,498	62%
1978	6,054	114.5	5,060	20,733	31,715	500	62,176	66%
1979	6,574	0.5	5,981	21,062	29,648	498	63,764	60%
1980	7,021	20.7	6,719	21,168	44,087	4,428	83,444	69%
1981	6,781	0.1	6,637	16,134	54,000	0	83,552	81%
1982	3,498	6.8	7,484	53,398	55,672	0	120,059	56%
1983	1,752	1.4	2,815	54,905	63,761	0	123,235	55%
1984	2,250	1.7	9,422	54,222	67,040	0	132,936	59%
1985	3,576	0.6	12,577	33,650	82,421	0	132,224	75%
1986	4,312	0.6	14,080	10,082	88,201	0	116,675	91%
1987	3,892	0.0	23,772	0	92,061	0	119,725	100%

Source: Centeno, et.al 1988.

represented over 75 percent of total availability.

African palm fruit is produced primarily on large plantations located in Los Ríos and Pichincha provinces in the Costa and Napo province in the northeastern region of the Oriente. There is a great deal of forward and backward integration in this industry. Six of the top 11 and three of the top four crushers have invested in plantations in the Oriente. Also, at least three of the largest plantations have set up crushing and refining plants. The crushing of African palm fruit and a small amount of native palm fruit is not highly concentrated, there being at least 27 crushers active in the country. Nevertheless, the two largest crushers have over one-third of all crushing capacity and could begin to increase their market share. Refining of crude palm oil is far more concentrated, with four firms dominating the industry. Among all oils, the top four refining firms control nearly 70 percent of production.

The concentration in this industry raises difficult policy questions regarding the best manner to encourage efficiency and avoid oligopoly and oligopsony pricing. These issues will be addressed below.

Fruits and Vegetables

The production and marketing systems for fruits and vegetables present many problems. Production tends to be very small-scale and geographically scattered. In addition, the products are relatively perishable. Furthermore, agricultural research and extension institutions have devoted little attention to improving varieties and cultural practices in support of commercial fruit and vegetable production. Consequently, quality is generally low.

Local periodic markets provide opportunities for small farmers to sell surplus

fruits and vegetables directly to local consumers and to intermediaries who collect produce for resale in larger urban markets. Farmers with larger volumes can often sell to buyers on the farm. Classification and packaging is minimal and shipping losses and transport costs tend to be high, especially on the more perishable products.

A network of new urban wholesale markets has been considered as a major element in improving the marketing of fruits and vegetables. These markets could be the focal points for introducing new classification, packaging and handling methods and could serve also as centers for price formation. Market information systems could then provide traders and producers with useful data on prices and volumes traded. These activities have been initiated at the Quito wholesale market and are being extended to other major trading centers.

The wholesale markets can also serve as assembly centers for nearby producers who can deliver products directly to them. Rural assembly markets will be needed to serve more distant producing areas. Ambato has been an important concentration market for cool climate fruits and vegetables to be transhipped to Guayaquil and other cities in the Costa as well as to Quito. A new wholesale transhipment market facility was under construction in 1989.

Given the many micro-climates within Ecuador, there are opportunities to time fruit and vegetable production so as to reduce seasonal and short-term supply and price fluctuations. This initiative could be advanced by a combination of efforts by MAG, the National Institute of Agricultural Research (INIAP), the agricultural extension service and the integrated rural development projects in close collaboration with producers.

Agricultural Export Commodities

Cacao, coffee and bananas have been produced primarily for export for many decades . Shrimp and other seafood exports have expanded rapidly in the past decade. The relative importance and the historical trends in agricultural exports are described and analyzed in Chapter 3, Section IV. This section will focus on the market conditions and problems for selected export commodities.

Bananas

The banana industry is dominated by a few large exporting firms, the three largest being Noboa, Standard Fruit, and Reybanpac. Several thousand growers have production contracts with the main exporters. There are thousands of other growers that produce outside the contract system and sell through export agents located in the production areas. When the export market is weak and or there is surplus production, substantial quantities are left unharvested or fed to livestock.

The major markets for Ecuadorian bananas are the United States, West Germany, Belgium, Luxembourg and Italy. Over the medium to long term, there is little reason to expect significant increases in export sales above the slow upward trend of the past two decades.[13] Some increase in export demand may develop as the Eastern European market opens up. The major problem facing the banana industry is the intense competition in international markets, where Ecuador has nevertheless been able to maintain a leading position.

Cacao

For many decades Ecuadorian cacao had an excellent worldwide reputation

for its distinctive flavor. It therefore commanded a significant price premium from manufacturers of high quality chocolates located in Europe and the United States. However, this reputation has been severely eroded over the past 20 years and a substantial proportion of Ecuadorian cacao now sells at a discount. Disease problems have further reduced export revenues from this crop.

A recent study of the international market for Ecuadorian cacao (Harrison, et al. 1988) documents export buyers' and cacao users' assessments of the quality problems they have experienced with Ecuadorian cacao. The authors identified the post-harvest handling and marketing practices that contribute to the quality problem. They recommended vigorous industry-wide efforts to regain a solid reputation for a high quality product. An aggressive educational program and public sector supported research and extension were strongly recommended. It was also suggested that the industry consider a self-imposed export tax to generate funds to support research, education and market development activities. The implementation of this proposed program will be a major challenge since cacao is currently produced by a large number of small farmers who sell their cacao beans to many small assemblers. At present there is very little price incentive reflected through the market channels to producers.

Coffee

The coffee production and marketing system probably involves over a million people in various aspects of growing, processing and marketing. There are approximately 120,000 farms producing coffee, some of them as the principal commercial enterprise and others using it as a cash crop along with other enterprises. The main domestic marketing problems stem from the relatively low level of technology being used in the production, harvesting, drying and sorting of coffee beans. In addition, wide international price fluctuations, such as occurred in 1988/89, have created significant market risks, especially for coffee producers. The termination of the International Coffee Agreement will increase price instability. The Ecuadorian coffee industry will find it necessary improve the quality of their coffee and reduce production and marketing costs if they are to compete effectively with other exporting countries.

Shrimp

The rapid growth of the Ecuadorian shrimp industry is often cited as one of the success stories in the promotion of "nontraditional" exports. The initiative came from the private sector with some support from public financial institutions. The United States and Japan have been the principal export markets for Ecuadorian shrimp. During the late 1980s, international competition has increased, especially from China, Taiwan and Indonesia. Meanwhile, the Ecuadorian shrimp industry has experienced serious production problems due to the inadequate supply of shrimp larvae needed to stock the growing ponds. The apparent solution is to expand the artificial production of larva but this has met with limited success. The industry is also confronted with growing concerns among environmentalists regarding the ecological impacts of the ponds (Espinoza; see also Chapter 4).

Continued growth in the demand for shrimp in international markets will stimulate efforts to expand Ecuadorian production for export. Although there are about 180 exporting firms the Association of Shrimp Producers considers that only 25 to 30 are capable of offering an export-quality product. Access to investment and operating credit, reduction or elimination of export taxes and increased

scientific research are priority concerns if Ecuador is to maintain a position as a leading shrimp exporter.

Non-Traditional Agricultural Exports

Since the early 1980s the GOE has consistently expressed a strong interest in expanding non-traditional exports as a means of diversifying and expanding foreign exchange earnings. Agricultural production, processing and exporting enterprises are being promoted but growth has been slow and export levels remain very low.

A flower export industry is becoming established and a few, small initiatives are emerging in fruits and vegetables. For these initiatives to expand significantly will require a combination of macroeconomic policies that provide incentives for exporting, less time-consuming and costly legal requirements for arranging export transactions and public sector supported research, extension and market information programs. The expansion of non-traditional exports should be approached as a long-term effort that takes place in conjunction with the further development of an efficient and progressive domestic production and marketing system.

Marketing Margins

Marketing margins are important indicators of a marketing system's performance. In its simplest form, a margin is the difference between the price of a product at one level in the system and the price of a similar product at a higher level in the system. This margin represents the price paid for the provision of necessary marketing services. Marketing services add form, time and space utility to the product and involve costs which must be covered, plus adequate profit, if they are to be provided by the private sector.

A typical farm-consumer gross margin for potatoes in 1987 was 41 percent of the consumer price (Consultores Asociados 1989e). Gross wholesale-retail margins as a percentage of wholesale prices that year ranged from a low of 20 percent in Quito to a high of 37 percent in Portoviejo. However, relatively stable absolute margins and a highly variable price resulted in margins that often exceeded 50 percent during the harvest months of March through July.

Spatial margins are tremendously variable. Between Quito and outlying markets, the general pattern is of slightly negative margins during February through April, followed by pronounced increases through September or October. In summary, both wholesale-retail and spatial wholesale potato margins indicate probable marketing inefficiencies which merit further attention.

A typical farm-consumer gross margin for rice during the winter, 1988 harvest was 49 percent of the consumer price (Ramos 1989a). Of this, nearly 17 percent was earned by the rice miller and covered assembly, farm to mill transportation, drying, cleaning and milling.[14] Twenty-three percent was earned by between one and three wholesalers and covered transportation and distribution costs. Finally, 9 percent was earned by retailers for the purchase, transport and sale of the rice in one pound bags. A 23 percent margin for wholesalers appears to be above the level which could be justified by simple cost considerations, and therefore raises the possibility of market power at this level in the rice marketing system. A definitive answer on this issue must await further investigation.

Milled rice wholesale-retail margins between 1981 and 1988 averaged 17 percent, with a high of 22 percent in 1981 and a low of 13 percent in 1988. Both

absolute and percentage margins tend to rise during the harvest. This pattern appears to extend to the farm level and may be related to insufficient liquidity in the marketing system. Wholesalers play a major role in financing rice purchases by millers. Nevertheless, surveys indicate that when rice is most abundant, wholesalers provide less credit. As a result, many rice millers experience liquidity problems during the harvest. A logical result of this situation is the reduction of producer prices and increased margins.

With some exceptions, marketing margins for agricultural commodities in Ecuador appear to be reasonable, given the existing marketing and institutional infrastructure. For the most part, returns to labor are low and returns to capital are highly variable. Little evidence exists to support frequent allegations that middlemen as a group are earning consistently high and unwarranted profits. On the contrary, the earnings of thousands of small retailers, assemblers and transporters are less than or equal to the minimum wage. For many intermediaries, this low income represents their best employment opportunity. Further study is required to identify specific conditions where marketing margins are higher than necessary and to prescribe appropriate measures to increase marketing efficiency.

IV. Input Marketing Subsystems

This section will focus on the marketing systems for pesticides (principally herbicides and insecticides), fertilizers (of which urea is the most important), seeds and agricultural machinery and equipment. Land is treated in Chapter 4, labor in Chapter 5 and capital in Chapter 9.

Pesticides, fertilizers, seeds and machinery, in conjunction with the scientific knowledge base in agriculture, are major determinants of the productivity of the Ecuadorian agricultural sector. It is therefore critical that the marketing systems for these products provide widespread and timely access, that they ensure consistently high quality and that they do so at prices consistent with competitive conditions.

Recognizing the importance of these inputs, the GOE has taken a direct role in the marketing of all except pesticides. It created two parastatals to market certified seeds and fertilizer and a mechanization program within the MAG to sell machinery services to farmers. The National Seed Company (EMSEMILLAS) was created to replicate and market certified rice, hard and soft corn, soybean, cotton, wheat, barley and potato seeds developed by INIAP. It dominates the certified seed market, selling 71 percent of all rice, hard corn and soybean seed and 63 percent of certified seeds of all types in 1987 (EPI 1987c). Six other firms along with INIAP share the remaining 37 percent of the market. EMSEMILLAS has the processing capacity to easily supply the entire Ecuadorian certified seed market and is the only firm capable of cold storage, giving it a further strategic market advantage.

Certified seed quality is generally considered good. Seed use in the Costa has increased tremendously over time, despite prices which rose relative to product prices. Between 1981 and 1986, seed:product price ratios rose nearly 7 percent for soybeans, 15 percent for rice and 114 percent for hard corn. Table 8.9 shows the approximate percentage of land in each crop which is planted with certified seeds. Interestingly, use of improved seeds in the Sierra is much lower than that in the Costa, despite falling and generally lower seed:product price ratios. Average ratios in 1986 for the top four Sierra food crops (potatoes, soft corn, wheat and barley) were 1.44, compared with 2.57 for the top three grains in the Costa (rice, hard corn and soybeans).

The principal reason for this differential use of certified seed may be

Table 8.9 Percent of Area of Selected Crops Planted with Certified Seed, 1986

Crop	Sierra	Crop	Costa
Wheat	9%	Cotton	100%
Barley	7%	Soybeans	95%
Soft Corn	3%	Rice	65%
Potato	3%	Hard Corn	58%

Source: Economic Perspectives, Inc. 1987a.

inadequate marketing systems. Sales outlets are mostly located in and around large cities, making it impossible or at least very inconvenient for most small and medium sized farmers to purchase the seed. Too, technical assistance is negligible for the use of certified seed within the entire technical package of which it should be a part. What assistance there is generally does not reach small farmers. As a result, small and medium farmers use unimproved seed almost exclusively (most stored by the farmer from harvest to harvest) contributing greatly to the relatively low crop yields in the entire sector. Thus, the Ecuadorian seed industry has to date failed to uniformly provide one of the critical elements necessary for a broadbased transition into highly productive technical agriculture.

Although no precise data is available, pesticide use per hectare appears to have remained relatively stable during the past 10 years. Most pesticides are used by technified and semi-technified farmers in the Costa, for whom these chemicals comprise a larger proportion of production costs than do fertilizers (EPI 1987d). All pesticides are imported without quantitative restrictions but the industry is nevertheless tremendously concentrated. Between 1984 and 1986, the top three firms controlled 52 percent of all imports.

There is virtually no publically provided technical assistance in the safe and efficient use of pesticides. What exists is generally offered by the chemical companies. Nor do effective public regulations exist to prevent the sale or misuse of toxic chemicals. As a result, serious health problems have emerged due to the misuse of pesticides.

The fertilizer industry is also dependent entirely on imports. Overall, it suffers from problems nearly identical to those affecting the chemical inputs industry. Local market power can be very strong and service to small and medium farmers is relatively poor. The Ecuadorian Fertilizer Company (FERTISA) is the government parastatal charged with rectifying this situation. In the past, it has imported simple fertilizers and mixed them to produce compound fertilizers and has also produced urea locally. Its production and mixing capacity would allow it, if functioning efficiently, to dominate the Ecuadorian fertilizer market. However, as of December 31, 1988, its accumulated losses were equal to 92 percent of its total capital and it made no sales in 1989. Its major shareholders, the National Development Bank (BNF), with 65 percent of all shares, the National Finance Corporation (CFN), with nearly 21 percent and the MAG with nearly 6 percent, have to date been unable to reach agreement on a solution to FERTISA's financial problems.

Fertilizer use in Ecuador appears to be low by Latin American standards.

Average use varies between 20 percent and 33 percent of recommended levels, depending on the nutrient examined. EPI (1987a) estimates that optimal fertilizer use on all planted area of the top 14 crops could add US$ one billion in net value.

All motorized farm equipment and 80 percent of non-motorized farm equipment is imported. Although the import process is cumbersome and time consuming, any individual can import machinery. Nevertheless, the industry is quite concentrated. In terms of total value, the top five firms imported 50 percent of all machinery in 1986 and the top 10 imported 66 percent. Concentration is significantly higher within sub-groups. For example, the top three firms in 1986 imported nearly 90 percent of all harvesters and milking equipment and 75 percent of all replacement parts. The National Program for Agricultural Mechanization (PRONAMEC) is the government's response to this highly concentrated industry structure. Operating out of 17 centers, 11 in the Sierra and six in the Costa, it sells machinery services to farmers, in direct competition with private sellers of the same services. It was created in 1974 and by 1985 had acquired 435 tractors and 36 harvesters, as well as 784 other pieces of equipment. Although the program may serve to regulate the price of such services within the area served by each center it suffers from a number of serious problems (EPI 1987b). Fundamentally, these relate to a lack of funds and ineffective management. By 1987, only 313 tractors and 28 harvesters were in working order, the others having been damaged and not repaired, or used for spare parts. Given the current financial limitations of the GOE, it appears unlikely that sufficient funds will be allocated to repair damaged equipment, service functioning equipment and replace equipment which has reached the end of its useful life. Other problems include a personnel management system in which staff and workers are assigned by a government agency with little knowledge of the program and its needs and the lack of any systematic attempt to forecast demand for its services and thereby plan its activities. Unless these problems are addressed, PRONAMEC will inevitably play a diminishing role in the provision of machinery services to the agricultural sector.

This brief review of the agricultural inputs industry in Ecuador has highlighted at least two important facts. First, the industry is highly concentrated. Second, the marketing systems are rudimentary, serving larger farmers relatively well, while largely neglecting small and medium farmers. These facts raise difficult questions for price and marketing policy, which will be dealt with below.

V. An Agenda for Market System Development

This chapter has presented a descriptive and diagnostic assessment of the Ecuadorian agricultural marketing system. This final section will attempt to sketch an agenda for market system improvement, focusing on five interrelated issues: (a) the general issue of subsidies, which have had major impacts on Ecuadorian agriculture; (b) price policy, which with macroeconomic and regulatory policies will provide an important part of the incentive structure within which marketing takes place; (c) strategic investments in market system development, which will increase the efficiency and flexibility of the system, thereby enhancing the effectiveness of price policies; (d) market regulations; and (e) public sector support services to facilitate trading and contribute to the development of an efficient market system.

This assessment began, in Chapter One, with a discussion of the emerging integrated world market and the need for Ecuador to take advantage of the very significant efficiency gains that this market offers by opening its economy to it. At the same time, it was noted that this world market has become increasingly

unstable and that many countries may want to moderate the impacts of this instability on their domestic markets. The fundamental challenge facing Ecuadorian policymakers, then, is to design a system open to the world economy so as to exploit the efficiency gains it offers, while moderating some of the less desirable effects that world market instability can generate.

Regarding price policy, a governing principle in the recommendations to follow is that domestic and international markets should be utilized whenever possible to attain price policy goals. Tight budgets and limited analytical and administrative resources will make such solutions, when they are possible, far more cost effective than extensive government regulation of and participation in the market. Nevertheless, market failures mean that government will have an important role to play in encouraging and facilitating the development of a more efficient, dynamic and flexible marketing system, as well as designing strategic, focused interventions to eliminate or moderate specific problems.

Subsidies

Subsidies have become ubiquitous in Ecuadorian agriculture. For every winner from these subsidies, there are also losers. Overall, they have exacted a high price from Ecuadorian society, in terms of both reduced output and less equitable distribution. At the macroeconomic level, a historically overvalued exchange rate has subsidized imported agricultural inputs such as fertilizers, pesticides and machinery, while penalizing exporters. Widespread credit subsidies have been captured predominantly by large farmers, while reducing the total supply of credit. This supply reduction has increased the cost of credit to those primarily small and medium farmers not enjoying access to the subsidies. Subsidies in the form of minimum producer prices which include a guaranteed profit have been captured disproportionately by large grain farmers in the Costa. ENAC grants storage subsidies to feed manufacturers and rice wholesalers by selling hard corn and rice during January through April at prices that do not cover storage costs. Survey data shows that the hard corn storage subsidy is captured predominantly by the largest manufacturers. In contrast, subsidies channelled through ENPROVIT and meant specifically for low-income consumers have reached a minuscule proportion of their target population. In short, a very clear pattern has emerged showing that already powerful groups are the primary beneficiaries of state subsidies. Less privileged groups not only have less access but suffer the costs that these subsidies impose on the entire system, in the form of inflation and reduced quality of government services in other, possibly more important areas.

As a general recommendation, most if not all un-targeted subsidies should be eliminated in Ecuadorian agriculture. It is critical that the exchange rate be allowed to closely track its real level. Overvaluing of this rate will continue to impose very large costs on the country and will seriously hamper the implementation of the price policy recommended below. Interest rates should move toward positive real levels. ENAC support prices for those crops in which it intervenes should not automatically cover all fixed and variable costs of production, plus profits. Finally, ENAC purchases and sales should be at prices that allow it to at least recover interest costs and depreciation on its facilities. The objective of market stabilization should be clearly separated from that of favoring low-income producers and consumers.

As these generalized subsidies are eliminated, the government savings they generate should be used to fund a small number of carefully designed targeted subsidies. In this regard, ENPROVIT's role needs to be redoriented to provide a

small number of basic foods to a very carefully delineated target population of nutritionally and otherwise highly vulnerable consumers.

Price Policy for Grains

Basic grains in Ecuador have for many years received special attention with regard to price policy, for a number of reasons. First may be the importance of food grain prices in determining the real income and consequent nutritional status of poor consumers and farmers. The production, marketing and utilization of feed grains are also important in providing nutrients and employment to a growing sector of Ecuadorian society. In addition, grains' inelastic short-run demand schedules mean that shifts in supply can cause great price instability. Finally, the non-perishable nature of these products makes an active government policy more feasible than it would be, for example, in potatoes or soft corn, which share many of the above characteristics.

For these and other reasons, the GOE will in all likelihood continue to intervene in some way in its grain markets. The objective, then, is to design a system that in the words of Ahmed and Bernard (pp. 9 and 14) "...would minimize economic waste but preserve the elements that address food security and price support concerns arising from severe price instability."[8] Such a system must acknowledge the inescapable role of markets in allocating resources and attempt to modify only the more extreme results of market forces. It is therefore recommended that a "rule-based" price band policy be applied to Ecuador's basic grains. These would include primarily rice and hard corn, although the band could potentially be applied in different forms to wheat, barley and soybeans.

Price bands are a well-known and increasingly popular means to stabilize prices of basic grains, while allowing unimpeded market forces to set prices except in "extreme" circumstances.[9] The band consists of a price floor and a price ceiling. No legal sanctions of any kind are used to enforce these price limits. Market participants can freely buy and sell domestically and internationally at whatever market clearing rice results. However, "rules of the game" are set so that this equilibrium price will generally lie between the floor and ceiling.

In principle, two alternative mechanisms can be utilized to achieve this result. In one extreme, this can be accomplished solely through direct government purchases at the floor price, management of the resulting stocks and sales at the ceiling price. In the other extreme, the band can be applied exclusively through variable duties and/or subsidies on imports and/or exports, with no direct government participation. The variable duties and subsidies are set so that importers always pay the ceiling price and exporters always receive the floor price. Imports are subsidized if world prices exceed the ceiling and taxed if they are below it. Likewise, exports are taxed if world prices exceed the floor price and subsidized if they are below it. In practice, some combination of the trade and government intervention approaches will likely be necessary to effectively defend the price floor and ceiling. The principal issue then involves the most desirable mix of the two approaches.

The system is "rule-based" in the following sense. The announcement of floor and ceiling prices prior to planting establishes the price levels facing importers and exporters and which trigger government purchases and sales. Once these prices are announced, the system becomes largely self-regulating. The government acts predictably according to the buy/sell and variable levy/subsidy rules implied by the band, and private sector producers, traders and processors choose freely to buy and sell domestically or internationally at whatever market

price they face. Such a rule-based system saves very scarce administrative and analytical capacity and thereby improves the probability of the policy's success.

Two cases relevant to Ecuador can be identified in which the recommended mix of policy instruments (direct government intervention vs. trade) differs: the import case and the self-sufficiency case. The import case refers to a situation in which a country imports significant quantities of grain every year and faces no significant probability of being a self-sufficient or surplus producer. This case currently applies very well to wheat and barley in Ecuador and could also apply to hard corn in the near future. The self-sufficiency case is one in which a country is on the edge of self-sufficiency, sometimes facing deficits and sometimes surpluses. Rice is currently such a crop in Ecuador and hard corn had been until fairly recently. Briefly, direct government participation is relatively less important in the import case and more important in the self-sufficiency case. In the import case, a price band on imports will be sufficient to roughly enforce the same price band on domestic prices. Nevertheless, government purchases and/or sales may be necessary in isolated areas, or to more closely enforce the band. In the self-sufficiency case, imports and government sales at the price ceiling and exports and government purchases at the price floor are both necessary.

There are a number of requirements to ensure the success of a price band policy. One of the most important is a streamlined import and export process. Other important requirements include administrative and operational flexibility on the part of the government marketing agency to make and implement timely purchase and sale decisions; sufficient annual budgets and credit lines for the agency to finance its required intervention; a balanced and stable relationship between the level of the band and the level of world and other border prices (this requires a reasonably stable and realistic exchange rate); timely situation and outlook information on world and domestic markets; and the ability to analyze this information and recommend timely actions which are appropriate for the country's situation.

Finally, certain principles must be applied in determining the floor and ceiling prices. These principles relate to the <u>level</u> and <u>width</u> of the band, as well as to the ease with which it can be understood and applied. First, the floor price should not be located "too" far above the minimum producer price which would result in the absence of State intervention. Similarly, the ceiling price should not be fixed "too" far below the maximum consumer price which would result without State intervention.

The width of the band should be sufficient to allow "normal" seasonal price movements without government intervention. This movement will be closely related to normal trading margins and direct financial costs of storage. If seasonal price movements are unduly restricted, public storage will begin to replace private storage and the complexity and cost of the policy may reach unacceptable levels.

In the short run, Ecuador's relatively low productivity in all the basic grains may necessitate a band which lies somewhat above world price levels. But in the longer run, as productivity is increased, the band should closely track world price trends. In this case and as the marketing system becomes significantly more efficient, flexible and outward-looking, more emphasis could placed on trade rather than direct government intervention as the principle regulating mechanism. With the band tracking world price trends, required subsidies and duties should cancel each other over time. Nevertheless, the possibility of large expenditures in certain years must be clearly understood and accepted.

Finally, the band should be relatively simple to understand and should leave a margin of error for the policymakers who design and implement it. Transparency,

in the sense of clearly and widely understood rules governing direct and indirect State intervention, is critical to the success of the policy. Similarly, a band which attempts to too closely regulate prices, thus leaving an insufficient margin of error to accommodate random daily, weekly and monthly price movements, will almost certainly fail.

In summary, attempting to impose a very high, low, narrow, or complicated band, or one divorced from world market prices, will result in an expensive and unsustainable policy. By limiting its actions to the elimination of extreme rises and falls in prices, the government will avoid the large expenses and chronic financial losses that so often lead to the failure of well intentioned price policies.

Price Policy for Other Products

The relatively perishable nature of potatoes, soft corn and dry beans rules out the type of active price policy suggested for the basic grains. In this case, government actions should encourage strategic investments in their marketing systems, to make them more efficient and adaptable, thus contributing to lower costs, more stable prices and fewer post-harvest losses. Administrative price setting should be avoided.

Significant market concentration at the processing level in the sugar and oilseed markets requires that these processors be exposed to world market competition. All quantitative restrictions on foreign trade should be eliminated for raw products (sugarcane and soybeans), intermediate products (unrefined sugar, unrefined oil and soybean meal) and final products (refined sugar and oil). Over time, the access to alternative markets that this policy gives to retailers and farmers might be expected to negate the market power that processors currently enjoy.

If the government desires to stabilize the prices of soybeans and soybean by-products, then reference prices tied to world market medium-term price trends must be set at the factory door for both raw and final products. The system would closely resemble that described for rice and hard corn, with the exception that the reference price for the final products should be enforced solely through a free-trade, variable-levy system. Any reference price for soybeans would have to be backed-up with government purchasing power.

Milk and beef price controls should probably be eliminated, given the near impossibility of enforcing them. The GOE should instead focus its efforts on establishing an effective system of grades and standards and developing the capacity to enforce sanitary regulations.

Input Pricing Policy

The previous discussion of the agricultural input marketing system highlighted its highly concentrated structure, its relatively rudimentary state of development and the failure of government intervention to solve existing problems. The first characteristic presents the danger of prices significantly above competitive levels, while the second results in much better service to larger farmers than to their small and medium neighbors. The failure of government efforts to improve these systems indicates that existing policies must be seriously rethought. Both price policy and strategic market investments will thus be critical

elements in any approach to improving the performance of this system.

The capacity of an efficient EMSEMILLAS and an efficient FERTISA to supply the entire Ecuadorian market (or a very large portion of it) with certified seed and fertilizer indicates that these industries may be natural monopolies in this country. If this is the case, three alternatives to the current ineffective approach could conceivably be used to capitalize on the economies of scale this situation offers, while avoiding monopoly pricing: (a) a government monopoly could be imposed; (b) the sector could be privatized but subject to government price setting; or (c) the sector could be privatized and subjected to vigorous price competition from imported materials, without government price setting.

The current financial and administrative problems of FERTISA and EMSEMILLAS and the probability of their continuing to one degree or another for the foreseeable future, argue against government monopoly as a recommendable policy in this sector. The third alternative, private ownership subject only to import competition, may be well-suited to fertilizers. Imported fertilizers can be utilized in Ecuadorian agriculture without the need for adaptation to local conditions. This approach would probably not be successful in the seed industry, since imported seed generally needs to be adapted to local conditions prior to use. Thus, if EMSEMILLAS is to be privatized, there seems little choice but to subject it to government price setting. These prices must be based on cost of production studies as well as some international standard of efficiency.

The chemical industry, though clearly not a natural monopoly, does show signs of market concentration. Therefore, the third alternative above should be aggressively pursued. But in both this case and that of fertilizers, a free import policy will not create effective competition for existing importers unless local farmer organizations and other cooperative institutions have unhindered access to imported products. This will require not just new laws or executive decrees but streamlining of the bureaucratic import process, increased managerial capability within these organizations, training in the intricacies of the import process and innovative institutional arrangements to channel credit to these organizations, many of whom are not allowed under current law to receive credit. If these problems can be successfully addressed, the third option could effectively correct the distorted prices which can result from the structural failures in the Ecuadorian market. But if the condition of farmer organizations and other cooperative organizations remains in its current state, pricing problems will probably continue to exist in these industries.

Strategic Investments

Public Sector

During the 1970s and early 1980s the Ecuadorian government was able to make substantial investments in a highway network that has facilitated the development of a more integrated national market for food and agricultural commodities. The depressed economic conditions since 1982 have greatly reduced the financial ability of the government to maintain the existing highway system and to extend and improve roads serving rural communities. It is clear that further exploitation of the agricultural potential in the Costa, Sierra and eventually the Oriente could be accelerated by strategic investments in the road system. Additionally, export enterprises will need improved seaport and airport facilities if they are to compete internationally, especially in perishable commodities. Some combination of user fees, domestic taxes and long-term international loans will be

needed to finance these infrastructure investments. At the regional and local levels investments in electricity generation and distribution and water systems will also be necessary for the development of new and expanded agricultural processing industries.

As indicated above, the rapid growth of the larger cities has stressed the traditional system of food wholesaling, especially for perishable commodities. The planning and construction of new wholesale market facilities to serve the larger cities could contribute to lowering marketing costs through improved logistics and greater transparency of the price formation process. Improved market facilities in smaller towns which link rural areas and urban centers will also be important if the efficiency of the entire system is to be improved. However, the experience in other Latin American countries should be assessed in the process of designing and planning the operational characteristics of these markets. These are long-term investments that need to be carefully planned in the context of rapidly growing urban, suburban and rural areas and related technical and institutional changes in food production and distribution.

Other strategic investments are being made in slaughterhouses operated by municipalities. The deplorable sanitary conditions in existing slaughter plants should corrected and clandestine, unsupervised slaughter eliminated. However, over the longer run there should be greater support for the entry of privately-owned slaughter plants along with more effective government supervision of them.

Government ownership and operation of grain storage and handling facilities became an area of controversy during the mid 1980s when political leaders initiated efforts to reduce direct government intervention in markets. The policy debate continues on this issue. Meanwhile, existing government owned grain storage facilities are operated by insufficiently trained technicians and lack the maintenance necessary to function efficiently. Alternative courses of action are to upgrade government facilities and staff, transfer the ownership and operation of the facilities to the private sector, or lease the facilities to the private sector on a long term basis. In the latter two cases ENAC could intervene in grain markets simply by purchasing and selling warehouse receipts and maintaining reserve stocks in privately operated storage facilities. This would greatly increase the efficiency of government intervention, in terms of the cost required to obtain a given level of price stability.[19]

Private Sector

Over the medium to long-term there needs to be substantial private sector investment in facilities and equipment for cleaning and drying, transporting, storing, processing and distributing agricultural commodities for both domestic and export markets. The economic feasibility of domestic industries producing simple product-handling and processing equipment should be assessed. The production and servicing of refrigeration and transportation equipment should be advanced through applied research, training, technical assistance and investment credit. Such research will be especially important in the meat and fluid milk subsectors, which lack sufficient refrigeration capacity and suffer from relatively poor quality products.

Market Regulations

Market regulations can facilitate trading and contribute to the development of efficient market systems. However, regulations can also serve as barriers to the

exploitation of new economic opportunities. This is likely to be the case when regulations become obsolete due to changing technologies and business practices, or when unrealistic rules and standards have been established at the outset.

There are always laws, regulations or informal rules that structure the incentives confronting market participants and place limitations on their behavior. Only the more common and fundamental market regulations that apply to the Ecuadorian agricultural marketing system are discussed below.

Ecuador has made considerable progress in establishing standard weights and measures but enforcement capabilities are limited. Hence, there are opportunities for fraudulent behavior by retailers, traders, processors and farmers. Quality standards on agricultural inputs (seeds, fertilizer, pesticides and feed) are not well developed and the standards that do exist are infrequently enforced. The Ecuadorian Institute of Grades and Standards (INEN) has issued quality standards for more then 1,500 processed food products but much remains to be done to extend this effort and to focus attention on problems with processed foods where consumer health may be compromised.

The specific areas of concern which are being addressed by INEN are the following: (a) lack of sanitation in food processing that results in the transmission of toxic pathogens to consumers; (b) fraudulent labeling regarding ingredients, nutritional content and net weights; and (c) chemical residues in food from pesticide application at the farm level and chemical additives used in food processing.

The concern over chemical contamination of the food supply has become an international issue. In Ecuador and other developing countries there is increasing evidence that excessive application of chemicals by farmers is contributing to significant health risks for consumers. These risks may be greater than those in more developed countries where there is a higher level of technical knowledge and more strictly enforced regulations on chemical use. Furthermore, exports of fresh fruits and vegetables are being subjected to more stringent inspection upon arrival in foreign markets such as the United States, Europe and Japan.

Descriptive quality grades for raw agricultural commodities are beginning to emerge along with an expanding market information system. The widespread use of "grading criteria" in the pricing of commodities is badly needed to provide economic incentives for improving product quality. However, care must be taken to develop and promote the acceptance of realistic grades and standards without requiring mandatory use throughout the private trading system.

There are few that would deny that the government has important regulatory functions in the development of efficient and equitable food systems. In Ecuador, there is a strong disposition towards the "control" of private trading. This has resulted in increased risks and costs to private sector entrepreneurs and has not contributed in any significant way to the achievement of the GOE's stated development goals. Hence, a general recommendation is that government policy makers and administrators be sensitive to the societal cost of regulations that may have laudable objectives but negative effects on the food industry. Consultations with industry representatives and technically qualified personnel from research institutes can and should be part of the regulatory process.

Public Sector Support Services

In addition to creating a flexible regulatory environment which allows markets to function effectively, the GOE must provide direct market support services to actively improve market performance.

Market Information Systems

Over the past several years the agricultural statistics and market information service within the MAG has had a very limited ability to produce and disseminate reliable and timely estimates of crop and livestock production, storage stocks and current market price information. Several other government agencies have made independent estimates of agricultural production and marketing statistics. The result has been incomplete, inconsistent and often conflicting data sets which fail to provide the information needed to support sound administrative decisions by government and well-informed production and marketing decisions in the private sector.

The crucial importance of improving the Ecuadorian agricultural statistics and market information system was recognized in the design of the Agricultural Sector Reorientation Project, sponsored by the U.S Agency for International Development (USAID). A major objective of the project has been to strengthen the technical capabilities of two agencies, the National Institute of Statistics and Census (INEC) and the MAG, in order to develop a more coordinated national agricultural information system. The activities that have been supported include: (a) an expanded market news service; (b) a crop and livestock reporting service; (c) agroclimatic data collection and analysis for use in crop production forecasts; and (d) a computerized data management system.

The market news service now has regular reporting from 26 market centers covering some 60 commodities (MAG 1988; Abt Associates). Prices and related market information are disseminated daily. Weekly printed reports were given limited distribution until the end of 1989, when insufficient funding forced the suspension of even this limited distribution. As of April, 1990, distribution had not been renewed. Personnel have been partially trained and a market information office has been organized within the MAG. Much additional work is needed to improve the quality of the information through the use of generally accepted grades and standards. Quantity data would also be extremely useful to enable a better understanding of how the different markets function. Finally, the usefulness of market information could be substantially increased with carefully prepared commodity market analyses. These analyses might include periodic "outlook reports", i.e., assessments of forces that will affect market supplies and prices in the future.

Much remains to be done to improve crop and livestock production estimates. An "area frame sample" is being used to estimate crop production. Yield forecasting is being attempted and will be assisted by the on-going agroclimatic data collection and analysis.

An important constraint facing all these efforts has been the difficulty of coordinating activities between INEC and MAG and in obtaining adequate long-term funding support from the GOE to maintain a trained staff and the necessary facilities (Abt Associates). An additional constraint is the negative public sector attitude toward the private sector and especially toward processors and traders. Distrust of government also exists within the private sector and reduces their willingness to share data with publicly-sponsored market information services. It will take considerable time and demonstrated objectivity in the gathering and use of market data before this distrust can be overcome.

Marketing Credit and Financial Institutions

Special lines of subsidized credit have been allocated to agricultural

production and to a limited extent to processing operations. The Central Bank of Ecuador (BCE) has also channeled subsidized credit through the BNF to finance commodity inventories held by the public agencies, ENAC and ENPROVIT. However, there has been very little credit for medium and long-term private sector investments in marketing facilities and equipment. Commercial banks have been the primary source of short-term credit to finance inventories held by agricultural commodity processors and wholesalers. Small traders and many processors must depend to a great extent on their own funds and various schemes for deferring payments for products purchased from farmers or other traders. Rice millers depend to a large extent on cash advances from large wholesalers. The concentration of capital in relatively few wholesalers' hands may inhibit effective competition at this level. Thus, limited access to credit has continued to constrain the development of a more modern, cost effective marketing system (see Chapter 9 for more detail).

Research and Extension

The agricultural research and extension programs carried out by INIAP and the Foundation for Agricultural Development (FUNDAGRO) are directed almost entirely toward production technology. Marketing problems are not being seriously addressed by these institutions. This is an issue that deserves priority attention as a means to facilitate better economic adjustment between agricultural production and market opportunities. Applied research and extension should provide decision support to farmers, private sector intermediaries and public sector administrators. Poorly-informed decisions contribute to market failures, missed opportunities and inefficient allocation of resources.

It is particularly important that an institutional capability be established to improve post-harvest handling and processing of agricultural commodities. This capability could contribute to a reduction of product losses and expand the potential for the delivery of higher quality products to domestic and export markets. Success in promoting the export marketing of non-traditional, perishable commodities can only be achieved through a demonstrated capability to supply a dependable volume of high-quality merchandise. The development of post-harvest technologies and effective institutional arrangements will require close cooperation between the public and private sector. All of this will take time and can only occur with a major investment in human resources.

Education and Training

The lack of trained personnel is a serious constraint to the development of a more efficient and progressive system of agricultural marketing in Ecuador. Training is needed at different levels. At the operational level, there is a need to train people to operate more modern systems of product handling, storage, processing and distribution. Specialized training is also needed in food processing, wholesaling and retailing. More comprehensive academic training is needed to prepare managers, administrators analysts and planners for leadership positions in both the public and private sectors of the agricultural marketing system. At the present time, relatively little is being done in Ecuador to meet these needs.

The project paper for the USAID-sponsored Agricultural Sector Reorientation Project called attention to the almost complete lack of professionals trained in the field of agricultural economics. Provisions were made in the project for six scholarships for graduate study in the United States, with special emphasis on

agricultural marketing and policy. During the first three years of project implementation, five scholarships have been awarded and three of the recipients have now returned to Ecuador. Meanwhile, the experience of the MAG and the Agricultural Policy Institute (IDEA) in arranging contract studies has verified the extreme shortage of qualified professionals to carry out high quality, applied marketing and policy analyses. IDEA has begun organizing agricultural economics courses at a local university and is committed to work with the university toward the development of a comprehensive agricultural economics curriculum. However, this effort will likely not be successful without the support of a long-term, donor-assisted program. This program should include further graduate training of qualified students and existing faculty and be supplemented with in-service training of public sector personnel. In addition, extension education should be undertaken to address the marketing problems facing private sector groups.

VI. A Concluding Statement

The Ecuadorian agricultural marketing system has played a key role in the country's overall economic development by adding value to farm production and by providing employment to a broad cross-section of society. As population growth and rapid urbanization proceed and as per capita income begins once again to grow, this system will play an increasingly important role in the development process. The efficiency and progressiveness of the system will determine whether it impedes or facilitates this process.

The agricultural marketing system has been subject to a great deal of stress over the past twenty years. In general, it has responded positively to the growing demands placed upon it and has in the process contributed to the formation of a nationally integrated agricultural market.

Nevertheless, this system continues to be affected by a number of problems. Foremost among these might be public attitudes towards private sector marketing agents and activities. As indicated in earlier sections, a persistent and deeply embedded bias against private marketing agents has resulted in widespread government attempts either to replace these agents with public ones, or to rigidly control their activities. One result of this bias has been insufficient public and private investment in the creation of a more efficient and progressive marketing system.

This chapter proposes an alternative approach which can best be summarized as "helping markets work." Such an approach stands in contrast to both the government's deep mistrust of markets and to the idea that markets must be simply "allowed to work." It is based on an appreciation for the tremendous efficiency of markets in allocating resources to their most productive uses. But it also recognizes that market system performance is directly determined by the legal framework within which it operates, the availability of information, the level and distribution of human and physical capital, the ease of entry and the performance of each of the individual markets within the system.[20] The government can and must play a more proactive role in helping create an environment within which markets can function efficiently and equitably. This will require the design of more neutral and outward-oriented macroeconomic policies, sectoral price policies which reduce government intervention and clarify the conditions under which and the specific manner in which it will occur, and improved market regulations which contribute to rather than impede efficient market performance. These reforms must be accompanied by strategic investments in marketing infrastructure, support services and training to increase the private sector's ability to respond positively

to the improved policy environment.

Finally, even efficient markets will not meet the needs of all members of society. Cost-efficient, targeted interventions must be designed to protect the nutritional status of the most vulnerable population groups. In the long-run, emphasis must be continually placed on providing viable economic opportunities to these groups, so that they may more fully participate in the development process.

NOTES

1. Derived demand for feed grains, driven by increased demand for meat products, generally increases rapidly (Vocke, 1989).

2. Space, form, and time utility are basic concepts in marketing analysis. They refer, respectively, to the locational value of a product, the value added through processing (drying, cleaning, milling, etc.) and the product's temporal value, e.g., the value of having available for consumption in March, a product which was produced in July.

3. This occurs principally in Manabí province, where the arid climate permits leaving corn on the stalk to dry. Farmers "store" corn in this way, often temporarily suspending its harvest during the coffee harvest.

4. These relative proportions are especially variable in hard corn, due to the substitutability in production between this crop and soybeans during the dry season. Relative price policy between the two crops thus has very significant effects on the production of each crop. Erratic policies have in the past seriously disrupted the hard corn market.

5. Nevertheless, these farmers are not as large as the largest soybean farmers. The largest 5 percent of hard corn farmers averaged only 71 total hectares with 18 hectares in corn. In contrast, the largest 24 percent of soybean farmers averaged 237 total hectares, with 162 in soybeans.

6. Macroeconomic policies have had very significant indirect effects. See Chapter 2 for a general overview and Scobie and Jardine (1988a, 1988b, and 1989) for detailed discussion of these policies.

7. ENAC did not intervene in hard corn and rice markets until 1974. An official producer price for soybeans was not set until 1983 and ENAC did not intervene until 1984.

8. Payment at the official price implied very steep losses during February through April, since the market price exceeded the official price by more than 100 percent at that time. During the winter harvest, seizures caused smaller losses. Although the volume of seized grain was relatively minor in both instances, these actions can cause great uncertainty in the market. Based on discussions with traders and government price reporters, there is reason to believe that, in times of shortage, such actions induce them to withhold grain from the market, rather than release grain to it. The conventional wisdom in Ecuador is the opposite, i.e., that seizures will cause existing grain to flow more quickly to the market.

9. It is interesting to note that, of the predominantly large soybean farmers who made their largest sale to ENAC or soybean crushers in 1987, 25 percent also chose to sell a smaller volume to local traders. The reason for this sale was to take advantage of the traders' immediate cash payment (Tschirley 1988a).

10. The Four Firm Concentration Ratio (CR4), which indicates the percentage of a market's total production under the control of the four largest firms, is a widely

used measure of industry concentration. According to Marion (1985), the CR4 can be divided as follows:

CR4 > 65	Highly concentrated oligopoly
50 ≤ CR4 < 65	Oligopoly of high-medium concentration,
35 ≤ CR4 < 50	Oligopoly of low concentration, and
CR4 < 35	Unconcentrated market

11. Hard corn and sorghum are direct substitutes in the production of balanced feed for poultry.

12. See Tschirley (1989a) for more information on this issue.

13. See Chapter Six for more detail on production trends over the past 25 years.

14. All calculations are done in milled rice equivalents. Thus, the calculated margin covers only the cost of drying, cleaning, and milling. It does not cover the weight loss which occurs during these processes.

15. Ahmed and Bernard provide a helpful and concise discussion of the economic justifications for grain price stabilization policies. See also Timmer, and Streeten for excellent discussions of, as Timmer phrases it in the subtitle to his work, "the scope and limits of price policy."

16. Variations on the basic price band approach to price stabilization have been utilized in Indonesia, Kenya, and Chile, among other countries. Research on the approach has been carried out in Costa Rica, Honduras, Belize, Peru, and Southern Africa. See Ahmed and Bernard; Pinckney; Edwards and Ducci; Paz-Caferatta and Escobal; and Rebolar for more information.

17. For a detailed discussion of the recommended mix of policy instruments in each of these cases, see Tschirley, Ramos and Hugo.

18. The National Federation of Small Traders and Retailers (FENACOMI), a national association of 800,000 small retailers, could eventually be the primary importer of vegetable oil and sugar, though it is not currently capable of filling this role. SUPERMAXI, the largest modern supermarket chain, is currently capable of such imports. AFABA, the largest feed manufacturers' organization, has the existing capacity to import soybean meal. The attitudes of producers will have to be significantly changed to encourage an outward-oriented strategy.

19. Too, the demonstrated spatial integration of Costa grain markets means that such an approach would do a fairly good job of defending the price floor (adjusted for transport costs) country-wide.

20. For example, an inefficient domestic capital market can greatly reduce competition in domestic commodity markets.

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CHAPTER

9

CREDIT AND CREDIT POLICIES

HUGO RAMOS AND LINDON ROBISON

I. Introduction

This chapter analyzes agricultural credit and credit policies. The goal is to explain how these have influenced the development of Ecuador's agricultural sector. Since agricultural credit and credit policy are the major themes, they are first defined. Credit is the ability to borrow. Thus credit is a reserve or a resource that can be exchanged for loans or maintained as a reserve to be used when needed. The amount of credit available to an individual borrower depends on lenders having funds to lend and borrowers having demonstrated they are trustworthy. Loans then are not credit but what is exchanged for credit.

Credit is important in agricultural development because all investments in agriculture require an initial commitment of funds in return for expected future profits. As a result, there will be a lapse between the time funds are committed to the investment and when the investment generates the income necessary to repay the costs of the investment. Few firms have the liquid funds (cash and legal instruments easily converted to cash) necessary to pay for investments initially and therefore will need credit to invest. Unless there is a well-functioning credit system that provides loan funds on a timely basis and at a reasonable cost, investments and resulting increased productivity will be reduced and economic development retarded.

Ecuador's agricultural credit policy consists of the private and public terms and conditions under which savers save and borrowers borrow and how these terms are enforced in Ecuador's agricultural sector.

These policies are important in agricultural development because they influence the access to and cost of loan funds. This, in turn, helps determine which firms will make the investments required to produce, process and distribute agricultural products. Those firms with adequate access to credit will have significant advantages over firms without such access. Thus, the organization of

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the agricultural sector will be influenced by agricultural credit policies. Agricultural credit policies also affect consumers because the organization of production helps to determine the price and availability of food products.

The evidence presented in this chapter supports the conclusion that the policy of administered and subsidized interest rates has created a condition of excess demand for agricultural loans. This condition, in turn, has resulted in non-market allocations of loan funds through processes that are dominated by the interests of large and well-to-do farmers who divert loans from their most productive use in agriculture. Thus, subsidized interest loan programs have largely benefitted the large, well-to-do farmers who already have adequate credit and other subsidies such as import tax exemptions for some agricultural inputs, support prices for their products and subsidized inputs made available through parastatals.

This chapter also concludes that the policy of charging below-market interest rates on loans has decreased total investments in agriculture. Subsidized interest rates for loans leads to below market rates of interest on savings. This, in turn, discourages savers from depositing funds with banks which would allow them to increase their loans and therefore to increase investments. Evidence is that National Development Bank (BNF) loan funds supplied from loan repayments and deposits has decreased as a result of the subsidized interest rate policy.

A further consequence of the policy of subsidized interest rates is that the BNF, a major source of loan funds to the agricultural sector, is being decapitalized. Allowing borrowers to repay with Sucres that are worth less than those borrowed is a policy that cannot long be sustained. In the past this policy has been supported by foreign loans and direct government subsidies to recapitalize the BNF. The evidence is that this source of support will likely be diminished in the future.

Finally, this chapter concludes that macroeconomic policies leading to inflation have reduced long term investments in agriculture. This is a consequence of the liquidity problem accompanying inflation. An inflationary economy creates capital gains on investments; long term investments earn capital gains at a higher rate than shorter term investments, other things equal (Barry and Robison). An inflationary economy also increases interest rates on loans that are used to fund investments. But capital gains are not in the liquid form needed to pay for the higher loan payments caused by the higher interest rates. The result is a liquidity problem that is most severe for long term investments. As a consequence, more liquid, short term investments are more likely during an inflationary period.

The rest of this chapter is organized as follows. Section II provides a brief description and history of Ecuador's agricultural credit policies. Section III describes Ecuador's agricultural credit system, including both private financial intermediaries and public financial organizations. Section IV analyzes the agricultural credit policy of administered rather than market determined interest rates for borrowers and savers. Section V reviews the influence of an inflationary macroeconomic policy on agricultural credit. Finally, Section VI presents the conclusions and recommendations for changing Ecuador's agricultural credit policies to improve the productivity of and to increase the amount of agricultural sector investments.

II. Ecuador's Credit Supply Policy

This Section has three parts. The first describes the role of the Central Bank of Ecuador in determining the amount of loanable funds available for the

agricultural sector. The second part reviews the terms and conditions under which loan funds are made available to agriculture. Finally, the third part describes the relationship between credit policies, macroeconomic policies and inflation.

The Central Bank of Ecuador and Agricultural Loan Funds

The main source of loanable funds for lenders--banks and other financial institutions--serving the agricultural sector is the Central Bank of Ecuador (BCE). Sources of BCE funds are described next.

Sources of BCE Funds

There are four major sources of BCE funds: the Government of Ecuador's (GOE) budget allocations, foreign loans, contributions of Ecuadorian private banks and other financial organizations, and sale of bonds in the national capital markets. The GOE's budget allocations increased rapidly during the petroleum boom but diminished during the 1980s. Foreign lenders and donors to Ecuador's agricultural sector include the International Bank for Reconstruction and Development (World Bank), the Inter-American Development Bank (IDB), regional organizations such as the Andean Finance Corporation (CAF) and foreign private banks. Funds from foreign lenders and donors increased during the 1970s but began to shrink after the 1982 financial crisis. BCE funds obtained from private financial organizations in Ecuador are basically BCE stock purchases and private bank deposits.

How The BCE Provides Money and Credit

The BCE influences the supply of money in Ecuador through its sale (purchase) of bonds. Both the GOE and private financial institutions issue bonds which the public is supposed to purchase. In practice, these bonds have been purchased by the BCE and have never been sold in the national capital market. The BCE could sell these bonds in the stock market should it need to withdraw money from the economy, or it could buy them whenever the economy needed cash. Currently (1990) the bonds are not being sold privately because the yield on them is well below the inflation rate and the BCE is unwilling to discount them enough to make them attractive to private investors.

The BCE provides credit through its rediscount operations. It also supplies credit by offering direct loans and advances, issuing bankers acceptances and providing emergency loans.

Financial intermediaries participating in BCE's rediscount operations act in some ways like a loan officer making loans on behalf of the BCE. They first grant a loan to a borrower. Then the note associated with this loan is submitted to the BCE which lends to the financial intermediary a percentage (usually 80 percent) of the original loan. The interest rate the BCE charges the bank is called the rediscount rate. Banks are allowed to add a margin (spread) to this rate which is supposed to cover the bank's cost of administering the loan. The rediscount rate plus the margin is the interest rate paid by borrowers who obtain loans from the financial intermediaries serviced by the BCE. By adjusting this spread, the BCE influences the amount of money borrowed from it and hence the amount lenders are willing to lend.

The BCE offers direct loans to banks, finance companies and private firms to finance specific programs or projects. Examples of this type of operation are

BNF advances used to finance the Marketing and Storage National Enterprise's (ENAC) intervention in the grains market.

Bankers acceptances are BCE operations by which financial institutions are able to rediscount their loans to private traders and especially to exporters of agricultural products.

Finally, emergency loans are made by the BCE to institutions unable to meet the legal reserve requirement.

BCE Lines of Credit

Another way the BCE provides credit is through its established credit lines which are accessed mainly through rediscount operations. The Financial Funds Mechanism (FFM) and the Marketing Line of credit (*Regulación* 696) are the BCE's most important agricultural lines of credit. The FFM was created at BCE in 1972 to channel the large flow of oil revenues and funds from domestic and foreign resources to the various sectors of the economy. The FFM organizes the loan funds into five basic categories: the agricultural and livestock fund, the industry and artisan fund, the integrated development projects fund, the export promotion fund (FOPEX) and the external resources fund. Another special fund known as the Regulación 696 is available to finance marketing activities.

Users of BCE Funds

The single most important user of BCE's agricultural funds is the BNF. During the 1980-1988 period the BNF has financed, on average, about 41 percent of its total loan portfolio with BCE resources. Another important group of users of BCE agricultural funds is the private banks which have the obligation of building their loan portfolio with at least 10 percent of agricultural loans. Finally, the private financial companies and the National Finance Corporation (CFN) are major users of the BCE funds, especially through the BCE rediscount operations.

Administered Credit Policies

Ecuador's credit policies are administered rather than market determined. That is, interest rates on loans, reserve requirements and distribution of loans are the result of government policies and associated administrative decisions rather than a response to market forces.

Determining Credit Policies

The loan policies of the BCE are established by the Monetary Board. The Monetary Board includes representatives from the Presidency, the Ministries, the agricultural sector, industry, chambers of artisans and small industry and chambers of commerce. The board prepares its annual budget and loan policies in coordination with and in support of the National Development Council's (CONADE) development plan.

Once the Monetary Board has decided on its allocation of loan funds the BCE implements its plan. The BCE operates basically by making credit lines available to the financial institutions. Most credit lines are defined by the Monetary Board as preferential and are offered at subsidized interest rates.

Interest Rate Discrimination

The Monetary Board discriminates among their preferential credit lines. For example, in 1984 the BCE advance and rediscount rates were set at 11 percent for the Fund for Marginal Rural Development (FODERUMA), 13 percent for the BNF and 18 percent for private banks. By mid-1989 the rates had risen to 18 percent for FODERUMA, 27 percent for BNF and 31 percent for private banks.

In addition to interest rate discrimination among financial institutions, the Monetary Board sets the margin between what it charges participating financial institutions and what they can charge their borrowers. By the middle of 1989, BNF was allowed to charge a margin of five points, placing an upper limit on the loan rate they offered borrowers of 32 percent. Meanwhile the margin for private banks was seven points, allowing them to set a maximum rate of 39 percent.

Private banks, and to a lesser extent the BNF, currently can provide loans to the agricultural sector from privately supplied funds at market determined rates. However, these so-called "market" rates are not completely free since the Monetary Board limits the rate to 15 percentage points over a "reference rate" estimated and published by the BCE. The reference rate is calculated as the average rate paid by banks on savings and 90-day certificates of deposit. Financial companies are allowed to charge 17 percentage points over the reference rate but they are not allowed to receive monetary deposits.

The rates paid on savings and 90-day certificates of deposit are determined competitively. By mid 1989, the average deposit rate was about 36 percent, setting the private bank loan rates at about 53 percent.

Reserve Requirement Discrimination

Another way BCE discriminates among lenders by is by requiring different levels of reserve. Since the late 1970s, the legal reserve rate for the BNF has been set at 10 percent. Meanwhile this rate has varied for the private banks. In 1984 this rate for private banks was 22 percent; by mid 1989 it had increased to 31 percent. In February of 1988 the reserve requirement reached a peak of 37 as the BCE tried to restrict the money supply and to reduce inflation. Despite efforts to restrict the money supply with increased reserve requirements on private banks, Ecuador's money supply tripled from 1984 to 1988 and from December 1988 to September 1989 increased 16 percent (BCE).

Distribution of Loanable Funds

BCE's allocation of loanable funds discriminates against the private financial sector in favor of the BNF. In 1980 BNF use of BCE credit lines represented 15 percent of the total credit available at BCE and private banks utilization represented 28 percent; by mid 1989 the shares were 22 percent for the BNF and 16 percent for private banks. Private banks claim that the margin between the loan rate they are allowed to charge their borrowers and the rediscount rate paid to BCE does not cover their costs. Thus, they cannot justify fully utilizing BCE credit lines. On the other hand, BNF is becoming more and more dependent on BCE funds, as well as on foreign loans, because of its continuing decapitalization and its inability to attract private savings and monetary deposits.

III. Financial Intermediaries

Financial intermediaries are firms whose main activity is obtaining funds and providing loans. Examples of financial intermediaries include private banks, private finance companies, credit unions and savings cooperatives. In addition, informal lenders provide important financial intermediation services to the agricultural sector even though they cannot be classified as financial intermediaries per se. This Section discusses the most important public and private financial intermediaries and other organizations that supply loans to agriculture. For each organization this section presents a brief history, purpose, source of loanable funds, the unique credit policies under which it operates, the clients it serves and the interest rate it charges.

Public Financial Institutions

BNF

The BNF was created as the Mortgage Bank (*Banco Hipotecario*) during the 1926-1933 progressive banking years. In 1947 the Mortgage Bank was reorganized and transformed into the BNF banking system. According to the law that created it (*Ley Orgánica*), the bank's main purpose is to help medium and small farmers and producers to increase production and improve productivity. Since its creation, the BNF has constantly expanded its operations, especially during the 1970s when oil revenues significantly increased the amount of loanable funds in Ecuador's financial system.

The BNF is the single most important institutional source of credit for the agricultural sector (Figure 9.1). During the 1980s it provided, on average, 36 percent of the funds used in the agricultural sector. The loans provided by the BNF have been funded mainly by the BCE through the FFM, the development bonds and the marketing fund programs. The use of the FFM by the BNF has been facilitated by its extensive infrastructure (72 bank offices) and the location of its operating offices in cities and towns not served by commercial banks.

The monetary deposits of public institutions were a significant source of funds for the BNF until 1980, when the government changed the regulations. The changes in the regulations obliged public agencies and institutions to transfer all disposable funds held as deposits in the BNF to the National Treasury Account opened at the BCE. Since the public funds deposited in its branches by municipalities, provincial councils and other public institutions were used to provide loans, they could not be immediately recalled for deposit at the BCE. The process of transferring public funds to the National Treasury Account destabilized the BNF during the transition period. The BNF could not repay part of its rediscounts to the BCE requiring it to negotiate two debt consolidations.

The savings rate offered by the BNF has not been sufficient to attract private depositors and savers. The interest rate paid on savings deposits at the BNF is at least two points below the rate offered by commercial banks and savings and loans associations and at least 25 percent below the rate offered on certificates of deposit. As a consequence, not only savers have been discouraged from saving at BNF but also borrowers obtaining BNF loans frequently deposit their loan funds in commercial banks. There they also receive better financial intermediation services and their deposits can be used to leverage private bank loans.

Another important source of funds for the BNF are foreign loans contracted directly with multinational financial institutions. Among the lenders, the IDB and

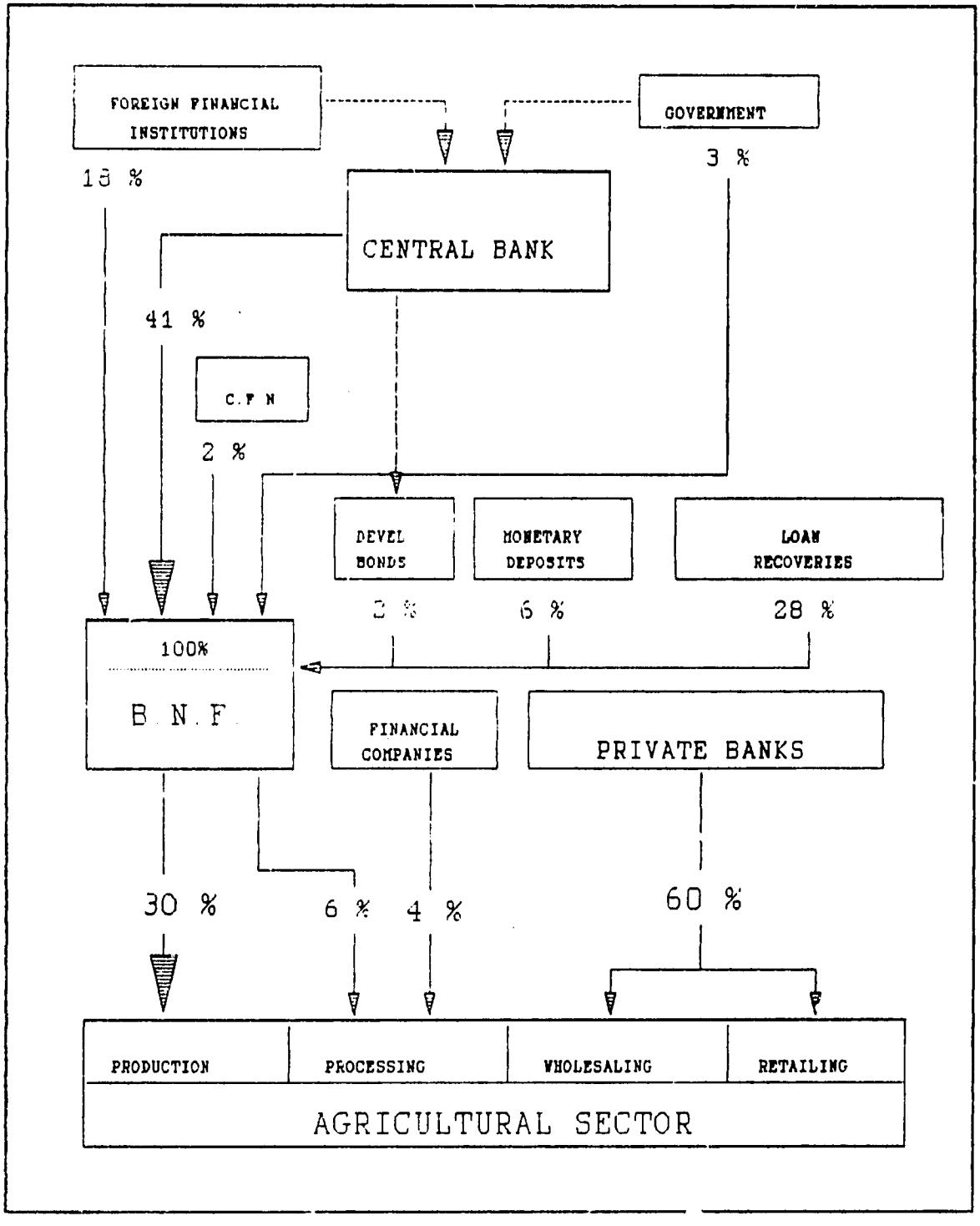

Figure 9.1 Sources of funds for the BNF and flow of funds to the agricultural sector (percentages are averages for the period 1980-1988).

the World Bank have been the most important suppliers of financial resources. This source of funds is becoming more and more important as other sources, mainly monetary deposits and savings, are rapidly diminishing due to the low savings and term deposit rates paid by BNF.

The BNF offers basically two types of loans: the training loan and the banking loan. Training loans are designed to help exclusively small borrowers by providing them technical assistance and funds at lower interest rates than charged on banking loans. Banking loans are directed to borrowers who graduated from the training loan program and need no more technical assistance and who are supposed to be able to pay for technical services. Historically, the banking division portfolio has been larger than the training division portfolio. BNF's category of bank loans are treated much like any commercial loan in a private bank, except that the interest rate is lower than in commercial banks.

To obtain BNF loan funds, borrowers must meet a cumbersome set of requirements. One of the requirements is the certification of land ownership. This turns out to be one of the BNF's most restrictive requirements for small farmers. In addition to a deed, title of land ownership, or a certificate of legal possession, there are other requirements that are especially difficult for small farmers to meet. One of these is the identification card issued by the *Centro Agrícola* certifying that the borrower is a farmer.

Meeting these requirements are costly for the farmers and when only small amounts of loan funds are involved, the benefits of the loan do not justify the high transactions cost involved.

CFN

The CFN was created in 1953 primarily to serve the small industry and artisan sectors of the economy. Later on, CFN's purpose was expanded to include the financing of non-traditional agricultural export products.

As with other financial companies, the CFN is not allowed to receive deposits. Therefore, its sources of funds are limited to loans from multinational lending organizations and the central government, through financial allocations of funds managed by the BCE.

Within the CFN there is a special credit program called the Small Industry and Artisan Fund program (FOPINAR). This program is important to the agricultural sector because it supports agro-industrial investments such as processing equipment and storage.

The Export Promotion Fund Program (FOPEX) is another special program of CFN. This program is funded by rediscounts from the BCE and by direct loans from foreign governments and agencies. This program finances the export of non-traditional agricultural products such as flowers, shrimp, exotic fruits and vegetables. The interest rates charged by the CFN, like those charged by the BNF, are set by the Monetary Board. Investment loans carry a lower interest rate than short term loans such as those for shipping expenses. The average term for short term loans is 180 days and the maximum term is two years. The term for long term loans ranges from five to twelve years, including a grace period varying from two to four years.

CFN loans, like those of the BNF, are supervised. The loans require a pre-investment inspection. The loans are granted in increments that depend on completion of intermediate steps and favorable reports from credit supervisors. These loan supervisory visits all increase the transaction costs of the loan, causing the CFN to favor large investment projects.

Private Financial Intermediaries

Private Banks

Private banks were created primarily to provide financial intermediation services to the private sector. The private banks of the Costa region served the financial needs of producers of traditional export crops such as cacao, coffee and bananas. The private banks of the Sierra were created mainly to finance large farms (*latifundios*) and the country's interregional trade.

Ecuador's private banking system is highly concentrated. It consists of 32 banking institutions, including four foreign banks (Citibank, the largest foreign bank, *Holandés Unido*, Lloyds Bank and Bank of America). Ecuador's five largest private banks, based on a three year average (1986-1988), hold about 45 percent of the assets of the private banking system. They also hold 44 percent of the loan portfolio, more than 50 percent of the monetary deposits (including certificates of deposit) and about 42 percent of the total capital and reserves of all private banks. The remaining 27 private banks are medium and small banks created mainly by industrial investors who are eager to gain access to the subsidized credit available at the BCE through the FFM.

The main sources of funds for private banks have been the monetary deposits (demand and time deposits and savings) and foreign loans. Since 1985 private banks have aggressively competed for domestic savings through the issuance of certificates of deposit and by offering market determined interest rates.[2]

The BCE has become an important source of funds for private banks as the gap between the inflation and the interest rates has widened. To access BCE funds, private banks are required to make 10 percent of their loans to the agricultural sector. Private banks have met this obligation by allocating large amounts of resources to a few large borrowers to reduce transaction costs.

The majority of funds lent to the agricultural sector by private banks have been to finance short term investments, basically annual crops and trade. The rest of the funds have been targeted to a few large, long-term investments secured by land, processing plants and the goods financed by the loan such as cattle, machinery and equipment. During the last few years private banks have reduced their financing of long term investment, recognizing that the acceleration of the inflation rate vis-à-vis fixed interest rates was resulting in large financial losses. Private banks have been financing long term investments by permitting short-term loans to roll over.

The interest rate charged by private banks on their agricultural loans is higher than that charged by public financial institutions such as the BNF and the CFN. However, many borrowers express the viewpoint that after adding the transactions costs of BNF loans, the total cost of a loan from a private bank is less than the cost of obtaining a loan from the BNF or CFN.

Private Financial Companies (PFCs)

Private financial companies are basically new institutions, created during the 1970s. The largest and most closely linked to the agricultural sector is the Ecuadorian Finance Corporation (COFIEC). The main purpose of PFCs is to provide specialized financial intermediation services to such groups as home and office builders, consumer groups and selected agricultural enterprises.

The existing monetary laws do not permit private financial companies to

receive deposits although they can borrow private resources to be channeled to private borrowers. Private financial companies do have access to the BCE's FFM rediscount window. During 1988, the BCE provided about 22 percent of the loanable funds of the PFCs.

The role of PFCs in the agricultural sector has been limited. Most of their loans have financed capital investments and operating expenses in the dairy and beef industry, palm oil plantations and shrimp farms. The share of agricultural loans in the portfolio of these financial companies during 1988 was about 22 percent. The rest of their loans financed industrial and manufacturing investments (about 38 percent) and construction (approximately 20 percent).

The interest rate PFCs charge agricultural borrowers is determined by the Monetary Board. In addition to the interest rate, however, financial companies charge additional fees for commissions, inspections, insurance and other administrative expenses, making their loans even more expensive than private bank loans.

Credit Unions

Credit Unions were created to provide deposit and short term loan services to their members. It is estimated there are about 1,000 credit unions throughout Ecuador, of which 150 are approved and supervised by the National Credit Union Federation of Ecuador (FECOAC) compared to only 39 Savings and Loans Co-ops that were registered by the Superintendency of Banks in 1988. The majority of credit unions are located in the urban areas and serve specific groups of people such as employees, artisans and small industrial firms. Credit unions in rural areas, however, are community-oriented and their members include farmers as well as others.

Credit unions are not allowed to receive demand deposits but they can accept savings deposits in the form of shares. Nor do the credit unions have access to the BCE's rediscount window. Thus, the funds they have for lending are self-generated. Their widespread distribution has made them the principal means for mobilizing savings in many communities where neither banks nor financial companies have offices. Yet restrictions on receiving demand deposits and using the BCE rediscount mechanism limit the range of financial services they can provide.

The loans provided by credit unions are mostly for commercial activities, urban construction and small industrial production. Credit unions direct their agricultural loans to mainly small producers and to finance marketing operations.

Informal Credit Suppliers

Informal credit suppliers include moneylenders, processors of agricultural goods, wholesalers advancing money for the purchase of agricultural products under a future delivery type of contract and agricultural input suppliers.

Moneylenders generally finance their operations with their own savings, while processors and wholesalers finance their loans with both their own resources and with bank loans. Agricultural processors usually have access to subsidized credit from the BNF to finance their agro-industrial activities. Those vertically integrated with production add these funds to loans obtained from banks to finance their production activities. Part of the processors' resources are used to develop agricultural production, lending them again them to small producers who are unable to borrow directly from the BNF or private banks because of their size or bad

credit history.

Agricultural input suppliers, especially those located in the rural areas and close to their farmer customers, often provide credit in kind; that is, they advance agricultural inputs with payment expected at harvest. The credit they provide is based on their own resources, loans from banks, or credit from their larger suppliers who allow them to make purchases using post-dated checks (checks redeemable after 15 or more days).

The cash resources obtained through informal channels are used mainly to finance the harvest and the trade (including some processing activities) of agricultural produce. In some cases, these funds are used to finance production activities as well, especially when planted area is estimated to be low and processors want to guarantee their supply of raw products.

Credit arrangements in the informal financial markets are secured mostly with personal confidence and trust developed through many years of doing business or relationships established in other contexts. First-time participants in the informal credit market are required to secure their loans, handing in valuable assets to lenders, such as jewelry, consumer durables and small equipment not necessary for agricultural activities (sewing machines, for example).

Although the transactions costs of closing loans in the informal credit market are lower, the interest rates charged are higher than rates charged in the formal credit market. During May-June 1989 a field survey of rice marketing revealed that this rate was, on average, 10 percent per month, not compounded. The survey revealed also that the term of these loans was usually less than two months (Ramos 1989).

External Financial Institutions and Donors

The World Bank

The World Bank has been a major supplier of funds to Ecuador. In January of 1986, the World Bank granted an agricultural sector loan of US$ 100 million to be monitored by the BCE through its FFM mechanism. In January of 1987 it granted another loan to Ecuador for US$ 48 million (Loan 2752-EC) to help finance the development of agricultural exports.

IDB

The IDB has been an important source of external funds for the agricultural sector and especially for the BNF. Past IDB funds have been provided directly to the BNF. During the 1980s the IDB provided a total of US$ 374 million to finance three global agricultural credit programs executed by the BNF. In December of 1983 the loans identified as: 463/OC, 464/OC and 743/SF, totaling US$ 54 million, were negotiated to help finance the First Global Agricultural Credit Program intended to help boost productivity of agricultural products directed to local markets. In 1985 a new loan, the 510/OC, equal to US$ 120 million, was approved to help finance the Second Global Agricultural Credit Program. A Third Global Agricultural Program, EC-245, for US$ 200 million, was approved to increase agricultural production and to improve agricultural productivity.

Other Foreign Lenders

There are other foreign lenders who provide credit to Ecuador's agricultural

sector. One of these is Andean Development Corporation (CAF). The CAF has provided loans directly to the BNF and the CFN to finance specific investments. Three recent loans to BNF have been used to finance palm oil plantations in the Pichincha and Esmeraldas provinces. The U.S. Agency for International Development (USAID) has also provided a credit line to help support the export of non-traditional agricultural products. It also has provided limited credit lines as part of rural development projects.

The government of Ecuador has also received grants and loans from other governments, both in cash and in machinery and equipment, to help the country to develop its agricultural sector. The governments of West Germany, Denmark, Czechoslovakia and, lately, Italy, have provided credit to Ecuador.

IV. Consequences of a Subsidized Credit Policy

Ecuador's credit policy is one of administered interest rates on loans. In effect this is a policy of charging below market rates of interest to privileged borrowers. Then, because the rate paid savers cannot exceed the rate charged on loans, the interest rate paid on deposits also is below the market rate required to induce savers to save.

Since the BNF is the most important credit source for Ecuador's agricultural sector, this section focuses on how the credit policy of administered interest rates affects the BNF and the agricultural borrowers it is directed to serve.

The interest rates charged on new BNF loans were always less than the rate of inflation during the 1980s (Table 9.1). Moreover, during 1983 and 1988, the inflation rate was at least 30 percent higher than BNF's interest rate. This means that BNF borrowers were being paid by the bank to borrow money since the real rate of interest on their loans was negative. Clearly, BNF borrowers have been offered a good deal.

Concentration of Loan Benefits

BNF's loans at below market rates of interest have largely benefitted their large borrowers. This, of course, is not the group the BNF was supposed to serve. According to its charter under which it was organized (Ley Orgánica), the bank's main purpose is to help medium and small farmers and producers. The BNF was to accomplish this purpose by providing the medium and small borrowers the credit necessary to make needed and timely investments. The evidence is that the BNF has not accomplished its purpose (Table 9.2).

The percentage of small loans (less than 100,000 1980 Sucres) fell from 29 percent in 1980 to 2 percent in 1988, while loans larger than one million Sucres increased from 20 percent in 1980 to 60 percent in 1988. Thus, assuming that large loans are granted to large borrowers, the benefits of the BNF subsidized loan program are increasingly being concentrated in the hands of larger, more well-to-do borrowers.[3]

The concentration of BNF loans in the hands of fewer and larger borrowers may be explained partly as BNF's effort to reduce their transactions costs or to reduce the effective demand for BNF loans. Consider how such pressures might concentrate the benefits of BNF's loan program.

Credit markets are in equilibrium when the demand for loans equals the supply of loans. When financial institutions such as the BNF offer credit at below market rates of interest, the demand for loans exceeds the supply of loans.

Table 9.1 Comparison Between the Inflation Rates and the Average Interest Rates Charged on Loans by the National Development Bank

Year	Price Index	Inflation Rate	Interest Rate[a]	Real Interest Rate[b]
1980	1.00	12%	11%	-1%
1981	1.15	15%	13%	-2%
1982	1.34	16%	13%	-3%
1983	1.98	48%	15%	-33%
1984	2.60	31%	17%	-14%
1985	3.33	28%	19%	-9%
1986	4.10	23%	21%	-2%
1987	5.31	30%	23%	-7%
1988	8.31	57%	27%	-30%

Source: BCE.

[a] Average interest rate charged on loans.
[b] Defined us nominal interest rate minus the inflation rate.

Nevertheless, the supply of credit must be distributed among borrowers; because interest rates no longer serve as an allocation device non-market mechanisms are used.

Excess demand for credit, the result of BNF's below market interest rates, however, invites political patronage, bribes and other mechanisms for allocating loan funds. Moreover, those with the most influence rather than those who can use the loan funds most productively will ultimately be granted loans.

BNF helps equate the supply of loans to the demand for loans at below-market interest rates by increasing the transactions costs of obtaining loans. Transactions costs that reduce the profitability of BNF loans and hence reduce the demand for loans include the following: increases in the collateral required for loans; increases in the number of times a borrower must come to the bank before receiving his or her loan funds; increases in the number of forms documenting the loan; reductions in the amount available for specific loans; delays in receiving the loans funds; and a shorter term of loan. The BNF has imposed all of these non-interest costs on its borrowers. These, however, represent a fixed cost which decreases per Sucre borrowed as the size of the loan increases. Smaller borrowers pay a higher cost per Sucre borrowed than do large borrowers. Thus the demand for BNF loans by small borrowers has been reduced, because of transaction costs induced by the policy of subsidized interest rates.[1]

Subsidized credit policies result in higher costs for small borrowers than large borrowers. This helps explain the concentration of loans from the demand side. It is also important to examine whether or not a subsidized interest rate encourages the BNF to lend to large borrowers. The conclusion reached here is

Table 9.2 The Distribution of the National Development Bank's Loans by Loan Size (millions of 1980 sucres)

Year	Size of Loans :							Total Annual Loans
	< 0.1	0.1-0.5	0.5-1	> 1[a]	1-5	5-20	> 20	
	million sucres							
1980	1764	2258	832	1242	0	0	0	6095
1981	1532	2411	915	1513	0	0	0	6371
1982	1236	2270	875	1413	0	0	0	5794
1983	1025	2403	1078	2508	0	0	0	7014
1984	748	2545	1302	3878	0	0	0	8474
1985	539	2645	1663	0	3726	1546	0	10119
1986	389	2334	1708	0	3647	2433	0	10512
1987	257	1968	1708	0	3161	1620	0	8715
1988	114	1214	1420	0	2412	1464	310	6934
	%							
1980	29	37	14	20	0	0	0	100
1981	24	38	14	24	0	0	0	100
1982	21	39	15	24	0	0	0	100
1983	15	34	15	36	0	0	0	100
1984	9	30	15	46	0	0	0	100
1985	5	26	16	0	37	15	0	100
1986	4	22	16	0	35	23	0	100
1987	3	23	20	0	36	19	0	100
1988	2	18	20	0	35	21	4	100

Source: BNF.

[a] Until 1984 all the loans greater than 1 million sucres were included into one category because there were few loans greater than 5 million sucres and none greater than 20 million sucres.

that it does.

Since the BNF does not have the authority to charge borrowers the market rate of interest on loans, they attempt to remain viable by reducing the cost of granting loans. Experience has demonstrated that loan servicing costs are directly related to the number, not the size of loans (Araujo and Meyer). Recognizing this fact has encouraged the BNF to make fewer and larger loans.

Transactions costs for the BNF also can be reduced by lending to repeat borrowers since these loans may not require reinspection and collateral for the loan often is already secured. Finally, the bank's transactions cost of lending may be reduced by offering loans only to financially secure firms whose default risk is low. But offering large amounts of credit to repeat borrowers who are financially secure

serves to concentrate the benefits of the subsidized loans in the hands of the large, well-to-do borrowers.

Subsidized Credit and Savings Mobilization

Agricultural finance researchers have repeatedly concluded that subsidized loans and negative real interest rates offered savers results in a failure to mobilize savings in the rural sector (Adams; Gonzalez-Vega). This result is especially likely when the only depository services are those available from public financial intermediaries. Ecuador's experience offers particular support for this conclusion. In the private economy, impressive increases occurred in savings in the form of certificates of deposit when private banks were allowed to offer market determined rates of interest during the 1985-1987 period.

In partial response to Ecuador's financial crisis, the Febres Cordero government freed interest rates on all savings and loans except those subsidized from the BCE to specific sectors.[5] This policy, however, had minimal effects on the agricultural sector because the Monetary Board refused to remove interest rate restrictions on the BNF. Nevertheless, allowing interest rates to be market-determined for the private sector demonstrated how important savings mobilization could be when stimulated with positive real interest rates.

In 1985, private banks were allowed to issue certificates of deposit at market determined rates of interest. In the first year, the total amount issued reached 33.2 billion Sucres. By the end of 1986 the total amounted to 58.5 billion and by the end of 1987 reached 88.5 billion--equivalent to 21 percent of the total liabilities of the commercial banks to the private sector.[6]

The impressive saving mobilization role provided by the certificates of deposit testify to the availability of financial savings. Moreover, by lending these funds in the sector in which they are saved, a multiplier effect is generated on other savings and loans. Unfortunately, there are no data that distinguishes what quantities of certificates of deposits are provided by rural savers. Nevertheless, the BNF has the rural branches available to receive deposits that could be mobilized if they offered incentives to savers. Then deposits would increase and so would the loanable funds of the BNF.

Savers suffer an additional cost of not being able to save at positive real interest rates. It means they must hold physical goods or make investments for which they may be ill prepared to manage. Thus the failure to provide profitable alternative depository opportunities precludes the separation of the savings and investment functions and the advantages which this separation offers. Moreover it forces potential savers into investments less profitable and less liquid than could be earned if the credit market were allowed to function properly. Finally, it results in capital flight to secure capital markets operating in foreign countries.

The low domestic interest rate paid on Sucre-denominated financial assets, relative to the rate paid on financial assets held in dollars offers a substantial interest rate arbitrage gain. Additionally, holding dollar-denominated assets has been perceived as a secure way to save and hedge against economic instability and inflation. The amount of money that has been expatriated under these conditions has not been documented. However, Connolly notes that Ecuadorian private sector monetary deposits in U.S. banks is over five billion dollars, equivalent to about 50 percent of the Ecuadorian foreign debt.

Subsidized Loans and BNF's Viability

Offering loans at negative real rates of interest, unless there are individual savers or donors willing to save at negative rates of interest, will eventually decapitalize financial intermediaries. The explanation is simple. With inflation, Sucres are devalued. If the interest rate on loans is less than inflation, loan principal and interest repaid the bank will be worth less than the original loans received by borrowers. If the bank is lending its own capital funds, which is the case of the BNF, then offering negative real interest rates on savings guarantees its decapitalization.

The BNF has been obligated by the Monetary Board to offer interest rates that are less than the rate of inflation. Moreover, the negative interest rates offered savers has not attracted deposits from the private sector in any significant amount. Thus, its continued operation is made possible only by continued infusions of capital by BCE, CFN, the GOE and foreign donors (Table 9.3).

In 1980, 1981 and 1982, when BNF's interest rate was on average only 2

Table 9.3 The National Development Bank's Source of Loan Funds

Year	Monetary Deposits	BCE & CFN	Foreign Loans	Development Bonds	GOE Capital	Loan Recovery	Annual Loans
	million sucres						
1980	878	2624	284	40	221	2048	6095
1981	411	2044	147	444	314	3959	7319
1982		2300	194	418	186	4646	7744
1983		6884	277	1535	844	4369	13909
1984	2360	7089	514	1668	2197	8219	22047
1985	339	17043	7708	400	1146	7066	33702
1986	1229	21098	11293	220		9228	43068
1987	5317	21698	8940	479	944	10277	47655
1988	3346	22797	14050	257	1595	15604	57649
	%						
1980	14	43	5	1	4	34	100
1981	6	28	2	6	4	54	100
1982	0	30	3	5	2	60	100
1983	0	49	2	11	6	31	100
1984	11	32	2	8	10	37	100
1985	1	51	23	1	3	21	100
1986	3	49	26	1	0	21	100
1987	11	46	19	1	2	22	100
1988	6	40	24	0	3	27	100

Source: BNF.

percent less than the rate of inflation, the percentages of funds from loan repayment were 34, 54 and 60 percent, respectively. In 1986, 1987 and 1988 the rate of inflation exceeded BNF's loan rate by over 20 percent. As a consequence, the percentages of funds obtained from loan recovery fell to 21, 22 and 27, respectively. Meanwhile, the percentage of loan funds provided by foreign loans increased from about 2 percent to well above 20 percent. Foreign lenders, however, are not likely to continue to subsidize large BNF borrowers that eventually decapitalize their loans. Evidence of this is the IDB's late 1989 suspension of disbursements of a credit to the BNF until its subsidized credit policy was modified.

Subsidized interest rates contribute to the decapitalization of the BNF in another way; they encourage borrowers to default on or to postpone their loan payments. Consider the evidence. BNF's current practice of offering loans at subsidized interest rates implies that the real value of loan repayments will be less than the value of loans granted. Consequently, the longer the period that a borrower can maintain his or her control over a BNF loan, the larger is the subsidy that can be claimed. Delayed loan repayments, however, reduce the real value of the revolving fund available for lending, contributing to the decapitalization of the bank (Table 9.4). Normal banking standards would expect less than 2 percent of a lending institution's funds be overdue. At BNF, however, the rate averaged over 10 percent during the 80's.

In the past, the BNF penalized defaulted loans, but the penalty was not sufficient to reduce the amount or proportion of delinquent loans. The inflation rate has been above the subsidized interest rate plus the default rate (which has fluctuated between 2 and 4 percent). In addition to this consideration, farmers believe that the transactions cost to obtain a new loan or to renew the outstanding one could be higher than the extra 2 to 4 percentage points charged as a default rate. Borrowers have decided, therefore, to default and keep using the resources

Table 9.4 Total and Overdue Loans of the National Development Bank.

Year	Overdue Loans (1)	Total Loans (2)	Overdue Loan Rate (1/2)
1980	1781	13879	13
1981	2065	16129	13
1982	2479	17927	14
1983	2525	23386	11
1984	3068	33901	9
1985	4760	51551	9
1986	7203	70674	10
1987	9388	88857	11
1988	9877	105774	9

Source: BNF.

at the slightly higher interest rate. Consequently, this study concludes that unless there are significant penalties for defaulting or postponing loan payments, subsidized interest rates encourage delayed loan repayments or loan defaults.

The evidence to support the conclusion regarding the effect of subsidized interest rates on loan repayments comes from the BNF's own experience. During 1988, the BNF adopted a policy that stipulated that overdue loans be treated as normal commercial loans bearing the market interest rate after the due date. According to BNF's officials, this mechanism seems to be effective in reducing loan defaults, although it has raised strong opposition from some groups of producers.[1]

Subsidized Credit and Other Issues

Investment practices

Another conclusion reached in this chapter regarding the use of BNF's subsidized credit is that much of it is not used for the purposes for which it was loaned. This, of course, depends of the amount of loan supervision provided by BNF and may not be all bad considering that many times loans are made for unproductive investments.

The demand for a loan is derived from the expected return from its use in a productive activity. But when subsidized credit is available, and particularly when it is targeted to a specific investment, the specific investment may be undertaken even though it is not the most profitable one and would not be undertaken if the loan funds were acquired at competitive interest rates.[2]

On the other hand, if loan supervision is weak, the loan recipient may benefit by not using the loan funds for the purpose intended. This will be the case when the credit line is directed towards investments that do not represent the highest and best use of the resources. For example, consumer credit is often the most costly and is rarely subsidized in Ecuador's economy. Consequently, cheap loan funds made available for agricultural investments often are used to purchase consumer goods such as cars, boats and vacations abroad.

Evidence to support this assertion is difficult to obtain, nor are there reliable estimates of the significance of the diversion. But among agricultural producers and even BNF's credit officials, the diversion of the loans is well known and discussed.

In addition, the fungible nature of the loans even with tight loan supervision is unlikely to increase the total amount of loan funds invested in agriculture as a result of subsidized and targeted loan programs. Mostly what occurs is that loan funds for worthwhile projects simply substitute for investment funds that would have been made without the loan program. One undesirable diversion of funds is their conversion into dollar denominated financial assets that effectively make the funds not available for either the agricultural sector or for domestic use and reduces the foreign reserves of the BCE.

Capitalized Gains from Targeted Credit

Earlier, this chapter discussed the Monetary Board's policy to administratively allocate loan funds to specific purposes rather than letting the market do it. With the line of credit allocated to production agriculture, a significant proportion of funds has been directed to irrigation and land improvement (Table 9.5).

Thus far these investments have been unproductive and their benefits have

Table 9.5 National Development Bank's Loans for Irrigation, Land Improvements, and Agricultural Machinery, as Compared to Total Annual Loans.

Year	Irrigation Loans	Land Improvement Loans	Machinery Loans	Total Annual Loans
	million S/			
1980	73	202	271	6095
1981	89	213	456	7319
1982	91	217	257	7744
1983	104	347	601	13909
1984	398	1027	1607	22047
1985	1054	863	1907	33702
1986	1062	1537	3226	43068
1987	527	1224	2386	47655
1988	725	2072	2438	57649
	%			
1980	1.20	3.32	4.44	100
1981	1.22	2.91	6.24	100
1982	1.18	2.80	3.31	100
1983	0.75	2.49	4.32	100
1984	1.81	4.66	7.29	100
1985	3.13	2.56	5.66	100
1986	2.47	3.57	7.49	100
1987	1.11	2.57	5.01	100
1988	1.26	3.59	4.23	100

Source: BNF.

largely been capitalized into land values, benefitting again the current owners of the now improved land who are primarily large farmers. Meanwhile, Ecuador's agricultural productivity remains among the lowest in South America (Chapter 6).

Targeting agricultural loans allocates credit based on criteria other than profitability of the investment. Thus, many unproductive investments are made because of the availability of low cost loans. In addition, many productive investments are not made because the loan funds have already been committed to another purpose.

A peculiarity of Ecuador's agricultural credit policy is to exclude wholesalers and processors from any significant amount of credit. By failing to recognize the credit needs of these and other legitimate agricultural sector participants, those most dependent on capital investments have been denied public sector loan funds. As a consequence, the entire agricultural chain from producers to consumers has been constrained (Chapter 8).

Subsidized Interest Rates and Welfare Programs

In most large organizations, and especially in government organizations, programs multiply and the leadership of the programs are decentralized and coordination is weak, two likely outcomes occur. First, certain programs may duplicate each other. Or worse, programs may exist with conflicting goals. Both of these consequences have occurred in the agricultural credit policy of Ecuador.

The policies intended to transfer income to the less well off, via subsidized credit, have had just the opposite effect. They in fact concentrate cheap loans in the hands of borrowers who have the largest quantity of collateral for securing their loans and who often have friends in the banks who help them obtain their loans. Thus, neither the goals of increasing production nor improving the well-being of the worse off are being achieved by the policy of administered interest rates or administratively determined credit allocations.

Subsidized Credit and Financial Intermediation Services

Subsidized interest rate policies have one undesirable effect that has not been discussed. It reduces the supply of financial intermediary services available in rural areas. Private banks and other financial intermediaries are more dependent on savings mobilization than are the parastatal lenders such as the BNF. Consequently, it is unlikely they will develop and profitably operate in areas where they do not have significant deposit and loan activity.

In the rural areas, however, private lenders are not likely to be able to compete for loans with the BNF which offers subsidized credit. Although there likely exists opportunities for savings mobilization by offering market rates of interest, inability to compete for loans will discourage private lenders from establishing themselves in rural areas.

In addition, if private lenders cannot compete for loans, they are unlikely to successfully compete for deposits either, since one of the significant incentives for depositors establishing a relationship with the financial intermediary is that it creates credit. For the reasons above, private banks and financial intermediaries tend to locate in areas where lending activity is at the market rate of interest and where the savers often become the borrowers from the bank as well. Thus, subsidized credit discourages financial services from developing in rural areas (Araujo and Meyer).

V. Inflationary Macroeconomic Policies and Liquidity

Macroeconomic policies leading to inflation increase interest rates and lower the credit available to firms. In addition, they create a liquidity problem that is not usually recognized nor well understood. The relationship between an inflationary macroeconomic policy, high interest rates and liquidity problems is discussed next.

An inflationary economy is the consequence of an irresponsible fiscal and monetary policy at the national level. The detail of Ecuador's macroeconomic policies that produced inflation were discussed in Chapter 2. These policies have included import substitution policies, subsidized credit, excessive government spending and until recently an expansionary monetary policy.

During an inflationary period, the supply of money increases faster than the

supply of goods and services in the economy causing the price of goods to increase. Unless influenced by relative changes in demand or supply, the prices of physical goods, such as agricultural land and machinery, will increase at the rate of inflation. Also in a free capital market, the price of borrowing increases with inflation. This increase is required to maintain the ability of savers to purchase higher priced physical goods in future periods.

Now consider what gives rise to the liquidity problem. The price of money, the interest rate, rises with the rate of inflation. But profits on investments do not rise sufficiently to pay for the higher interest costs on loans because total earnings on assets are reflected mostly in capital gains. Thus, an investment may be profitable once capital gains are included with the cash return but still may not be earning sufficient liquid returns to meet the required interest and principal payments on a loan, especially during the initial years (Robison and Brake).

The consequences of the liquidity problem are severe, especially during the early periods of an investment, when repayment of the loan will require subsidies from the firm's equity. This again, however, limits those able to invest to the already well-off and equity-strong borrowers. Thus, inflation will be much more of a restraint for small borrowers than for large ones.

Another consequence of the inflation-induced liquidity problem is that it discourages long-term investments. Obviously, the shorter the life of an investment, the less effect inflation has on liquidity. To illustrate, suppose a farmer has a one year investment. Then that investment, if profitable, will pay for itself and interest costs in one year and there is no liquidity problem. In general, the shorter the economic life of a durable, the less severe will be the liquidity problems created by inflation.

The relationship between the inflation and liquidity problem has important implications for Ecuador's agricultural sector. This is because the most agricultural investments for agricultural (new technology and human capital improvements) are long term (Chapter 12). In fact, of all sectors in the economy, the agricultural sector is likely to be the one most adversely affected by the inflation-induced liquidity problem because its investment base has the longest economic life.

An inflationary economy creates one more problem, perhaps the most severe of all. It often leads policy makers to take inappropriate actions that do not solve the liquidity problem, that create new problems, or make the liquidity problem worse. The appropriate action is to attack the inflation problem directly through fiscal and monetary responses. The incorrect responses taken by the government has been to blame the inflation problem on certain participants in the economy, especially the merchant class, and to adopt a subsidized credit policy.

This section has pointed out that offering subsidized credit is not likely to solve the liquidity problem created by inflation except in the case of extremely large subsidies. Since the initial liquidity problem is directly related to the magnitude of the inflation problem, subsidized interest rates could be negative in real terms and still not solve the liquidity problem.

VI. Conclusions and Recommendations

The principal conclusion of this chapter is that the dominant agricultural credit policy of administered and subsidized interest rates has impeded rather than facilitated development in the agricultural sector. This chapter has supplied evidence that the following undesirable consequences can at least in part be attributable to this policy.

First, the agricultural credit policy of administered and subsidized interest

rates has created a condition of excess demand for agricultural loans. This condition, in turn, has required non-market allocations of loan funds that are dominated by the interests of larger, more well-to-do farmers who may divert loans from their most productive use in agriculture. Thus, subsidized interest loan programs have largely benefitted the large farmers.

Second, in response to the excess demand for loan funds, the BNF has increased the transactions costs of securing its loans. These increased transactions costs have fallen more on the resource-poor and small borrowers. Consequently their effective demand for BNF loans has decreased.

Third, although the BNF was created with the explicit purpose of aiding small farmers, in practice it has failed in this mission. This is because it has been necessary for the BNF to reduce transactions costs by lending to fewer and larger, more secure borrowers to both survive and to offer subsidized interest rates.

Fourth, offering subsidized interest rates on loans generally results in a below-market rate of interest offered savers. Thus, in the agricultural sector where deposits are needed, they are not forthcoming because of the negative real interest rates being offered potential savers. Consequently, there is a lack of savings mobilization forcing the BNF to reduce its lending activities and to depend on funding sources other than deposits of savers.

Fifth, the subsidized interest rate policy of the BNF is a major cause of its decapitalization. It is increasingly dependent on outside sources of funds to maintain its viability. Evidence is that foreign lenders are not willing to continue to see their loans used in such clearly unproductive and resource-concentrating loan programs.

Sixth, strong evidence supports the conclusion that subsidized interest rates lead borrowers to default or to postpone their loan repayments. Consequently, BNF has sustained an unacceptably high default rate by most banking standards.

Other possible consequences of subsidized interest rates include inflation, discouragement of the development of private financial intermediaries and diversion of the loan proceeds to purposes for which they were not intended.

Finally, inflation creates liquidity problems. This point is not well understood and as a consequence, it is often argued that the apparent liquidity problem is a profitability problem that requires a subsidized interest rate to solve. Nothing could be further from the actual facts. What is needed is increased disbursements in the early years of the loan.

To overcome many of the problems discussed in connection with the policy of subsidized interest rates, this chapter concludes by recommending the following changes in Ecuador's agricultural credit policies.

First, it is recommended that the policies of administratively determined credit allocation and interest rates be eliminated for all sectors. The elimination of subsidized credit for all sectors will allow credit to be supplied on nearly equal terms to potential borrowers who will employ it in more productive uses. Market interest rates also will lead to much greater savings mobilization. Such a policy change will also permit the government to separate agricultural production policies from welfare policies, maintain the BNF as a reliable source of agricultural loan funds and reduce its dependence on foreign donors and discourage political patronage and high transactions costs for borrowers.

Second, innovations in the disbursal and collecting of loan funds must be adopted for the agricultural sector to compete for loan funds with other sectors demanding credit. One such solution has been proposed to the BNF and has been adopted on a trial basis (Ramos 1989). The program establishes an existing business network between millers and producers of rice. The miller in essence

becomes a financial intermediary for the BNF. The millers receive a line of credit from the BNF to support producers who use the services of their mill. Their line of credit is secured by the mill. Having millers provide credit to producers that is secured by the mill reduces the supervision cost of producer loans to the BNF and facilitates, at a reduced cost, a function already being performed informally by the millers. The result of improving the efficiency of credit allocation to the agricultural sector is its increased ability to compete for loan funds.

Third, it is recommended that the discriminatory credit allocation system that now exists be eliminated. There is no justification for the selective credit bias against certain agricultural sector participants who provide important marketing services. Adequate access to credit by all agricultural sector participants is needed to develop more competitive trading structure (Chapter 8).

Fourth, as long as there are significant levels of inflation there will be liquidity problems associated with long-term investments. These liquidity problems will not be solved through loan subsidy programs as experience has demonstrated. To overcome the liquidity problem the following approach is recommended. Establish loan terms based on the real balance of the loan. During periods of high inflation this may require that nominal loan balances be increased in each period. It also implies a system of graduated loan payments. One reason lenders are reluctant to extend loan terms or adopt graduated payment plans is because inflation and the possibility of changing inflation rates increase their risk. To overcome this reluctance and to maintain their viability as financial institutions it is recommended that a system of variable interest rates be adopted. This variable interest rate scheme has been employed successfully by many banking systems and could be effectively employed in Ecuador.

NOTES

1. Both the BNF and the private banks are allowed to add another 2 to 3 points to these rates as charges for social services institutions such as the Fire Department and Health Research Centers, and bank commissions and insurance fees, raising the cost of the loans even further but having no effect on the banks' earnings.

2. The interest rate charged by private banks is not completely market determined because the government limits the spread between the rate banks pay savers and the rate they can charge on their loans. As inflation increases, the real value of this spread has decreased.

3. The inference that large loans are made to well-to-do borrowers with large amounts of equity is defensible because they are the only borrowers with the collateral required to secure large loans.

4. Most BNF borrowers recognize the real cost associated with subsidized loans and would prefer credit to be available on a timely basis and at market rates of interest rather than pay the high transactions cost of obtaining a BNF loan. Evidence of this feeling among farmers comes from a seminar sponsored by the Agricultural Policy Institute (IDEA) in Guayaquil. Farm sector participants at this conference concluded by proposing the following: "...that BNF charge market interest rates but deliver the loans on time and in adequate amounts." (IDEA.)

5. See Chapter 2.

6. Other benefits of positive interest rates for savings include the integration of markets, the encouragement to hold larger proportions of wealth in domestic financial assets rather than unproductive inflation hedges or foreign assets, reduced transactions costs and the establishment of bank-customer relationships that may extend to loan arrangements.

7. Once a loan payment is not fulfilled, the BNF transfers the loan from the subsidized line of credit (where borrowers pay 38 percent in 1990) to the commercial loan portfolio, where the interest rate is near the market determined rate (about 50 percent).

8. Investments in irrigation projects discussed in Chapter 7 exemplify this point.

9. Another way to describe how inflation creates liquidity problems for borrowers, and hence discourages long-term investment is to examine the reduction in the average real balance on loans, holding the term of the loan constant but increasing the inflation rate. Consider the following.

Suppose a borrower takes out a loan of 100 million sucres which is to be repaid in equal annual installments of 20 million sucres for five years. If there is no inflation, then the real average outstanding balance over the five years is: (100+80+60+40+20)/5 = 60 million sucres. Now suppose that the economy is suffering a 100 percent annual rate of inflation. Moreover, assume the term of the loan is not changed. Then the average real balance of the loan must be calculated anew. The first year's real balance with 100 percent rate of inflation is 50 million sucres (S/100/2.00); 20 million (S/80/4.00) in the second year; 7.5 million in the third year; 2.5 million in the fourth year; and .6 million in the fifth year. On average then, the

real balance has fallen to (50+20+7.5+2.5+.6)/5=16.1 million sucres instead of 60 million sucres. This represents a decrease of over 70 percent is the average real balance of the loan over its original term.

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CHAPTER

10

SOCIAL INSTITUTIONS, GENDER AND RURAL LIVING CONDITIONS

RAE LESSER BLUMBERG AND DALE COLYER

I. Introduction

Social, economic and other factors influencing rural living conditions in Ecuador vary tremendously. Life is affected by the region (Costa, Sierra and Oriente), by farm characteristics (large, medium or small size), type of farm (crops, livestock, commercial, subsistence etc.) and by the ethnic group to which a family belongs (indigenous, *mestizo* and white). Other important sources of variation include climate, soil, topography, education and public services. These factors all interact and effects of one may be modified by those of another. In addition, there are significant differences within regions, farm types and ethnic groups so that making generalizations based on specific situations can be misleading.

However, there are commonalities within the overall social, cultural and economic environments of rural Ecuador. One is the hegemonic Latin culture with its tradition of male domination, close family relationships and kinship ties that operate at the expense of societal cohesiveness and effective functioning of the public sector. In contrast, gender relations are relatively more egalitarian among the Indians of the Sierra and Oriente. Another shared experience is the economic crisis that has affected the country for the last several years and for which an end is not in sight. For a very large proportion of Ecuador's rural residents this means continuing to endure lives of poverty, due to low levels of resources, technology and productivity, coupled with large families.

Analysis of these factors is hampered by a lack of current data. The 1982 censuses of population and housing provide some relatively recent information but there has been no agricultural census since 1974 and most of the other reliable general information and data about rural living conditions also date from the mid-1970s. The Sierra area has been the subject of a relatively large number of studies which provide information on living conditions for specific situations and localities but there are few similar studies for the Costa and Oriente. Thus, for the purposes

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of this study, existing information was supplemented by fieldwork using rapid rural appraisal (RRA) methods.

The rest of this chapter is organized in four sections. Section II reviews gender roles based on previous analyses. Section III presents the results of the RRA. Section IV describes govermental, educational, economic, organizational, religious and social characteristics of rural communities. Section V examines part-time farming activities.

II. Gender Roles in Agriculture

The Ecuadorian constitution recognizes equal rights for women. Paragraph 5, Article 19 states: "Women, whatever their civil status, have equal rights and opportunities to men in all aspects of public, private and family life..." (translation by the authors). But Spanish American culture, like many others, continues to be characterized by *machismo* and women often must defer to men, at least in appearance. This generalization applies in the agricultural sector as much if not more than in other areas. Women, however, contribute very importantly and directly in the production and distribution of farm products. In addition, the extent of their actual subordination varies by region, ethnicity and social class. Indeed, as in other aspects of Ecuadorian life there are notable differences in sex roles between regions (women are more active in farming in the Sierra than in the Costa) and ethnic groups (women are more active in farming among Indians versus whites and mestizos). Furthermore, both a recent empirical study (Alberti) and the RRA found a noteworthy interaction among gender, ethnicity and social class. Among rural whites and mestizos, an inverse relationship emerged between social class and women's economic activities with poorer women more likely to play more active farm production roles which make substantial contributions to family subsistence. Conversely, among Indians, there seems to be little variation by social class, with men and women farming more as partners. Overall then, while agriculture tends to be dominated by males, women play key roles, especially in the Sierra and among indigenous groups in both the Sierra and Oriente regions. Women also are major actors in the traditional marketing system for agricultural products.

Production Activities

Census data from 1982, the last population census, indicated that only a relatively small percentage (7.5) of farm women were economically active, i.e., participants in the measured labor force. Women's activities were reported as being concentrated on "household activities," a practice that greatly understated their agricultural contributions (Luzuriaga and Fiallo). Haney summarized information from a number of surveys and other studies which documented that women contributed substantially more to the agricultural labor force than reported by the census. A national study of the agricultural labor force was conducted for 1974-75 (Torres, Cañadas and Ribadeneira). These data, summarized in Tables 10.1, 10.2 and 10.3, show that women participated more in the agriculture of the Sierra than they did in the Costa but even there about one-fifth of the

Table 10.1 Division of Man-Days of Labor by Gender of all Farming Activities, Ecuador 1975

Province	Family Labor		Permanent Hired		Temporary Hired		Help or Exchange		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Carchi	2,275,609	677,266	335,495	34,992	1,497,036	133,651	59,217	33,890	4,167,357	879,779
Imbabura	4,562,977	1,755,019	23,898	0	1,613,063	98,016	104,052	68,828	6,303,990	1,921,863
Pichincha	6,363,815	4,333,674	430,725	152,517	3,634,522	290,471	209,564	102,716	10,638,626	4,879,378
Cotopaxi	6,084,855	3,886,735	103,225	75,758	1,014,228	23,152	304,359	96,077	7,506,667	4,081,722
Tungurahua	3,943,405	2,634,535	612,418	9,866	2,576,689	125,586	114,002	12,705	7,246,514	2,782,492
Chimborazo	5,077,369	4,312,281	914,973	122,978	3,808,229	59,638	238,136	4,900	10,038,707	4,499,797
Bolívar	4,334,812	1,791,134	533,896	94,155	3,120,222	78,305	111,212	21,191	8,100,142	1,984,785
Cañar	3,360,378	3,527,655	557,270	4,796	2,055,540	106,271	99,800	63,831	6,075,988	3,702,555
Azuay	5,958,914	9,454,427	401,728	64,891	1,498,698	66,024	152,027	19,397	8,011,367	9,604,739
Loja	6,704,395	3,666,123	29,912	0	1,090,204	1,296	556,460	195,833	8,380,971	3,863,252
Sierra	48,666,529	36,038,849	3,945,540	559,955	21,911,431	982,190	1,948,829	619,368	76,470,329	38,200,362
Esmeraldas	3,656,778	647,369	153,081	[illegible]	1,415,388	13,982	321,270	112,207	5,546,517	[illegible]
Manabí	14,574,835	3,574,536	739,353	3,235	7,836,969	149	309,702	124,565	23,451,859	3,702,482
Los Ríos	6,269,035	2,220,392	295,721	19,706	4,794,448	22,519	123,157	24,408	11,482,361	2,287,025
Guayas	9,376,113	3,256,250	776,950	76,804	2,714,119	4,327	230,863	57,203	13,098,045	3,394,584
El Oro	4,118,998	1,238,656	471,575	0	1,995,056	5,414	318,858	57,203	6,804,487	1,301,273
Costa	37,995,759	10,937,697	2,427,680	99,748	18,755,980	46,391	1,203,850	375,586	60,383,269	11,459,422
Napo	2,780,797	716,532	33,893	0	416,405	1,483	44,208	1,322	3,275,303	719,337
Pastaza	627,425	271,589	19,150	0	298,522	0	0	0	945,097	271,589
Morona Santiago	1,903,736	403,402	0	0	353,567	0	29,506	14,054	2,286,809	417,456
Zamora Chinchipe	1,479,495	417,056	80,096	0	234,457	0	15,851	6,240	1,809,849	423,296
Oriente	6,791,453	1,808,579	133,139	0	[illegible]	1,483	89,565	21,616	8,517,058	1,331,679
Ecuador	93,453,741	48,785,125	6,534,359	659,703	41,[illegible]	1,030,064	3,242,244	1,016,570	145,170,656	51,491,462

Source: Torres, Cañadas and Ribadeneira.

Table 10.2 Division of Man-Days of Labor by Gender for Crop and Livestock Production, Ecuador 1975

Activity	Family Labor		Permanent Hired		Temporary Hired		Help or Exchange		Total	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Carchi: Crops	1,036,836	221,287	130,347	25,417	1,298,822	133,531	58,483	33,835	2,524,448	409,170
Livestock	334,939	208,356	78,603	14,575	5,297				418,839	223,431
Imbabura: Crops	2,099,084	539,642	25,151		1,425,615	93,016	96,005	68,828	3,640,855	706,486
Livestock	369,131	432,681	899		20,459				390,489	432,681
Pichincha: Crops	2,617,430	1,092,677	270,465	1,470	3,370,303	270,947	198,578	87,762	6,456,777	1,452,856
Livestock	784,437	1,114,833	47,731	142,459	21,778				853,946	1,257,292
Cotopaxi: Crops	2,072,294	1,185,692	18,998		851,149	23,152	303,934	96,077	3,246,375	1,304,921
Livestock	1,103,147	1,209,697	78,817	75,758	829		425		1,183,218	1,285,455
Tungurahua: Crops	1,666,099	837,836	500,612		2,287,586	90,658	104,724	12,705	4,559,021	941,199
Livestock	540,266	770,126	94,589		241,303	34,728			876,158	804,854
Chimborazo: Crops	1,699,352	1,007,469	363,354	27,008	3,352,065	57,258	235,678	4,900	5,656,455	1,096,635
Livestock	788,839	1,477,105	290,235	52,887	75,296	510			1,154,370	1,530,502
Bolivar: Crops	1,920,748	414,579	249,055	89,124	2,661,722	14,936	109,213	21,191	4,940,738	539,830
Livestock	954,714	779,468	176,116		33,759	2,080			1,164,589	781,548
Cañar: Crops	1,305,530	555,473	260,491	4,798	1,724,302	24,272	91,707	26,458	3,442,030	611,001
Livestock	587,790	902,915	157,499		1,195	21,999			746,484	924,915
Azuay: Crops	1,678,7[illegible]	1,192,744	237,224		1,208,273	3,112	148,382	13,397	3,272,396	1,215,259
Livestock	1,124,502	2,359,838	105,470	64,291	25,193	46,771	3,596		1,319,767	2,971,550
Loja: Crops	2,950,143	1,251,184	8,033		1,079,322	1,296	551,407	195,833	4,588,895	1,468,313
Livestock	941,798	1,373,755	18,211		2,506				959,515	1,373,756
Sierra Crops	19,046,229	8,310,583	2,058,521	142,917	19,325,159	717,284	1,898,081	566,986	42,327,990	9,737,670
Sierra Livestock	7,529,569	11,129,326	1,045,170	350,570	488,615	166,088	4,021	0	9,067,375	11,645,984
Esmeraldas: Crops	1,961,067	331,351	103,622		1,171,055	12,603	299,346	112,207	3,535,090	456,161
Livestock	245,660	59,703	42,320		20,946				308,926	59,703
Manabi: Crops	7,347,968	729,915	82,710	3,232	7,400,301	149	265,461	124,565	15,103,040	857,867
Livestock	2,054,632	786,452	364,971		102,392				2,511,995	786,452
Los Rios: Crops	3,814,464	582,233	125,562	10,327	4,516,175	22,519	122,881	23,664	8,679,082	638,743
Livestock	561,691	312,895	102,538	9,365	9,169				673,398	322,260
Guayas: Crops	2,250,623	517,840	212,244		1,210,449	4,327	210,970	57,203	4,490,286	579,370
Livestock	1,241,698	895,790	363,383	71,928	31,877				1,636,958	967,718
El Oro: Crops	2,250,623	517,840	218,244		1,810,449	4,327	210,970	57,203	4,490,286	579,370
Livestock	158,951	284,601	160,783		12,770	1,087			332,504	285,688
Costa Crops	17,624,745	2,679,179	754,382	13,565	16,809,029	43,925	1,109,628	374,842	36,297,784	3,111,511
Costa Livestock	4,262,632	2,339,441	1,023,995	81,293	177,154	1,087	0	0	5,463,781	2,421,821
Napo: Crops	1,257,705	374,031	9,359		220,258	1,483	33,516	1,322	1,520,838	376,836
Livestock	231,452	91,158	13,025		46,997				291,474	91,158
Napo: Crops	167,190	59,308			182,093				349,283	59,008
Livestock	167,440	92,896	15,703		1,531				184,674	92,896
Morona S: Crops	446,274	86,266			174,983		29,506	14,054	650,763	100,320
Livestock	706,366	165,747			8,597				714,963	165,747
Zamora C: Crops	459,465	61,234			83,735		15,851	6,240	558,052	67,474
Livestock	426,021	186,708	49,798						475,819	186,708
Oriente Crops	2,330,635	580,539	9,359	0	660,059	1,483	78,873	21,616	3,078,936	603,638
Oriente Livestock	1,531,279	536,509	78,526	0	57,125	0	0	0	1,666,330	536,509
Total Crops	39,001,609	11,570,301	2,822,262	156,382	36,794,257	762,692	3,086,582	963,444	81,704,710	13,452,819
Total Livestock	13,323,480	14,005,276	2,147,691	431,863	722,894	167,175	4,021	0	16,198,086	14,604,314

Source: Torres, Cañadas and Ribadeneira.

Table 10.3 Man-Workdays Used for Crop Production by Gender and Size of Farm: Ecuador 1975

Province Sex	0-1	1-2	2-5	5-10	10-20	20-50	50-100	100 +	Totals
Carchi: Male	32,318	107,557	247,789	313,162	159,438	156,660	6,069	7,730	1,036,823
Female	12,194	16,317	56,538	73,062	32,746	23,451	5,260	1,019	221,287
Imbabura: Male	105,112	169,475	493,428	362,386	403,392	158,437	310,699	69,163	2,098,094
Female	47,690	83,335	205,334	92,302	65,659	39,267	6,595	0	540,182
Pichincha: Male	179,309	237,190	432,994	587,648	329,579	483,309	209,561	4,860	2,524,450
Female	187,030	194,203	280,650	262,954	72,322	76,944	18,564	0	1,092,667
Cotapaxi: Male	189,590	386,531	588,701	555,068	177,797	171,802	0	2,805	2,072,294
Female	153,736	285,969	404,383	322,171	93,715	25,718	0	0	1,185,692
Tungurahua: Male	460,570	346,308	475,068	159,400	67,385	21,265	125,707	10,396	1,666,099
Female	375,965	152,155	179,943	68,197	15,490	16,314	29,772	0	837,836
Chimborazo: Male	365,140	313,224	448,118	226,357	62,377	167,394	26,013	70,135	1,699,358
Female	249,701	233,097	253,400	137,518	32,388	80,087	0	21,280	1,007,471
Bolivar: Male	96,554	109,122	267,738	406,003	247,708	716,941	38,086	38,586	1,920,738
Female	53,888	71,916	103,708	97,984	26,109	57,090	3,875	0	414,570
Cañar: Male	119,609	141,446	189,762	452,128	200,754	115,944	54,960	30,928	1,305,530
Female	142,004	86,074	82,397	149,276	36,250	60,806	1,396	0	558,203
Azuay: Male	296,307	446,410	483,385	156,660	49,088	158,714	38,356	30,926	1,660,747
Female	289,168	448,401	356,514	65,286	15,369	18,036	0	0	1,192,774
Loja: Male	229,565	611,216	1,074,721	526,935	287,813	580,259	10,621	28,923	3,350,053
Female	79,764	226,098	466,648	293,897	99,084	83,903	415	13,375	1,263,184
Sierra: Male	**2,074,073**	**2,888,579**	**4,.61,705**	**3,752,349**	**2,012,231**	**2,730,725**	**820,072**	**294,452**	**19,334,186**
Female	**1,591,140**	**1,798,165**	**2,389,615**	**1,462,647**	**489,132**	**481,616**	**65,877**	**35,674**	**8,313,866**
Esmeraldas: Male	24,099	69,131	356,423	267,543	409,445	496,578	201,573	136,293	1,961,085
Female	5,191	7,236	65,907	85,176	38,729	58,381	26,742	43,389	331,351
Manabi: Male	364,232	705,183	1,828,971	1,284,486	1,312,618	1,446,131	406,347	276,329	7,624,297
Female	60,887	104,472	216,856	107,091	86,733	145,338	6,558	0	729,935
Los Rios: Male	1,260,096	286,110	521,631	454,149	506,156	612,145	60,383	113,734	3,814,464
Female	281,098	27,250	64,413	75,258	4,761	86,552	9,068	33,833	582,233
Guayas: Male	509,963	787,674	2,228,404	1,728,383	1,103,138	1,276,635	99,879	161,764	7,895,860
Female	53,798	134,581	398,574	248,004	225,119	220,069	0	15,448	1,295,593
El Oro: Male	101,816	346,687	442,024	395,575	501,220	298,152	102,312	62,799	2,250,587
Female	68,677	88,957	126,909	84,992	72,923	43,214	15,271	16,897	517,840
Costa: Male	**2,260,228**	**2,194,785**	**5,377,453**	**4,130,136**	**3,832,577**	**4,129,641**	**870,494**	**750,979**	**23,546,293**
Female	**469,651**	**363,096**	**872,659**	**600,521**	**428,265**	**553,554**	**59,639**	**109,567**	**3,456,952**
Napo: Male	4,273	6,365	33,311	78,016	231,127	520,247	359,420	24,856	1,257,615
Female	1,287	1,812	14,423	24,379	36,924	151,887	141,096	2,223	374,031
Pastaza: Male	0	5,242	0	10,578	26,780	82,168	40,445	1,377	167,190
Female	4,472	0	0	4,312	14,636	28,750	6,838	0	59,008
Morona S: Male	10,034	14,294	41,401	35,054	46,422	181,964	115,768	1,337	446,274
Female	1,366	6,466	14,484	10,194	14,235	29,930	8,254	1,337	86,266
Zamora C: Male	3,532	6,367	14,989	30,297	90,674	131,489	61,570	120,548	459,466
Female	64	257	24,957	5,275	909	11,930	17,842	0	61,234
Oriente: Male	**17,839**	**32,268**	**89,701**	**153,945**	**395,003**	**915,868**	**577,203**	**148,718**	**2,330,545**
Female	**7,189**	**8,535**	**53,864**	**44,160**	**66,704**	**222,497**	**174,030**	**3,560**	**580,539**
Total Male	4,352,140	5,115,632	10,228,859	8,036,430	6,239,811	7,776,234	2,267,769	1,194,149	45,211,024
Total Female	2,067,980	2,169,796	3,316,138	2,107,328	984,101	1,257,667	299,546	148,801	12,351,357

Source: Torres, Cañadas and Ribadeneira.

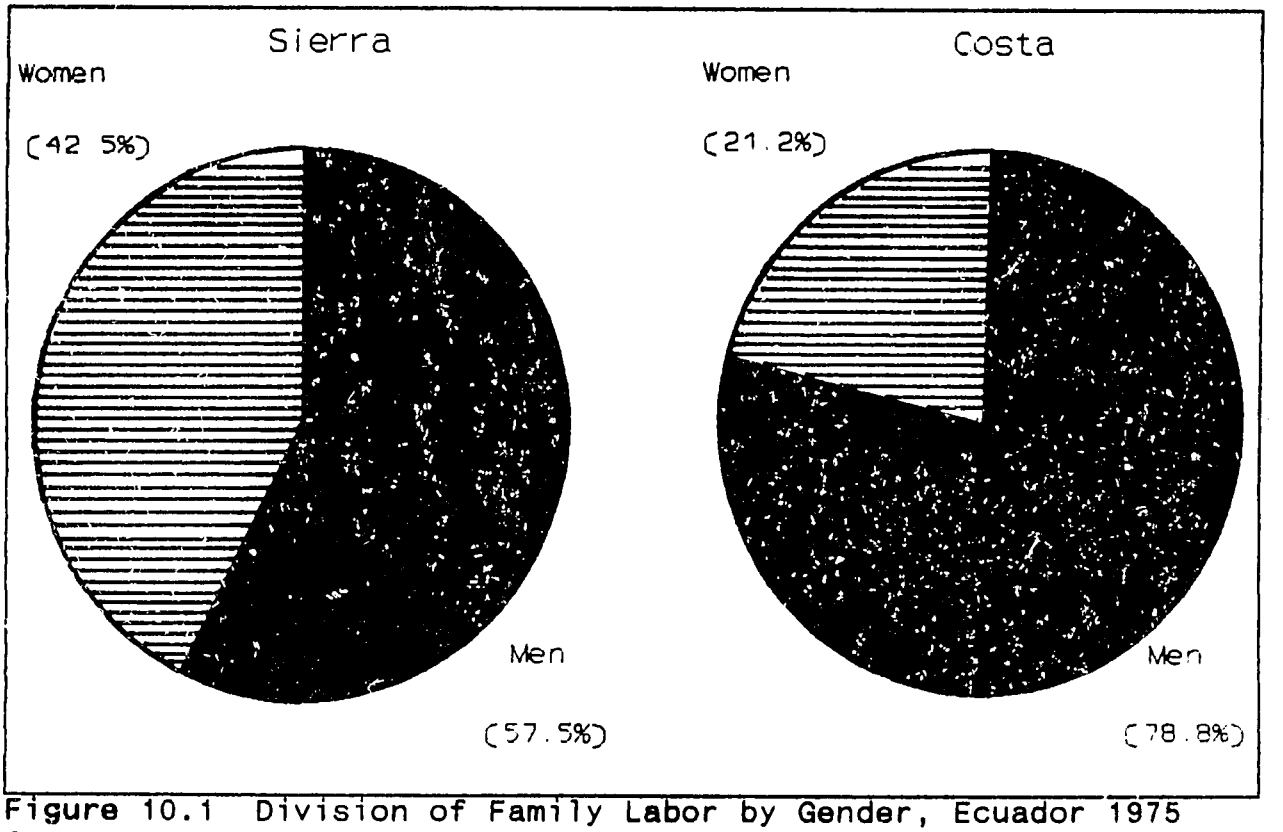

Figure 10.1 Division of Family Labor by Gender, Ecuador 1975
Source: Haney.

family farm labor was supplied by women (Figure 10.1). This is related to both the ethnic composition of producer groups and the types of agriculture practiced in the two regions (see also Phillips 1987, 1985a, 1985b).

A high proportion of the agricultural population in the Sierra consists of indigenous population groups in which women play a much more important role in farming than they do in nonindigenous populations (Alberti). The Costa population is composed of a much smaller proportion of indigenous groups than is true for the Sierra. Agricultural production in the Costa tends to be on larger farms, to be more strongly oriented to commercial production, uses larger amounts of hired workers and concentrates on export crops, situations where the participation rates of women are much lower than is typical of smaller family farms and subsistence units found in the Sierra. An exception in the Costa is that women frequently pick coffee for pay. Women also participate less in the larger commercial operations in the Sierra, except for some dairy operations where they are hired for milking, a role that has declined with mechanization of the operation (Stolen).

While, among the indigenous groups in the Sierra, women participate extensively in nearly all farming activities, there tends to be a division of labor by sex, with men's activities being more concentrated on crop production and women devoting relatively more time to livestock raising activities (Table 10.2). Women's participation is especially large on the small farms which are very important in terms of numbers and in the use of labor since the level of mechanization is very low (Table 10.3). Most small farms raise some livestock in addition to producing crops for the market as well as home use (Cornick; Ibarra; Pomeroy). The livestock

include cattle, hogs, sheep, chickens, rabbits and guinea pigs. Since the amount of land and forage per farm is very limited, to assure effective utilization, the livestock generally are not pastured in the open but rather are carefully herded or tethered to control their grazing or the forage is cut and taken to them. All these techniques are labor-intensive with women and children performing a large share of the work. Men generally do the heavier field work, such as land clearing and plowing, with women being more involved in planting, weeding and harvesting crops. In addition, women care for the children and do the housework. Men are more apt than women to participate in farm labor markets, working as day or permanent laborers on larger farms.

Marketing Activities

Farm women in the Sierra participate somewhat equally with men in the marketing of the products produced on their farms (Haney; Torres, Cañadas and Ribadeneira). Women also play very important roles in the agricultural marketing system, i.e., as intermediaries. This is especially important in the traditional marketing system which consists of *ferias*, the market days held one or more times per week in most rural towns. Bromley estimated that 75 percent of the intermediaries are women, although the larger merchants and wholesalers tend to be men. Women also operate a large share of the retail market outlets in the market centers and the small community stores in cities such as Quito and Guayaquil. While supermarkets have been growing in importance, the majority of food products are still handled by smaller merchants.

Impacts of Changes

Women's roles in agriculture are continuing to evolve in response to changing conditions in the sector as well as in the country's economy and society generally. As a result of the agrarian reform movement in the 1960s and 1970s, Ecuador's farm sector was further dichotomized into a group of a relatively few medium and larger commercial farms and a much larger group of small farms. The smaller farms had a substantial subsistence base prior to the petroleum boom, although most have since entered primarily into commercial activities. Women have much larger roles on the smaller than on the larger farms and greater than they had during the *hacienda* period when labor was tied to the larger farms (Haney). Participation by both indigenous and nonindigenous women is greater on the small farms, since conditions make their participation essential for economic survival.

A second factor has been the growing need for the small farm families to obtain off-farm income for economic survival, since many of the farm units are too small to support the family. The development of home-produced crafts and off-farm employment are the primary activities used for attaining additional income (Brea-Porteiro; Meier; Muratorio; Poeschel; Balarezo, et al.; Schroder). Women are frequently the producers of crafts, while men are more likely to do off-farm work. Off-farm work may consist of labor on neighboring larger farms, seasonal migration or commuting to other farm areas or to the cities. As a result, adult males tend to be absent from the farm during the day, week or season. Maintenance and control of the family plot fall increasingly on the women (Salamea and Likes). This phenomenon also has contributed to the decline in production of typical food crops in the Sierra since they tend to require more and heavier labor which is not available when the men migrate.

Attitudinal Impacts

Social custom dictates that women, especially of the dominant white-mestizo culture, defer to men in public matters. This is reflected in the title of Wendy Weiss's 1985 doctoral dissertation, *Es El Que Manda* (It Is He Who Commands). Despite this custom, the role of women is important and the changing social and economic circumstances are altering the perceptions as well as reality. Women inherit equally with men and thus own and control property and their increasingly important roles as income earners further add to their power and influence (Weiss). Illiteracy remains higher among women but their educational levels have improved and the numbers of female students in university agricultural curriculum have been growing more rapidly than those of males (Izurieta and Pinto). Cornick, et al. found that farming systems research objectives were often frustrated because the scientists failed to account for the influence and control of resources by women in agricultural communities. Agreements reached with the men in a village would not be carried out in practice because the women who controlled part of the resources would not cooperate. This was not apparent during negotiations because the village women did not participate when the farming systems research team was composed of males. The team recommended that all research teams contain females to assure that women's views were adequately taken into consideration. This seems relevant for most economic development activities involving small farms.

III. Findings of the Rapid Rural Appraisal

The objectives of the rapid rural appraisal were to examine the social and economic situations of rural families in the Sierra, Costa and Oriente, with special attention to impacts of male migration and off-farm employment on the division of labor and resources by gender, age, ethnicity and class. For this, RRA fieldwork was conducted in the Provinces of Chimborazo (Sierra), Manabí (Costa) and Napo and Sucumbíos (Oriente).

Methodology

The methodology of RRA is based on "triangulation," i.e., obtaining more than one source of data about a limited and focused number of issues. In the present study, the process began with the selection of sites that had both recent agro-socioeconomic diagnostic research by Ecuadorian or U.S. social scientists and a project sponsored by the U.S. Agency for International Development (USAID). These provided base-line data. Additional data were generated via a variety of methods.[i] It should be noted, however, that the RRA fieldwork did not involve random samples, so that the results about the cases studied cannot be generalized.

Family, Gender and Agricultural Development

The results of the RRA help to confirm the drastic underestimation of the female contribution to Ecuadorian farming by the *1982 Census of Population*. The official census statistics indicated that only 7 percent of rural women were economically active and only 7.5 percent of the population economically active in agriculture were women. This under-counting is due, in large part, to the use of a question that tends to exclude women from being classified as economically active. When asked about their occupation, women, or their husbands, generally answer

that it is *quehaceres domésticos* (housework) or *ama de casa* (housewife). A totally different picture about women's agricultural labor results if questions are asked first about the crops produced and then about the extent of participation by family members, males, females and children, as well as hired labor. The results of a 1974-75 sample survey show considerably higher rates of female participation in family agricultural labor than does the census (Torres. Cañadas and Ribadeniera). Although not based on scientific samples, the RRA indicates that the levels of female involvement in farming are higher than those reported by the 1975-75 study.

The RRA results for the Sierra are in line with the high rates of women's involvement in all phases of farming found in recent studies of Sierra populations, especially indigenous ones (Alberti; CIM; Poeschel). The RRA results for the Costa area studied, however, indicate a dramatically higher female participation than the few other published studies have shown (Leonard; Luzuriaga; Phillips 1985a, 1987). Their findings indicated that women do almost no agricultural work. Balarezo, who worked in the Jipijapa area of Manabí Province shortly after the RRA was carried out, obtained results almost identical with the levels of female agricultural involvement found by the RRA. The Torres, Cañadas and Ribadeniera study also indicated substantial Costa female participation.

Findings for the Oriente represent one of the first efforts to ascertain the gender division of labor among colonists in Napo and Sucumbíos Provinces, although a recently conducted but unpublished survey by the Foundation for Agricultural Development (FUNDAGRO) interviewed both males and females in each household. The RRA found a level of female involvement intermediate between that of the Sierra and Costa, with Indian women very heavily involved in farming and poorer mestiza women moderately involved.

Sex and Age Division of Labor and Resources

Among the Sierra Indians, few farmers are very well off but, *regardless of level of wealth,* women generally participate as *equal partners* in the *division of agricultural labor.* These findings have been well-documented by other recent studies of Chimborazo villages based on random samples (Alberti; CIM). Women work with the men--as often do the children--in every main crop task except plowing and chemical applications. When a man is not available for those tasks, the women do the work, hire labor, organize a *minga* or obtain help from a male with obligations due to kinship or other ties. Women also care for small and medium animals, with the help of their children. Caring for chickens, guinea pigs and rabbits are almost 100 percent female activities while sheep and pigs are predominantly female obligations. Cattle and horses tend to be male dominated enterprises.

Seasonal migration by men tends to be subordinated to involvement in the main crop months, except among those Indians who have too little land to provide even for subsistence needs. This proved the case in the community of Magipamba, where the typical landholding is less than one-fourth hectare and where most men migrate and come back only once or twice a year from their work. In contrast, in the communities of Chimborazo and Yacupamba, which are not as land-poor, prime-age men migrate only when they are not crucially needed for farming. In both Chimborazo and a fourth community, Pisicaz, however, many of the men lived at home but worked off-farm on neighboring haciendas or in a nearby cement factory.[1] Thus, for those farms where male migration or off-farm labor is significant, women probably do well over half the farming.

With respect to the *division of resources* by age and sex it was found that

from very early ages, children may be given a chicken or a guinea pig to care for. It is their animal and they will benefit from its proceeds. As they get older, they gain access to larger animals. Similarly, inheritance customs mean that land is divided equally among sons and daughters. In Alberti's Indian sample, over 80 percent of the women had some land. For married couples, a joint decision-making pattern is dominant (the RRA; Alberti; CIM; and Poeschel). The husband and wife will discuss, for example, selling an asset and reach a consensus decision on both the sale and use of the proceeds. Women frequently sell small animals or artisan items in the market for funding household subsistence but men generally have more access to cash income. This does not seem to unduly diminish the woman's *voz y voto* (voice and vote) in the household. Studies of Sierra Indian populations emphasize women's stronger adherence to ethnic identity, language and customs and to attribute this, in part, to the women's reluctance to trade their greater relative gender equality as Indians for the subordinate position of mestiza women (Alberti; Poeschel).

Among the mestizos, the ideal is that a woman is economically dependent and should not have to work in the fields (Alberti; Stolen; Weiss). The higher the social class and/or economic level, the more likely the ideal is to be realized. The RRA found this among mestizos in the Oriente and the Costa; Alberti provides empirical documentation for her sample villages in Chimborazo Province in the Sierra. Among other things, this pattern means that the women of the better-off mestizo families have less household leverage vis-à-vis their husbands than do the women from poorer mestizo families. This is because the poorer the family, the more active the woman is likely to be in agricultural production and/or other income-generating activities (Alberti; Blumberg 1989). But the situation is complicated by the issue of high levels of seasonal migration among mestizos (both youths and household heads, as well as some young, single women). The head of the Ecuadorian Center for Agricultural Services (CESA) in Riobamba and a USAID/Ecuador official (citing a 1979 USAID study) indicated that for much of the year in many mestizo villages in Chimborazo Province, the population consists overwhelmingly of married and old women, old men and young children. Under such circumstances, the women do most of the agricultural work, although most of the income may come from off-farm activities.

Comparing the relative economic and social status of Indian and mestiza women, the Indian women not only play more important and equal roles in production, their status is further enhanced by strong cultural norms of "full partnership" that give them more household leverage than one might expect from their low cash incomes in comparison with their seasonally-migrating husbands. Mestiza women may do as much work in poorer families and in areas of high male migration but strong cultural norms of economic dependence reduce the household leverage these women get from their productive and cash contributions to the family.

The RRA area for the Costa was carried out around Portoviejo, Manabí Province, which is an overwhelmingly mestizo area. Women have been described as doing virtually no field work in the Costa region, except, perhaps, for working in the coffee harvest. The RRA found that coffee harvesting does provide the main source of women's income in coffee-growing areas. However, according to both men and women in the five communities surveyed for the RRA, women also are involved in family farming activities, performing substantial amounts of field work, much of the animal care and sometimes raising a garden. With respect to field crops, women were acknowledged by both sexes as having important roles in planting, harvesting and post-harvest processing. In addition, women, more than men, pointed out that

wives also helped in land preparation, weeding and seed selection. They stressed that a common daily work pattern for roughly six months of a typical agricultural cycle is for the woman to spend the morning doing domestic and productive (e.g., animal care) chores around the house. They then prepare lunch, take it out to their husbands in the fields and spend the afternoon working in the fields. In the coffee-growing areas, where harvesting was in progress during the RRA visit, the women did not hesitate to tell how much they were paid for a day's labor harvesting coffee. This was their principal source of independent income during the year and they said that they used almost all of it for their children's food and welfare.[5]

As of the 1982 population census, some 30 percent of the 115,000 inhabitants of Napo Province were lowland *Quichua* Indians. They farm by horticultural methods, specifically by "slash and mulch" cultivation and claim, like the Sierra Indians, an equal partnership pattern in field operations for most principal crops. But the equal partnership may involve more sexual differentiation among crops than in the Sierra. For example, cassava is largely a woman's crop. It also is their principal subsistence crop, consumed in both solid and liquid (*chicha*) forms. Women take primary care of the children and fill in when men leave for temporary migration.[6] They, however, tend to have less direct access to cash income than their female counterparts in the Sierra, since local markets are not as developed and ubiquitous. Thus, the women are less likely to be market sellers in the few local ferias than in the Sierra.

Among the mestizo colonists, the usual norm about women's ideal place as housewife prevails but the norm is observed even less than in the Costa. Pioneering on a remote farm is labor-intensive and both women and children, especially male children, work in agricultural tasks. Women were described as being important in doing the same tasks as detailed above for the Costa mestizos. Moreover, women colonists described the same common time pattern for farm work as found in Manabí. After a morning doing chores in the vicinity of the house, women prepare lunch, deliver it to their husbands in the fields and remain to spend the afternoon working. However, getting to and from the cultivated areas of their long, thin, still-largely-forested holdings is a more formidable task than in the Costa region. As discussed below, colonists' farms are 50 hectare plots 250 meters wide by 2,000 meters deep. These are organized in lines along the roads, with the 250 meters being road frontage for the first lines on each side of the road. A second line is formed at the end of the first, i.e., 2,000 meters (2 kilometers) from the road, a third line is then formed 4,000 meters from the road, etc. In many areas colonists have settled as far back as the eighth or ninth line from the main road. In the northern area of the Oriente, there is no real dry season, so male migration is not confined to any particular season. When there is an urgent need for money or when oil companies or a neighbor are hiring, the man may undertake outside work, leaving the wife and children to carry on as best they can. However, a report by Darío, Seré and Luzuriaga indicates that only about a fifth of the colonists work off the farm and that most of those are the newer immigrants who have not fully established their farms.

Wives of the colonists have fewer opportunities to earn cash income than in the other regions. Coffee is the main cash crop and some women work for pay in its harvest but it is difficult for those who live away from the main roads to get out to sell a chicken or eggs in the weekly market, let alone leave for a stint picking coffee. Furthermore, most of the farming in the study area is a family business so that day labor opportunities are very limited, for men as well as women. Thus, while women do a significant portion of the work, they have less

access to income than their female counterparts in the Costa and, especially, the Sierra.

Temporary Migration/Circulation/Commuting[8]

The RRA results indicate that, except for three situations (two are in Chimborazo Province, in the Quichua village of Yacupamba and the ten mestizo villages of Chingazo-Pungales, and the third involves the APPYs of Manabí) men increasingly work away from the farm.[9] The primary reason given was that the economic crisis had caused an increase in the cost of living. For the Oriente, the recent declines in coffee prices have reduced farm incomes, further aggravating the situation. The increased off-farm work includes all three activities: temporary or seasonal migration, circulation and daily commuting to nearby jobs. The latter range from day labor for local landowners to work in a cement factory (in the indigenous villages of Chimborazo and Pisicaz). The net result is that women and others not in prime labor force years (the young and old) do more of the farmwork. It also was evident that more of their production was being used for consumption than sale, unless a development project had enhanced their agricultural productivity.

Markets in the Sierra and Oriente

"Mini-censuses" of several markets in both the Sierra and the Oriente were undertaken as a follow-up to earlier, more extensive studies of Sierra markets. Bromley had found that women accounted for some 65 percent of the market sellers, including 85-90 percent of those retailing fresh foodstuffs. Counts taken in four Sierra markets indicate that quite similar patterns still exist. In Otavalo's textile/artisan market, 63 percent of the sellers were women. In the small/medium animal market of Guamote women were found to be the exclusive sellers of chickens and guinea pigs and to be in the majority (some 55-60 percent) of the sellers of hogs and sheep; whereas cattle, horses and donkeys were sold almost exclusively by men. All of the wholesalers observed buying the sheep and hogs were women. In the main, fruit, vegetable and miscellaneous market of Saquisilí, 85 percent of the vendors were women. In the Riobamba textile market about half the sellers were women, due to a preponderance of male tailors and male Otavaleños selling textiles from that area. In the Oriente, women were 65 percent of the sellers in the weekly market in Coca and 57 percent in Sacha's weekly market. A less precise count of the large Lago Agrio market found at least two-thirds of the sellers were women.

IV. Community Life

Although rural life in Ecuador tends to be centered around family and kinship interrelationships, community activities also are important. These include governmental, educational, economic, organizational, religious and social functions, activities that typically are interrelated.

Local Government

Ecuadorian local, sub-provincial, government units are *cantones* (counties), *parroquias* (parishes), *municipios* (municipalities) and *comunas* (communities). The latter is the smallest administrative unit and the one with which a *campesino* is apt

to have greatest contact (Colyer). The comuna is a form of economic and community organization, first legalized in 1937 and recognized by the 1979 Constitution. To be a legally recognized organization the comuna must be registered with the Ministry of Agriculture, as is the case for the other agricultural organizations discussed below. In 1983 there were 1,844 registe ed comunas with a total population of 682,663 (FIDA p. 83).

Most comunas are indigenous groupings, located primarily in the Sierra but with some located in both the Oriente and Costa regions. Historically, they possessed both communal land and individual family parcels, with the communal land often located in the high pasture land areas (*páramos*). With increasing population pressures, the comunas have tended to subdivide the common land so that new families could have their own land. Comunas operate through general assemblies consisting of all members 18 years of age and older, which develop policies and elect a council (*cabildo*) to carry out the policies. In addition, there are the *comuneros* consisting of the household heads, primarily men, who have the obligation to participate in community activities. A principal function is the administration of communal property but they also conduct other community business and promote development, education, health and other services.

Due to the centralized nature of governance in Ecuador, however, the powers of the communities are limited. They can be influential in community improvement activities and in obtaining better services from such centralized agencies as the Ecuadorian Electrification Institute (INECEL) and Ecuadorian Institute for Sanitary Works (IEOS).

Public Services

Public services in rural areas were upgraded substantially during the oil boom years, a process that has continued but at a much slower pace due to the economic crises of the 1980s. Rural electrification was expanded, roads were constructed, schools built, water was piped into many communities and health centers were installed. The "rural year" required for completion of medical degrees has made health services more available, as has the campesino health insurance program. School construction was expanded so that most communities are served by at least a primary school (six grades).

Medium-sized to larger farms tend to have adequate services. With access to electricity, such farms can install water and waste disposal systems. They can afford bottled natural gas or other fuels. These farms tend to be on or to have access to all-weather roads and most of the owners have trucks for transporting their products. They either live in communities with both primary and secondary schools or can send their children to private schools. Many of the owners of larger land units live in cities such as Quito, Guayaquil or the larger provincial cities and towns.

However, the same situation does not prevail for the majority of owners of small farms, who cannot afford to privately install such services. Despite very considerable improvements in public utilities, large numbers of rural areas and communities do not have many of the basic services. According to the *1982 Census of Housing*, 31.6 percent of the rural houses had electricity, 23.7 percent had running water (either within or outside the house), 28.6 percent had indoor or outdoor toilets and 15.5 percent had waste water disposal facilities such as septic tanks (Jordán p. 237; Páez, Ordoñez and Torres). Only about one fourth of the rural households (24.1 percent) obtained their water from public water systems, with the remainder about equally divided between wells and springs (38.6 percent)

and other sources such as rivers and streams (37.3 percent). Less than 30 percent of the rural houses were classified by census personnel as acceptable or better.

Important differences in the availability of water and electric services exist both within and between regions (Table 10.4). A higher proportion of rural households in the Sierra (28.7 percent) obtain their water from public sources than in either the Costa (16.3 percent) or Oriente (15.8 percent). In the Sierra the percentages vary from 22.0 in Bolívar to 45.6 in Imbabura while the variation in the Costa is from 4.1 in Esmeraldas to 44.8 in El Oro and for the Oriente the range is 8.2 in Napo to 31.4 in Zamora Chinchipe. About two thirds of the rural households in both the Sierra and Costa regions are without electricity, while over 85 percent of those in the Oriente lack such services. Less than half the rural houses in Tungurahua lack electricity, compared to nearly 89 percent in Napo.

While most of the primary roads are paved, the vast majority of the secondary roads are gravel or dirt and tend to be poorly maintained. Thus, transportation for both people and products is a serious problem for many small farms, especially those located at a distance from main roads or population centers, since they generally must depend on public transportation. Those who live away from main roads often have to walk, or use horses or donkeys, to transport themselves and their products to markets or to a point on a main road where they can access public transportation systems.

In the Sierra and Costa regions most farms are located on or close to roads, although the road quality may be poor. The colonization process in the Oriente, however, has resulted in a large number of farms that do not have direct access to a public road and must depend on narrow paths to the nearest road. Colonization has followed the construction of roads for oil exploration and production. Each colonist receives 50 hectares from the Ecuadorian Institute for Agrarian Reform and Colonization (IERAC) in a parcel that is 250 meters wide and 2,000 meters deep. These are organized in along the roads, with the 250 meters being road frontage for the first line on each side of the road. The second line is formed at the end of the first, a third line is formed the end of the second, etc. Typically colonization occurs in 4 to 5 lines but there may be 8 to 10 or more. Thus, many colonists must walk or ride horses or donkeys for several kilometers for access to roads, public transportation, schools, other public services and markets.

Many communities have piped water systems but most small farms depend on wells, rivers, rainwater or water hauled in by tank trucks. Many families must devote considerable amounts of time to obtaining water, a task generally performed by the women and children of the household. Water quality also is a problem with much of the water contaminated. This contributes very significantly to rural health problems, especially for children where gastro-intestinal infections and diarrhea are common.

Health services also remain a problem in many rural areas. While health centers have been established in some communities, others do not have such services or have them on a part-time basis. Health problems are more serious for more isolated farms, in all areas but particularly in the Oriente, where they are exacerbated by the lack of transportation that permits quick access to medical services in emergency situations. Although family planning access was not studied in detail, many women in all three regions indicated the need for more services (and, in the Oriente, for personnel other than the male military doctors now running the area's main such facility).

Access to a primary school is relatively easy in nearly all rural areas, although distances can be substantial for the more isolated farms. Secondary

Table 10.4 Rural Housing Characteristics, Ecuador 1982

Province	Number of Houses	Water Source			Percentage Without:		
		Public	Wells	Others	Elec.	Toilet	Sewage
All Areas Combined	779,942	24.1	38.6	37.3	67.2	70.6	83.3
Sierra	436,297	28.7	35.4	36.8	64.9	81.7	88.0
Azuay	60,660	25.8	44.1	30.1	67.2	87.4	90.0
Bolívar	24,940	22.0	53.0	25.0	79.6	78.7	86.4
Cañar	31,395	22.7	52.7	24.6	66.9	83.5	84.9
Carchi	14,620	25.2	29.8	71.8	55.1	83.3	88.5
Cotapaxi	50,140	22.1	35.2	42.7	71.8	84.6	88.9
Chimborazo	54,340	32.4	49.2	18.4	78.0	84.1	88.1
Imbabura	31,542	45.6	23.2	31.2	64.6	82.4	85.2
Loja	47,560	29.5	51.3	19.2	83.2	95.2	96.8
Pichincha	77,360	39.0	23.3	37.7	50.4	63.3	72.4
Tungurahua	43,740	29.9	14.3	55.8	45.7	71.0	84.8
Costa	299,053	16.3	40.6	43.1	67.0	55.6	79.1
El Oro	21,760	44.8	30.2	25.0	62.1	64.8	73.2
Esmeraldas	22,220	4.1	21.1	74.8	77.6	73.4	92.1
Guayas	109,760	14.9	31.2	53.9	51.8	54.1	73.3
Los Ríos	54,739	12.3	53.5	34.2	79.8	73.2	77.6
Manabí	90,574	16.5	51.5	32.0	76.2	40.2	85.1
Oriente	36,711	15.8	38.3	45.9	85.8	83.3	90.4
Morona-Santiago	9,974	15.1	44.9	40.0	86.2	85.8	92.3
Napo	16,170	8.2	39.8	52.0	88.9	81.8	90.8
Pastaza	3,709	22.2	19.9	57.9	71.8	74.4	80.3
Zamora-Chinchipe	6,858	31.4	35.1	33.5	85.3	88.1	91.9
Galápagos	346	24.9	7.5	67.6	60.1	50.6	76.6
Unassigned Areas	7,545	12.5	56.2	31.3	65.2	41.4	75.3

Source: Páez, Ordoñez and Torres.

school access is more problematic for many smaller communities or for the children from more isolated farms, since such schools tend to be located in larger communities and to serve several communities. Thus, relatively few farm children go to secondary schools because of the difficulty and costs of accessing the schools. Many farm families indicated they would like to send more of their children to secondary schools but cannot because of the cost.

In addition, some of the more isolated areas, primarily in the Oriente, have problems with obtaining or retaining teachers who are assigned by the Ministry of Education. In such places there may be only one teacher for all six grades and if she (or he) becomes ill or leaves in mid-term, another teacher may not be assigned, causing the loss of an entire year of education.

Historically, fewer girls than boys attended or completed primary school so that more women than men were illiterate. This was especially true in many indigenous areas where the women often spoke only Quichua. While a larger proportion of females than males still do not complete either primary or secondary schooling, most of the disparity has been eliminated. Currently, a literacy campaign aimed at completely eliminating illiteracy is being waged. Part of the campaign requires high school students to teach reading and writing for four months to receive their diplomas (*bachilleratos).*

Organizations

A large number of organizations of various types exist in or to serve rural areas of Ecuador (FIDA; Jordán). The country's constitution requires that campesinos receive state support in organizing and promoting their interests. Under the Agricultural Development Law, Agrarian Reform Laws and Law of Comunas, the Ministry of Agriculture (MAG) is charged with assisting and developing such organizations. All have to be officially registered by MAG to have legal standing, a status that is essential for receiving services such as training and credit.

Organizations which have membership of individuals are classified as first degree units, while unions or federations of first degree organizations are classed as second degree units. These tend to be provincially or regionally based. Third degree units generally are national or regional federations of second degree organizations. The FIDA study indicated that in 1987 there were 27 second degree organizations with a membership of 291 first degree associations. These second degree organizations can be of associations, cooperatives, comunas or combinations of these. National or third degree organizations generally consist of aggregations of second degree units. They attempt to represent their groups at the national level and to obtain political benefits for their members. Such groups represent, especially, campesino and indigenous interests. Examples are the National Federation of Campesino Organizations (FENOC), which represents some 15 small farmer organizations and the Union of Natives of the Ecuadorian Amazon (UNAE) which is composed of indigenous groups.

Official organizations. mandated by law, include the agricultural centers, organized at the cantonal level and to which farmers must belong to obtain farmer identification cards. These are federated into four regional chambers of agriculture which in turn are part of a national federation, although this latter unit is weak and lacks the influence of the regional chambers. The centers vary in activities but many provide services such as input stores, marketing and technical assistance.

Associations are groups of farmers organized for specific purposes, often to promote production of a particular product or improvement of farmer interests in a given geographical area. There are associations of large as well as small farm owners. Associations tend to be relatively easy to form but to be legally recognized they must be registered with the Ministry of Agriculture. Members of producer associations must have land titles or certificates of possession but the same rule does not apply to marketing associations. An example of first degree associations are the Association of Cassava Producers and Processors in Manabí Province (APPY). Through a second degree organization, the Union of Cassava Producers and Processors (UAPPY) and with the assistance of the International Center for Tropical Agricultural Research (CIAT), USAID, MAG and the National Institute for Agricultural Research (INIAP), some 350 cassava producers have

developed cooperative activities to process cassava into a dried product for use in mixed feeds for livestock and shrimp (Huffstutler; Romanoff and Toro).

There are a very large number of cooperatives in Ecuador for both agricultural and nonagricultural activities. Through May 1987, there were 2,245 MAG-registered, agriculturally-related cooperatives with 77,589 members (FIDA p. 84). Many of these are traditional organizations that provide goods and services for their members. There also are production cooperatives that were formed as a result of agrarian reform requirements, especially for receiving land that had been state-owned.[10] Many were created as a result of Decree 1001, issued in 1970 during the last Velasco Ibarra dictatorship. This decree was specifically for rice sharecroppers in the Costa region (Phillips 1985a, 1987). To be eligible for land expropriated under the decree, an individual had to be a member of a production cooperative, which received the land and other services. Colonists also must form or join a cooperative or pre-cooperative to obtain land under the colonization programs in the Oriente. Many, under both the agrarian reform and colonization programs, are cooperatives in name only since individuals join merely to receive land. The units are then operated as independent farms and many of the cooperatives do not function as active organizations. In other cases, cooperatives have been formed because the government provides benefits that accrue only to those so organized. Coffee marketing cooperatives, for example, were organized because of a law that granted them a proportion of the country's coffee quotas under the International Coffee Agreement.

Labor unions are a form of organization to which some rural agricultural workers belong but these are relatively few due to legal requirements and other factors. Unions are permitted where there are more than 15 workers with permanent employment. Employers often avoid union activities and other labor law requirements by contracting workers for short periods of time. Thus, unions are apt to exist only for relatively large agro-industrial firms.

Women's and youth organizations exist in some rural areas but the total numbers and membership are very small compared to the potential. Women can be members of associations and cooperatives although by law membership is limited to one member per household, who almost universally will be the head of the household, the husband. Women who are unmarried, widows, or who are the principal farm worker for some other reason, may be the official member of either an association or cooperative. There are some associations and cooperatives for women's activities. Two women's groups, for example, have associations within the cassava production and processing group in Manabí Province. They produce cassava starch, a process that is more labor-intensive than cassava flour production. But they are having difficulties becoming registered with the government as a producer association, since the land titles or certificates of possession required are not in their names. Lack of registration, in turn, limits their access to credit. Despite the equality of men and women proclaimed in the Constitution and the fact that the government began a new push in the summer of 1989 to abolish laws in conflict with the Constitutional guarantee of equality, there are no current plans to modify the laws permitting only one member of a household to belong to a producer association or cooperative and awarding land titles or certificates of possession to the head of the household (Gonzalez).

The primary rural youth organizations are the 4-F clubs, an organization run by a foundation with support from the Ministry of Agriculture.[11] These clubs are for the children, both male and female, between the ages of 14 and 25, of farmers with limited resources. Although the 4-F clubs have produced very positive results for their members, they benefit relatively few rural youth. There are only about

110 clubs with some 3,500 members out of around a million eligible for membership.

Finally, there are school-related organizations. The most important are the Parents Associations, which conduct efforts to maintain and improve local school systems. There also are student associations or clubs within some schools, generally the secondary schools. The majority of these, however, are involved with sports activities.

Religion

Ecuador, including its rural areas, remains a largely Catholic country although some Protestant denominations have made inroads in some rural areas (see, for example, Muratorio 1980, 1981). Church activities revolve around services, marriages, baptisms and religiously related festivals. Many rural areas do not have permanent priests but are serviced by circuit riders who come to the community, generally weekly, to hold services, hear confessions and to perform marriages, baptisms and other functions. The Church has been active in promoting agricultural, educational and community improvements. These include, especially, activities by the Center for Social Action (CEAS) in the Riobamba area.[12] The Church also has been active in missionary, educational and development activities among the indigenous groups in the Oriente. Catholic Relief Services (CRS) also provides resources for improving rural living standards in some areas, especially the Oriente.

While the total numbers are still relatively small, Protestant denominations--especially fundamentalist and evangelical groups--have become important community forces in many rural areas. They have changed community standards with respect to activities such as drinking. Some contribute substantially to community, health, education and other economic development activities. World Vision, for example, has carried out important development activities in the community of Chimborazo west of Riobamba, including development of a cheese factory, a water system, outdoor latrines and a trout production facility. These development projects were mentioned prominently by villagers when discussing their recent conversion. Conversely, however, villagers in Magipamba, which has had Protestant missionaries for over 25 years, only mentioned receiving traditional charity activities (clothing and food for the neediest, rides to a hospital for the sick, etc.) from the missionaries.

Community Activities

Although family and kinship ties (*compadrazgo*) dominate in the social and economic lives of most rural Ecuadorians, some activities occur as community functions. One of the more important of these is the minga, the joining together of a group to accomplish some objective by use of voluntary and unpaid labor. These are used commonly and extensively by the indigenous communities but also are practiced by many other groups. They may involve the entire community or some smaller group. Mingas are used for activities such as constructing facilities, maintaining infrastructure or carrying out some specific project. They also are used for agricultural production activities. In some communities, mingas are used for preparing ground, planting, cultivating and/or harvesting crops. This can be especially important in areas where many of the males migrate or work away from the farm during periods of critical farming operations, since it permits carrying out those critical functions even for families with limited labor supplies.

In nonindigenous communities, mingas may be used for specific community-

related tasks such as building a community center, school or other activity with common benefits. These also may be activities of an entire community or of some specific group within the community. Both the male and female cassava producing and processing associations, for example, have used mingas to carry out some of their association activities. These have included constructing and maintaining the facilities and preparing for the new production season.

Another common community-based activity in many rural areas is the conducting of festivals. These tend to be based on religious or related activities and are held at a time when nearly everyone in the community will participate. Community resources are pooled to finance the festival and those with more resources are expected to contribute more. During the *huasipungo* era, the large landowners (*hacendados)* helped finance festivals, although often complaining of the time lost from work. Those festivals were used to distribute bonuses, food, clothing and other items, to the farm workers. Crain documments the economic losses that accompanied the abandoment of one such festival after the 1964 agraian reform was implemented. However, even today larger farms and employers in an area often contribute to particular festivals as a way to help relieve the tedium of arduous farm labor and to maintain good relationships with their workers.

Market days also can be considered community functions since the markets squares (*plazas)* are public facilities. Larger towns in an area will generally devote one day per week to the feria, a time when rural and other residents come to the town to sell and buy farm products, livestock, clothing, artisan goods and other products. The market days vary considerably in the Sierra but tend to be on weekends in the other regions.

V. Part-Time Farming

A large percentage of the Ecuadorian farm families earn substantial proportions of their incomes from off-farm or nonfarm sources, including work on other farms. Data for sources of income in 1974, as reported by a Ministry of Agriculture-Office of Overseas Science and Technology Research (ORSTOM) study are shown in Table 10.5 (Torres, Cañadas and Ribadeneira). These data were developed during an early year of the petroleum era and do not fully reflect the impacts of the oil boom on nonfarm employment opportunities. They do, however, indicate that very small farms, those with two hectares or smaller holdings, earn half or more of their incomes from nonfarm sources. Although recent data are not available, studies of economic activities in several areas of the country indicate that local day labor, seasonal migration, circulation, artisan production, trade and other nonfarm activities continue to be important economically and that farm families with limited resources continue to depend on such sources for substantial portions of their incomes.

Trends in recent years probably have increased the dependence on off-farm work for many of the smallholders. This proved generally true in the RRA, although, as described above, campesinos in three areas indicated that they are now working away less than in previous years. Factors that tend to increase off-farm work are a greater pressure on land that exists in some areas, due to parcel subdivision as new generations reach maturity and form new households and a deterioration in economic well-being that the economic crises have produced. During the 1970s, there also were economic inducements to migrate from farms as employment opportunities expanded, due to the construction boom and increases in other economic activities from the use of oil revenue and increased international borrowing. Some of this resulted in permanent migration as farmers and farm

Table 10.5 Percentage of Farm and Nonfarm Income by Farm Size, Ecuador 1974

Source	Farm Size Range - Hectares								All Sizes
	0>1	1>2	2>5	5>10	10>20	20>50	50>100	100+	
Farm									
Product Sales	21.4	38.0	53.9	65.3	70.4	78.8	81.6	87.1	59.5
Home Use	6.8	12.7	13.4	13.3	13.8	10.0	5.3	2.2	9.2
Total Farm	28.2	50.7	67.3	78.6	84.2	88.8	86.9	89.3	68.7
Nonfarm									
Trade	7.9	3.9	4.5	4.9	4.6	2.7	4.4	4.2	4.9
Artisan Products	4.4	1.4	0.6	0.8	0.1	0.8	0.6	1.0	1.4
Agr. Wages	31.6	26.2	17.1	8.1	5.1	2.3	1.1	0.3	12.8
Nonagr. Wages	27.3	17.0	9.8	7.3	5.2	4.6	6.3	3.9	11.4
In Kind Income	0.7	0.8	0.7	0.3	0.8	0.9	0.6	2.2	0.9
Total Nonfarm	71.9	49.3	32.7	21.4	15.8	11.3	13.0	11.6	31.4

Source: Jordán p. 84.
Note : Totals may not sum to 100 due to rounding.

workers moved to urban areas, a factor that helped relieve some of the pressure on land. The economic crisis of recent years has reduced off-farm employment opportunities and may be exerting a negative influence on off-farm employment. However, such work still appears to be an important source of income for many families with small landholdings.

The net result has been a further "feminization of farming" in areas where men are away for much of the crop cycle, especially in the Sierra and parts of Manabí.[13] While many farm households reduce their production and rely increasingly on the men's off-farm earnings, the records of two development projects that introduced productivity-enhancing interventions in areas of high male seasonal migration offer food for thought. In the cassava processing project, the activities are contra-cyclical, beginning when the men normally would start their six-month migration. A market is being created for cassava and anecdotal evidence indicates that male migration is down. Recent studies do show that on-farm income is up sharply for APPY members (Chávez). In the Chingazo-Pungales area of Chimborazo, an irrigation project encompassing ten mestizo villages has dramatically turned around family income patterns and had a smaller effect on male migration. Previously, according to the CESA head for Riobamba, about 90 percent of income came from men's off-farm earnings. Since irrigation water began flowing, farm income has risen from 10 to about 60 percent of family earnings, while male migration is down 6-7 percent (Martínez). Women are participating in both projects, though much more heavily in the Chingazo-Pungales effort.

Further research is needed before it can be concluded that productivity-enhancing efforts for part-time,"feminized", smallholdings merit a substantial slice of the agricultural development budgetary pie. Rather, what is needed is greater realism; present projects aimed at smallholders tend to ignore male migration and women farmers, often to the detriment of both project and beneficiaries.[14] Future

aid may aim for a better balance by both farm size (smallholder and commercial) and gender. In this way donors would be able to target those actually contributing to Ecuadorian agricultural productivity and food security.

NOTES

1. Women did farm work during the *hacienda* era, especially indigenous Sierra women who worked on the household plot (*huasipungo*) assigned to the family in exchange for work on the *hacienda*.

2. The petroleum and construction booms of the 1970's and early 1980's resulted in more off farm employment opportunities and made both permanent and temporary migration feasible.

3. Techniques used in all three regions plus Quito included: (a) interviews with key informants; (b) group meetings with villagers, project beneficiaries and representatives of farmer and indigenous organizations; (c) semi-structured interviews with men and women farmers using a "topic sheet;" (d) a limited amount of participant observation; (e) "mini-censuses" of 4 markets in the Sierra and 3 in the Oriente; (f) secondary analysis of census and other large-scale data sets on Ecuadorian agriculture; and (g) a literature review of gender and agriculture in Ecuador. In the Sierra, data were obtained from 73 men and 79 women via these techniques. Three indigenous Chimborazo Province villages constituted the principal Sierra field sites: (1) Chimborazo, a high-altitude village with a fairly good natural resource base; (2) Yacupamba, a high-altitude, predominantly sheep-herding village with poor and eroded soils; and (3) Magipamba, a moderate-altitude, densely populated, very heavily eroded village with extreme land fragmentation. In the Coastal province of Manabí, data were obtained from 15 men and 14 women, most of them members of a Cassava Producer and Processor Association (APPY). Four of 14 men's APPYs and both women's APPYs were visited, with field observations and interviews concentrated in the villages of San Vicente, Bijahual and Jaboncillo. In the Oriente, data were obtained from 27 men and 22 women in Napo and Secumbios Provinces, with field observation concentrated in the colonist villages of San Sebastian de Coca and Yuca and the Quichua village of San Carlos. A bilingual (Spanish-Quichua) woman interpreter was used for fieldwork in the three Chimborazo Province villages and a bilingual man interpreted for fieldwork with Quichua speakers in Napo Province. In total, data were obtained from 115 men and 115 women in the three regions and, in the Quito area, nearly 30 additional individuals (key informants and 8 workers in an agroindustrial firm growing flowers for export).

4. Since the neighboring haciendas tend to be on the same agricultural calendar, men who spend considerable time as day laborers may find that the *hacienda* work conflicts with functions on their own farms. Under these circumstances, women, children and elderly men do more of the farm work.

5. The women who belonged to the only women's APPY group, San Vicente, that had operated--and successfully produced income--through an entire farming season, also stated that they spent their income on food and their children's health, education and clothing. This pattern of women more single-mindedly spending income under their control on basic needs and, especially, children's nutrition, health and welfare, is found worldwide, not just in Ecuador (Blumberg 1988; 1989). The women of the San Vicente APPY received a lower return for their cassava starch than the men's APPYs received for cassava flour. This is because starch production is more labor-intensive than flour production (it begins with hand-peeling the cassava tuber, whereas flour production begins by feeding the tubers

into a cassava chip-making machine) but both command about the same price. In addition to the income, the women stressed that they enjoyed working together in a group. Moreover, the income brought them greater self-confidence, respect from their husbands and families and more voice in household decisions.

6. There appears to relatively little migration of the older men although many of the young men work for the oil companies as guides or *macheteros* (using machetes to clear jungle areas). The main purpose of this work is to enable the youths to save funds to pay for marriage ceremonies.

7. It proved impractical to do RRA interviews on the back "lines," which are connected to the roads by narrow trails. Nonetheless, through group meetings, colonists living on the third and fourth line--and one man living on the eighth line--were interviewed. The man from the eighth line, an activist in Union of Small Farmers of the Northeast (UCANO), would take his wife and children "outside" of their holding only once a month, for a one or two day trip for marketing, meetings, etc. The woman key informant who had worked as an interviewer on the recent FUNDAGRO study had interviewed as far back as the fourth line. Her subjective impression was that health, children's education and other aspects of well-being are negatively related to living farther away from the road.

8. Temporary or seasonal migration refers to leaving the farm for a distant area for several weeks or months where returns to the home base are infrequent. Circulation refers to leaving to work in an area away from the home base but where returns are frequent, generally every week or two. Commuting is where the individual travels daily to either temporary or permanent work.

9. The men of Yacupamba have been devoting more effort to agriculture lately in the hopes of wresting some sort of harvest from their increasingly deteriorated agricultural base. Meanwhile, sheep remain the mainstay of that isolated *comuna*'s livelihood. In the ten *mestizo* villages migration used to be almost universal among prime-aged men, but an irrigation project (constructed largely by the women) has enabled the villages to raise impressive quantities of alfalfa, corn, peas, fruits, and vegetables. Consequently male migration has fallen and farm income has increased. Finally, the men of the three fully operational male APPYs claimed to be migrating less since work at the processing plants provides them with increased incomes.

10. The State owned lands that had been confiscated from the Catholic Church as a result of the Liberal Revolution of 1905. These were controlled by the Social Assistance Agency (*Asistencia Social*) which rented the *haciendas* to individuals who operated them in much the same manner as privately owned lands.

11. The 4-F clubs are similar in concept to the 4-H clubs of the United States. The Fs are from four words in the Spanish club pledge, "fe" (faith), "fecunda" (fertile or productive), "fortaleza" (support) and "felicidad" (happiness).

12. CEAS activities were the result of efforts by Monsignor Leonidas Proaño, a leader in the Latin American liberation church movement, to make the Church a more effective force for improving living conditions in indigenous communities.

13. In some *mestizo* areas of high male migration, it appears that female-headed families, *de facto* or *de jure*, are increasing. Balarezo, for example, found almost 30 percent female-headed units in the Jipijapa area of Manabí.

14. The RRA found a clear example in the Guamote Integrated Rural Development (DRI) Project. The three top technical officials mentioned that their biggest problem was the lack of continuous male participation, due to migration. They admitted that women were heavily involved in the crops and animals (especially sheep) they were targeting for assistance. But they did not work with women farmers, nor did they have plans to do so. Blumberg (1989) reviews the worldwide evidence on gender and agricultural development and finds that this bypassing of women, even given male absence, is the prevalent practice rather than the exception. The agent for Chimborazo Province of the USAID-assisted National Association of Sheep Growers (ANCO) sheep project is beginning to work with women as well as men, with positive results, given women's prominent role in sheep-raising. It is too soon to empirically assess this pioneer effort, but so far, income and productivity seem to be up.

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CHAPTER

11

AGRICULTURE AND THE PUBLIC SECTOR

DALE COLYER

I. Introduction

Agriculture has played an important role in Ecuador's turbulent political history (Hurtado). Conflicts between agricultural interests and disagreements with government policies have contributed to the country's political instability. In over a century and a half since achieving independence the country has had numerous changes in government with only a few democratically elected administrations that completed their terms in office. Although completed terms have become more common in the last forty years, there were interruptions in constitutional rule in both the 1960s and 1970s.

The Ecuadorian political situation developed within a conservative/liberal dichotomy, where the conservative forces tended to be concentrated in Sierra agricultural interests and the liberal views in Costa agricultural and associated commercial interests (Kasza; Hurtado). However, politics came to be dominated more by individuals with followings based as much on personality as ideology, as reflected in the long political life of J. M. Velasco Ibarra, who was popularly elected or appointed President five times from 1932 to 1968. Cultural and historical factors, economic forces, regional and personal conflicts led to internal disputes within the liberal and conservative parties and to the formation of many political movements and parties with no party being able to command support of a majority of the voters. Thus, election to power does not necessarily carry with it the popular mandate needed for effective governance.

The current political situation has been affected significantly by the discovery and development of oil in the Oriente. The era began with a period of military rule in 1972 when Velasco Ibarra was overthrown close to the end of his fifth term as President. The military government developed the policies and programs for exploiting and using the revenue from the oil. The approach included the nationalization of a large share of the oil industry and an import-substitution industrial policy. Other nationalistic policies were the development of additional

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state or mixed state-private sector enterprises, stronger economic regulation including price controls and a substantial expansion of the bureaucracy with increased activities in agriculture, education, health and public works.

The remainder of this chapter is divided into six sections. Section II describes the organizational structure of the Government of Ecuador (GOE) while Section III covers the activities of the Ministry of Agriculture (MAG). Section IV is concerned with other GOE agencies with activities that affect the agricultural sector and Section V discusses linkages between the government and the private agricultural sector. Section VI analyzes the government's budget and its impacts on the country's agriculture. The last section, VII, describes the activities of agriculturally-related foreign assistance programs in Ecuador.

II. Governmental Organization

The current Ecuadorian constitution, its 17th, was adopted in 1978 and revised extensively in 1983 (Constitución de la Republica del Ecuador). The governmental structure is highly centralized, but there are provincial, county (*cantón*) and municipal local government units with varying degrees of power and autonomy. Under the new constitution all literate citizens 18 years of age or older have the right and obligation to vote, except that members of the armed forces and national police cannot vote. The new constitution extended suffrage to include the illiterate, although they are not required to vote. It recognized four economic sectors (public, private, mixed and communal) and provided encouragement for organization and mobilization of the populace. A reform also requires a runoff for president between the two top vote getters if no one receives over 50 percent in the first vote. The new charter continues the U.S. type of structure with separate executive, legislative and judicial branches.

Executive

The executive branch is headed by a President and Vice President who run on the same ticket and serve a four year term. The President is limited to a single term, i.e., can never be reelected.[1] The system is basically one of strong executive power where the President and executive agencies have fairly wide authority to carry out their functions. The executive branch consists of 12 ministries and several other agencies. The President can create ministries "as needed" and appoints the Ministers and other agency heads, a process that does not require legislative confirmation, although such individuals can be impeached and then removed from office by a simple majority vote of the Congress. There are numerous other agencies to carry out administrative functions.

Economic policy is essentially an executive function. Major actors in developing and implementing economic policy, in addition to the President, are the Ministry of Finance, Central Bank, Monetary Board (*Junta Monetaria*) and Economic Front (*Frente Economico*) plus, at least in the planning stage, the National Development Council (CONADE). Within this group, the Monetary Board and Economic Front tend to be the more important policy-making bodies. The Monetary Board is composed of a presidentially appointed head (President); a General Secretary; the Ministers of Agriculture, Finance, Energy, and Industries; the Secretary General of CONADE; the General Manager of the Ecuadorian Development Bank; two representatives from Chambers of Agriculture, Commerce, Industries, and Construction--one from the Costa-Galápagos Islands and one from the Sierra-Oriente; a representative of the Private Banks; the Superintendent of Banks; and

the General Manager of the Central Bank. The Economic Front is comprised of the Ministers of Agriculture, Finance, Industry, and Public Works. The Monetary Board is concerned with monetary policy and develops programs implemented by the Central Bank. The Economic Front develops general economic policies, especially on macroeconomic issues although it also sets prices for controlled activities.

Legislative

The legislative branch was completely overhauled under the new constitution. It was converted to a unicameral system instead of the traditional Senate and House of Representatives, which had been used in Ecuador under most previous constitutions. The legislature consists of 72 deputies, with 12 elected nationally and the remainder popularly elected in each province, with the number per province determined by population--there is one representative for each 100,000 population up to two, with an additional representative for each additional 300,000 people or fraction thereof.[2] National deputies are elected for four year terms and provincial deputies are elected for two year terms with elections held during the first presidential round (January every fourth year) and at the midterm. A deputy cannot be immediately reelected but is eligible for reelection after one term out of office. The legislature meets in regular session only 60 days beginning on the 10th of August (9th in Presidential election years) each year. Additional special sessions can be called for by either the leadership of the legislature, the President, or by petition of the membership. Other interim legislative matters are handled by four commissions (committees) or a plenary of the four. The commissions are for budget, agriculture, labor and social matters. They must approve major new activities of the executive such as the budget or new regulations.

The main function of the congress is to legislate, although it also has certain appointive powers and the power to evaluate, criticize and judge the actions of the executive branch. This includes the power to impeach and remove the President, Vice President, Ministers of State and heads of major government agencies. The President and Vice President can only be impeached for treason or other grave offenses against the State. Ministers and others can be removed for offenses committed in the prosecution of their duties. The Congress also has the right to vote amnesty for political offenses and pardons for common offenses. With each new administration Congress appoints the judges for the Supreme Court and associated tribunals. From lists submitted by the President, it also appoints the heads of three control agencies, the Solicitor General and members of the Electoral and Constitutional Guarantees tribunals. For the latter the Supreme Court and other agencies also submit lists from which some members are selected.

Judicial

The judiciary consists of a Supreme Court of Justice with lower provincial and cantonal courts, the Fiscal Tribunal and the Tribunal for Administrative Disputes. Separate courts exist for the national police and military. The Supreme Court and Tribunal Justices are appointed each four years by the Congress. Provincial judges are appointed by the Supreme Court and cantonal judges are appointed by the provincial courts. Their primary functions are to try civil and criminal cases, although the Supreme Court has some power to settle contradictions in laws.

In addition there are two parajudicial organizations, the Tribunal of Constitutional Guarantees (TGC) and the Supreme Electoral Tribunal (TSE). The TGC

oversees compliance with the constitution and can suspend laws (not retroactively) which are contrary to the Constitution although Congress is the final arbiter of constitutionality (Torres). The TSE is charged with directing, overseeing and guaranteeing the electoral process. For example, the TSE certifies the winners for the President and Vice President who Congress is then obligated to install.

Provincial and Local Government

There are parallel national and local government organizations at the provincial, cantonal (county) and parochial (parish or township) levels. Appointed central government officials carry out national programs with local applications which are implemented through an hierarchial system. This includes Governors (appointed by the President) at the provincial level, Political Chiefs (Jefes Políticos) in the cantones and Political Lieutenants (Tenientes Políticos) in the parishes. While once very powerful officials they now have more limited powers and functions, although as agents for the central government with its resources and powers they can have significant impacts on local activities. These central government appointees differ from the relatively autonomous, elected provincial and local government officials who have strictly local functions.

The provincial and lower level government units are both considered to be local for public sector financial accounting. At the provincial level a council and prefect are elected to four year terms. The prefect is the executive and presides at the provincial council meetings. Provincial units are not strong governments when compared to, say, state governments in the United States. Local governments correspond to cantones, each of which is a municipality for government purposes. There are two types: (1) provincial capitals and other cantones with over 50,000 population and (2) all other cantones. Both elect a municipal council which is the governing body for the municipality (canton). The main difference is that the first type elects a mayor while the second elects a Council President but both perform executive functions. These local government units have considerable functional, economic and administrative autonomy. They have legislative authority by the passage of municipal ordinances and are relatively strong as local government units. Comunas, discussed below, also have governance functions but are not formal government units.

Public Administration

Public administration in Ecuador is carried out by an extensive civil service bureaucracy that was expanded greatly during the years of the petroleum boom. The administrative structure is based on a set of institutions created and laws passed in the late 1920s and 1930s. The institutions include the Monetary Board, Central Bank, Superintendency of Banks and Office of the Controller General. Laws were developed for managing the budget, monetary system, international trade, banking and tariffs and labor. A set of major administrative reforms were made in the 1960s when the Civil Service, Administrative Career and Municipal Government laws were passed and when modern techniques for personnel administration, administrative analysis, simplified procedures and program budgeting were introduced. Administration of the agricultural sector follows the general pattern described above, with the MAG being the principal focus of public sector agricultural activities.

III. Ministry of Agriculture

The Ministry of Agriculture was re-established in 1973, when it was separated from the Ministry of Production. Previously it had existed as a separate ministry and the 1973 realignment was only the last of several that the ministry has undergone. The MAG, along with most Ecuadorian institutions, expanded very rapidly during the 1970s as the public sector took on more extensive and intrusive roles in the economy. New agencies were created and the sizes and functions of the existing units expanded. Thus, it consists of an extensive bureaucracy with many functions and numerous agencies to carry them out. Its main offices are in a large, modern headquarters building in Quito and it has another large office building in Guayaquil. Offices and facilities for other agencies are located in various rural and urban cites throughout the country including an office in each provincial capital and canton, where an Agricultural Service Agency (ASA) office is located to carry out Ministry functions.

Functions

The primary purpose of the Ministry is to assist the agricultural sector in carrying out its basic functions; providing the nation's food supplies at reasonable prices, earning reasonable returns on its resources, contributing to export earnings, protecting the country's natural resources and contributing to the it's economic development (MAG 1985; Espinel). To accomplish this MAG has the responsibility for formulating and implementing agricultural policies. Its activities include providing technical assistance to farmers (extension and training), some inputs, marketing services, storage facilities, and information on production and marketing; administering price supports; promoting animal and plant health; licensing imports; conducting agricultural research; implementing agrarian reform and colonization; constructing and operating irrigation, drainage and flood control projects; and promoting agricultural development. MAG, in conjunction with the National Development Bank (BNF) also programs and allocates credit to the sector.

Organization

The MAG consists of the Office of the Minister, four Subsecretariats, a number of adjunct or attached agencies, linkages with other agencies and partial or complete ownership of a number of parastatal and mixed private/public sector enterprises (Figure 11.1). The organizational structure the Ministry is complex with many different and sometimes overlapping units, created at various times in the history of the Ministry and its predecessor organizations to carry out the multiple tasks and activities assigned to the institution.

The Minister of Agriculture is in charge of operations and policy, serves as a member of the cabinet and is an official representative to other government units including the Monetary Board, National Development Bank, the boards of public and mixed enterprises and development agencies. The Minister's Office consists a Ministerial Council, internal auditor, publicity department, advisors for legal and science matters, a department for economic and international affairs which also houses the Policy Analysis Unit, a unit for coordination of the Ministry's adjunct agencies and the forestry directorate. The Minister is concerned primarily with policy, with most of the day to day operations being implemented through the Subsecretariats.

Each subsecretariat is headed by an Under Secretary and each is composed

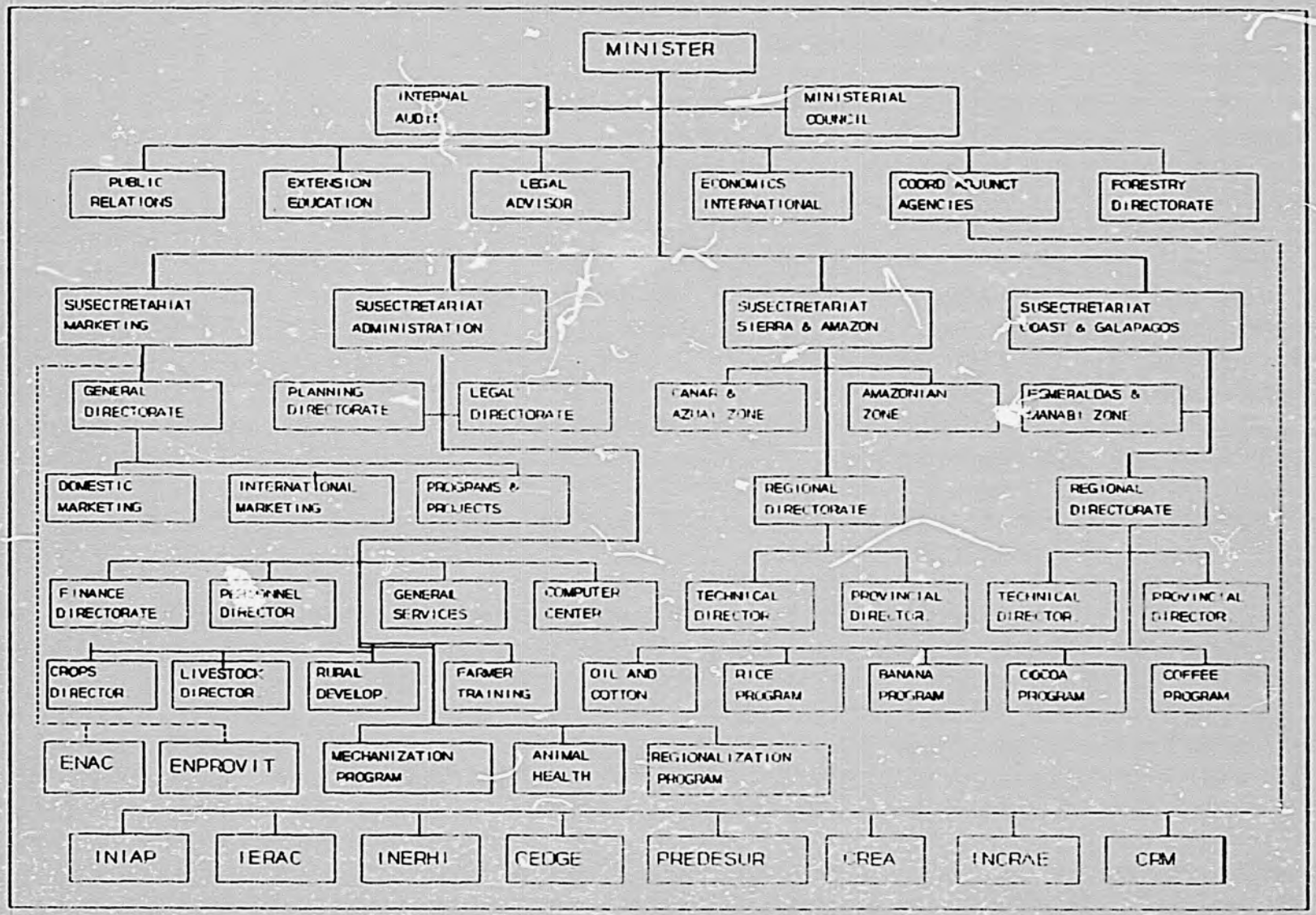

Figure 11.1 Organization Chart of the Ministry of Agriculture

of Directorates which are subdivided into Divisions and/or National Programs. Heads of Directorates and all superior or equivalent units are political appointees, while civil service personnel head the lower units.

The Subsecretariat for Administration handles administrative details through the Directorates of General Services, Finance, Planning, Legal Matters and the Computer Center. It also contains the administrative units of the National Programs for Crops, Livestock, Rural Development, Mechanization and Animal Health plus the Small Farmer (*Campesino*) Training Institute (INCCA) and the National Program for Agrarian Regionalization (PRONAREG).

The Subsecretariat for Marketing was created in 1984 to help solve one of the most persistent problems of the sector, a costly and inefficient marketing system. This unit was created with a single Directorate but with Divisions for domestic and international marketing. The unit is in charge of the Market News Service which provides daily information on market prices for agricultural products. It also was assigned the task of overseeing two of the Ministry's adjunct agencies, the National Company for Storage and Marketing (ENAC) and the National Company for Basic Products (ENPROVIT).

The two regional subsecretariats, one for the Sierra and Oriente regions and one for the Coast and Galápagos, also were created in 1984. Zonal subunits were added in 1987 for the Amazon, the Azuay-Cañar area and Manabí-Esmeraldas. The Costa Subsecretariat is located in Guayaquil and has its own administrative unit. The primary purpose of these regional units is to provide technical and other types of assistance to farmers as a means to stimulate and improve agricultural production practices. They are composed of the Technical Directorates and, in the Costa, the national crop programs (bananas, cacao, coffee, rice and cotton, and oil crops). They contain the Provincial Directorates which conduct MAG programs for their areas and which oversee the cantonal units, the Agricultural Service Agencies (ASAs). MAG technical assistance efforts are carried out directly by the technical units and national programs, through producer organizations and the provincial agricultural offices that extend into each canton via the ASAs.

Programs

MAG programs are as varied as the country's agriculture (MAG 1987a). One of the more important is to provide technical assistance, under the regional subsecretariats, to producers of a wide variety of products. These include the traditional food crops (rice, wheat, barley, soft corn, cassava), grain legumes (beans, peas, lentils), many fruits and vegetables, traditional exports (bananas, coffee, cacao), non-traditional exports (flowers, abaca, melons, asparagus), feed grains (corn, sorghum), native crops (quinua, triticale, oca, melloco) and industrialized crops (soybeans, oil palm, cotton). Technical assistance also is provided through the rural and regional development programs. Plant and animal sanitation programs carry out activities to control the severe disease and pest problems that are endemic in tropical regions. The ministry has some 613 extension agents distributed among the country's 21 provinces and varying from 71 in Pichincha to 3 in the Galápagos (Jordán, p. 241). However, these agents are scattered among the many programs and agencies of the ministry; there is no organized extension service (see Chapter 12).

The Division of Rural Development complements and, to a certain extent, duplicates, a similar program in the Ministry of Social Welfare's (MBS) Secretariat for Rural Development (SEDRI). The MAG division works primarily with indigenous communities to conduct training, provide technical assistance, reforestation and

soil conservation services, and construct infrastructure such as roads, bridges, water supply facilities, irrigation works, schools, community buildings, health facilities, storage buildings and sanitary facilities. The Training Division provides courses and other training for small and indigenous farmer groups. The Ministry also cooperates with the Military to provide agricultural training to recruits under the Agrarian Conscription Program. A mechanization program provides tractor and other machine services for farmers whose operations are too small for them to acquire their own machinery.

The forestry program is involved with reforestation, timber production and improvement, wood products development, watershed protection and agro-forestry activities that promote development of tree crops. The forestry unit also is in charge of operating the county's 2.8 million hectares of parks and natural areas including the Galápagos National Park. A soil conservation unit conducts a modest program, relative to what is needed, to protect the Nation's natural resources. PRONAREG does soils mapping and related activities to improve utilization of the country's agricultural resources and works with the National Institute of Meteorology and Hydrology (INAMHI) to provide agro-climatic data. Information, planning and policy analysis units provide data, information and analyses to assist Ministry administrators in developing appropriate programs and policies for agriculture.

Adjunct Agencies

Several semi-autonomous agencies charged with specific agricultural or rural development functions are attached to MAG. Each has its own budget and administrative unit. The Ministry is involved because the agencies have important impacts on agriculture and have common goals and objectives. The Minister, or his representative, sits on their Boards of Directors, may appoint or affect the appointment of the agency heads and may have influence through the budgetary process. A unit in the Minister's Office is charged with coordination of activities by the adjunct agencies.

The National Agricultural Research Institute (INIAP) was founded in 1959 and began operations in 1961 at what is now the Santa Catalina Experiment Station (Dow and Solís; Chapter 12). It has grown to encompass six experiment stations, five research farms and three research centers plus its headquarters in Quito and an office in Guayaquil. Research is carried out on a wide variety of crop and livestock enterprises with supporting research in soils, diseases, nutrition, entomology, weed control, engineering and a limited amount of economics. A very modest extension, outreach and technology transfer program is conducted through publications for producers, field days, farm plots and an on-farm production research program (PIP).

Management of water resources is the function of the Ecuadorian Institute of Water Resources (INERHI), an adjunct agency of MAG created in 1966 (Keller, et. al.). The majority of its activities is directed to irrigation, an important function for agriculture due to the existence of arid areas and normal seasonal rainfall patterns with the existence of distinct wet and dry seasons (see Chapter 7). Drainage and flood control also are important activities. Irrigation in the highlands, which has been practiced for centuries, is carried out primarily by local, private water users associations and generally involves small areas and projects. INERHI provides some assistance to the privately run associations. However, its primary activities involve the study, design, construction and operation of public irrigation projects, with the largest located in the Costa region.

Agrarian reform and colonization are functions of the Ecuadorian Institute for Agrarian Reform and Colonization (IERAC) which was created with the passage of Ecuador's first agrarian reform law in 1964. The basic functions of IERAC are to implement the agrarian reform law and to prepare and implement colonization plans for areas on the agricultural frontier, now located mainly in the Oriente although until recently the Northern Costa was still being colonized (Bromley). While land redistribution continues under agrarian reform, a large part of IERAC's current activities is titling land previously distributed. Colonization continues to be important in the Oriente.

ENAC and ENPROVIT perform marketing and pricing functions within the agricultural sector. ENAC owns and operates a network of storage elevators, built with Inter-American Development Bank financing in the 1970s and early 1980s and used to store such grains as rice, corn and soybeans. ENAC supports farm prices by buying grain from farmers at official prices, storing it and reselling it after the harvest season is over. ENPROVIT's basic function is to provide food in low income areas at "reasonable" prices (Riley; See, also, Chapter 8). For this function it operates a chain of retail outlets in selected areas, including many rural towns. It sells basic foods plus other products considered to be essential. Both ENAC and ENPROVIT have required large subsidies from the national treasury to cover operating deficits.

Five regional development agencies attached to MAG include: (1) the Commission for the Study of the Guayas River Basin (CEDEGE) whose primary function is to plan and implement development activities in the most important river basin in the country; (2) the Center for Rehabilitation of Manabí (CRM) which promotes and carries out development activities in Manabí Province; (3) the Center for the Economic Recovery of Azuay, Cañar and Morona Santiago (CREA) which has similar functions for those three provinces in Southeastern Ecuador; (4) the Regional Program for the Development of Southern Ecuador (PREDESUR) which covers the provinces of El Oro, Loja and Zamora Chinchipe, and (5) the Institute for the Colonization of the Amazon Region (INCRAE) which has functions similar to colonization activities of IERAC as well as developmental functions.

Public Enterprises

An important public involvement in agriculture is through the ownership, complete or partial, of business enterprises of various types. MAG is associated with businesses that produce, process, import and distribute agricultural inputs as well as operations that produce, buy, store and distribute agricultural outputs. These activities were greatly expanded during the era of military government and high oil revenues of the 1970s.

Examples of wholly owned enterprises are ENAC and ENPROVIT (which were discussed above).[5] Others are the National Semen Company (ENDES) which provides artificial insemination services and the National Fertilizer Factory (FAB), a small factory which makes fertilizer from organic wastes. In general, the state enterprises require subsidies of various types, often including specific budgetary line items.

Mixed enterprises are those in which the public sector owns a portion of the shares of a corporation. The portion can vary from a small percentage of the stock to nearly complete ownership. The largest public investor in mixed companies is the National Finance Corporation (CFN), although the MAG, National Development Bank and other government agencies own shares in many businesses.[6] The government uses the purchase of shares as a way to help finance new companies

or as way to save financially troubled enterprises. An advantage of the mixed enterprise approach is that the firm can continue to operate as a private sector enterprise even when the government owns nearly all its stock. Agriculturally-related mixed firms are in seeds, fertilizers, tea, palm oil, sugar, milk, food processing, alcoholic beverages, wood products, citrus products and a crop insurance company. The two most important are seed and fertilizer companies, which control a large share of the sales of those two important agricultural inputs (see Chapter 8)

IV. Other Public Sector Agencies Related to Agriculture

In addition to MAG, a large number of other government agencies have important impacts on agriculture. The sector is large, heterogeneous and complex and has a wide variety of soils and climates which, when combined an equatorial and Andean location, makes production of most crops feasible. The sector also is composed of a number socio-economic and ethnic groups. Since everyone must have food and other agricultural products, the sector affects and is important to all Ecuadorians. To serve this variety of interests and activities involves a similarly complex and extensive set of institutions. Thus, all ministries and most other public sector agencies have some connection with agriculture: providing products, services or information to some part of the sector; receiving its output; regulating its activities or those of the agroindustry and marketing subsectors; or utilizing its resources for related activities.

Other Ministries

Every ministry affects the agricultural sector to a greater or lesser extent. The Ministry of Defense operates a number of large farms and many of its draftees obtain training in carrying out agricultural and rural development activities. The taxing and other economic activities of the Ministry of Finance affect farmers and agricultural exports. An agency of the Ministry of Finance values property for tax and agrarian reform purposes. The Ministry of Health operates clinics in rural areas and oversees a program that requires medical personnel to serve in rural areas. The Ministry of Education and Culture (MEC) operates Ecuador's public schools, including some agricultural high schools and provides teachers in rural areas; activities that have greatly reduced illiteracy since 1970. The Ministry of Public Works (MOP) constructs rural roads, for which a portion of the oil revenues is earmarked, as well as providing electrical and telephone services through state enterprises. INECEL, MOP's electric utility, has an active program for rural electrification and IETEL is responsible for telephone and other communications services. The Ministry of Labor has farm-related activities, including enforcement of labor laws and minimum wages, regulation of unions and support of worker training.

The Ministry of Industry and Commerce (MICIP) is probably the most important non-MAG agency affecting agriculture. It has many linkages with the sector, several carried out jointly with MAG. Agro-industrial activities come under its purview as does most international trade. Imports of inputs and exports of agricultural products require permits which must be approved by both MAG and MICIP. The importation of food products such as wheat is programmed jointly by the two Ministries. The Grades and Standards Institute (INEN) is part of MICIP. While the use of official grades and standards is not extensive, they are used in

agro-industry and are becoming more important for grains and other products traded on the commodities exchange. Fisheries and seafoods functions are handled by a MICIP Subsecretariat located in Guayaquil. Its activities cover farm-produced shrimp as well as commercial fishing.

The Ministry of Government and Police affects agriculture through the National Police, which is charged with enforcing the Prices and Quality Control Law, the basis for consumer price controls. While price controls on many food products were eliminated or relaxed during the Febres Cordero administration, price regulation has received more emphasis under the Borja government and the law has not been repealed. The police also enforce anti-speculation (price gouging) activities which are illegal. The enforcement of these laws may be sporadic and inconsistent but they affect farm prices by causing uncertainty, raising the costs of marketing and holding down consumer prices, causing lower farm level prices.

Other Government Agencies

The Central Bank of Ecuador (BCE) affects credit, interest rates, exchange rates and the money supply. The Central Bank is a primary indirect source of credit for agriculture through its financing of BNF, ENAC, ENPROVIT and private bank loans to the sector. A subsidiary organization, the Fund for Development of Marginal Rural Areas (FODERUMA), provides financing for many small farmers and for rural development. In 1986 its activities amounted to 852 million Sucres for 72 projects in 18 provinces (BCE 1987c, p.79).

The National Development Council (CONADE), in the office of the Vice President, is in charge of national planning. It makes a four-year plan for each government, which becomes a guide for investment activities, although there is no necessary connection between the plan and what is actually carried out. The planning is done with the cooperation of planning units from other agencies, including MAG.

The National Institute for Statistics and Censuses (INEC) is in charge of national statistics. It conducts censuses including the agricultural census, although the last agricultural census was in 1974. INEC also conducts an annual survey of agricultural production based on an area sample frame, the National Agricultural Statistics System (SEAN). This project is to develop a set of agricultural production data based on procedures that permit a valid statistical evaluation of the information (see Chapter 6). In 1986 an inter-agency group began to integrate the SEAN data into the official agricultural statistics, resulting in a situation that made the data incompatible with those from previous years. While perhaps representing improvements over previous estimates the overall accuracy cannot be judged in the absence of periodic and accurate census data. INEC also collects the data and constructs official consumer prices indices based on urban low and middle income market baskets as determined by 1975/76 consumer surveys.

V. Private Sector Linkages

Agricultural production, marketing and processing functions generally are carried out by the private sector. The several government agencies with responsibilities in those areas interact not only with the individuals and firms involved but with organizations to which the individuals and firms belong. Many of these have been formed to enable the private sector to interact more effectively with the public sector. A relatively large number of agricultural organizations exist. They vary with respect to membership, functions, resources, influence and

stability (FIDA; Jordán). Despite the apparent organized nature of the sector, producers tend to be quite independent and there has been little cooperation among organizations that have common interests.

Quasi Public Organizations

Some agricultural organizations are required by law. These include Agricultural Centers, four Chambers of Agriculture and a federation of the four. The Chambers are, in turn, part of a larger system which include industry and trade and which were created by law, although predecessor organizations had existed. The four agricultural chambers are located in separate geographical areas, the Costa, Northern Sierra, Southern Sierra and Oriente. The Federation is headquartered in Quito and is composed of the Presidents of the four chambers with the chairmanship rotating annually.

Agricultural Centers were created in each canton with farming interests under the same law that set up the Chambers of Agriculture. Every farmer must be a member of an agricultural enter. Membership in a center provides the individual with a farmer identity card which permits access to certain services, the most important being, perhaps, the ability to borrow money from BNF. Although farmers are legally required to join a Center, many do not. Each center elects a delegate to the Chamber of Agriculture in its region and these delegates are the only members of the Chambers.

Comunas are a form of economic and political organization, recognized by the 1979 Constitution, which must be registered with MAG.[7] They serve as governing agencies for sub-parochial communities (Jordán, FIDA). They originated under a 1937 law as a legal organization for indigenous groups but also are now used for other small communities.

Cooperatives are used by the GOE to achieve agricultural objectives. Many are traditional organizations that provide goods and services for their members. However, there also are production cooperatives that were formed as a result of agrarian reform or colonization requirements, especially for receiving land that had been state owned.

Finally there are the professional organizations or "colleges." To work, particularly in the public sector, in a number of professions (economics, journalism, agriculture, accounting, etc.) one must belong to the appropriate professional organization which in turn requires that the individual meet certain requirements such as being a graduate in the appropriate field from an Ecuadorian university. The primary organization to which this applies in agriculture is the Association of Agronomists (*Colegio de Agrónomos*). The purpose of this requirement is to assure that persons filling technical slots have the professional competence to function effectively in the job, although it also serves to help assure employment of many university graduates.

Private Sector Organizations

Purely private sector organizations encompass a wide variety of types and sizes except that there is no nationwide general farm organization comparable to the American Farm Bureau Federation in the U.S. The Chambers of Agriculture are the closest to a general farm organization and their Federation could be of national importance in representing agriculture if regional and class divisions and conflicts could be resolved. Despite the lack of a general farm organization most agricultural and agro-industrial interests are represented by one or more

organizations.

Ecuador produces a wide array of agricultural products and there are producer organizations for most, with various local, regional and national groups. Other organizations may represent farmers from specific geographical areas, small farmers or indigenous farmers. Producer associations are varied in their activities, some exist for political or social purposes only, while others offer many services including inputs, technical assistance, diagnostic laboratories, research, marketing and training. Processing firms are represented by agro-industrial associations as well as by the Chambers of Industry. Agricultural marketing is probably the most unorganized activity in the food and fiber industry of Ecuador, except as marketing is part of overall agricultural activities and organizations. Small sized retail merchant operations sell much of the food and these are organized into a large, national and effective organization, the National Federation of Retail Merchants (FENACOMI).

Historically the Indians, subjugated at the time of the Spanish conquest, provided the bulk of the farm labor under the *hacienda* system, a generally exploitative regime. Gradually, however, the recognition of the needs and rights of this group grew and indigenous organizations began to be formed. A 1937 law formally recognized this and the Ecuadorian Federation of Indians (FEI) was formed. It and other organizations have attempted to protect and extend their interests. Rubio Orbe (pp. 109-110) listed 27 organizations together with a national level coordinating group (see, also, Chapter 10).

Labor unions represent a very limited number of farm workers. These tend to be concentrated in those farm activities where there are plantation and/or industrial types of activities--sugar, oil palm, bananas, etc. Federations of local unions connect the agricultural labor unions into the national network. Union efforts to improve working conditions have produced results, as in the recent extension of social security to farm workers or, historically, the minimum wage laws, the 13th, 14th and 15th month wage supplements and an extensive set of labor laws.

A number of nonprofit foundations are important in the agricultural sector of Ecuador. They help promote, protect, or develop agriculture, farmers and natural resources. The Nature Foundation (*Fundación Natura*) is active in environmental protection and education, natural resource conservation and reforestation. The Science Foundation (*Fundación Ciencia*) has conducted research in areas such as health and agriculture. The Agricultural Policy Institute (IDEA) conducts agricultural policy analyses. The Foundation for Agricultural Development (FUNDAGRO) is designed to help overcome some of the weaknesses in Ecuador's agricultural research program.

VI. Agriculture in the National Budget

The national budget of Ecuador is managed by the Ministry of Finance and monitored by the Controller General. Government revenues come from direct and indirect taxes and from the sales of products and services by government agencies and enterprises. A large share of the government's revenue is derived from petroleum sales, with nearly one-half typically from taxes on petroleum or sales of petroleum and its derivative products.

About one-fourth of total Government expenditures are for investments in schools, roads, dams, buildings, equipment, etc., while the other three-fourths is used for current expenses including the such government services as education, defense, health, justice, agriculture and economic development (BCE 1987c, pp. 283-284). Servicing the public debt has been taking an increasing share of public

revenues, accounting for 23.6 percent current expenses in 1986.

The Ecuadorian Tax System

The public revenue system of Ecuador depends on a wide variety of petroleum and other taxes, fees and other income sources. While there are a relatively large number of different sources, import duties, income taxes and sales taxes are the main sources of non-oil revenue. One of the characteristics of the tax system is the earmarking of significant portions of revenues from many sources for specific uses. This process begins with the Constitution which requires that 30 percent of the national budget be used for education. However, earmarking is common for other purposes including specific earmarks for local projects or activities (Colyer 1988a).

The laws and regulations with respect to the distribution of oil revenue are very complex, including earmarking, although the general revenue budget receives substantial amounts, too. Eighteen government entities are entitled to receive oil revenues with the proportions determined by complex formulas that depend on, among other factors, the price of oil (BCE 1987c, Appendix 3). A major earmarking is for the military, which implemented the system and, according to the World Bank (1987a), receives over 28 percent of the total. Agriculture receives very little directly but rural road development receives a relatively large share, 5.5 percent.

Trends in Public Revenues and Expenditures

An examination of real (1975 = 100) government revenues and expenditures from 1965 through 1986 indicates that they tended to increase slowly through 1972 but increased sharply in the following years as higher oil revenues became incorporated into the budget (Figure 11.2). Government revenues declined in 1980-82, rose again from 1983 through 1985 but dropped precipitously in 1986 due to a very sharp decline in oil prices. As shown in Figure 11.3, there were budget deficits in all but five of the 22 years examined. The last half of the 1970s and early years of the 1980s had large deficits which were compensated for by borrowing from international sources. Oil revenues had not increased as expected and to carry out its planned programs the government borrowed in anticipation of future earnings.

Debt Management

The external public debt of Ecuador has grown significantly as a consequence of continuous borrowing to cover deficits as well as for investments and other purposes (Table 11.1). The private sector also borrowed extensively from foreign sources in the 1970s and early 1980s. When the economic crisis of 1982-83 occurred the solvency of these firms was threatened because the debts were dollar denominated. The problem was resolved by "sucretization" of the debt. The government took over the dollar obligations and allowed the debtor companies to repay the loans, to the government, in Sucres.[8] Thus, nearly all the current foreign debt of the country is owed by the government.

The proportions of the deficits financed internally and externally varied considerably from year to year. Of the total amount of the deficits for the period, 41.8 percent was financed from external sources. However, about one half the total amount financed externally was in 1986, the year that petroleum prices dropped so precipitously (Table 11.2). The country was able to borrow from a number of

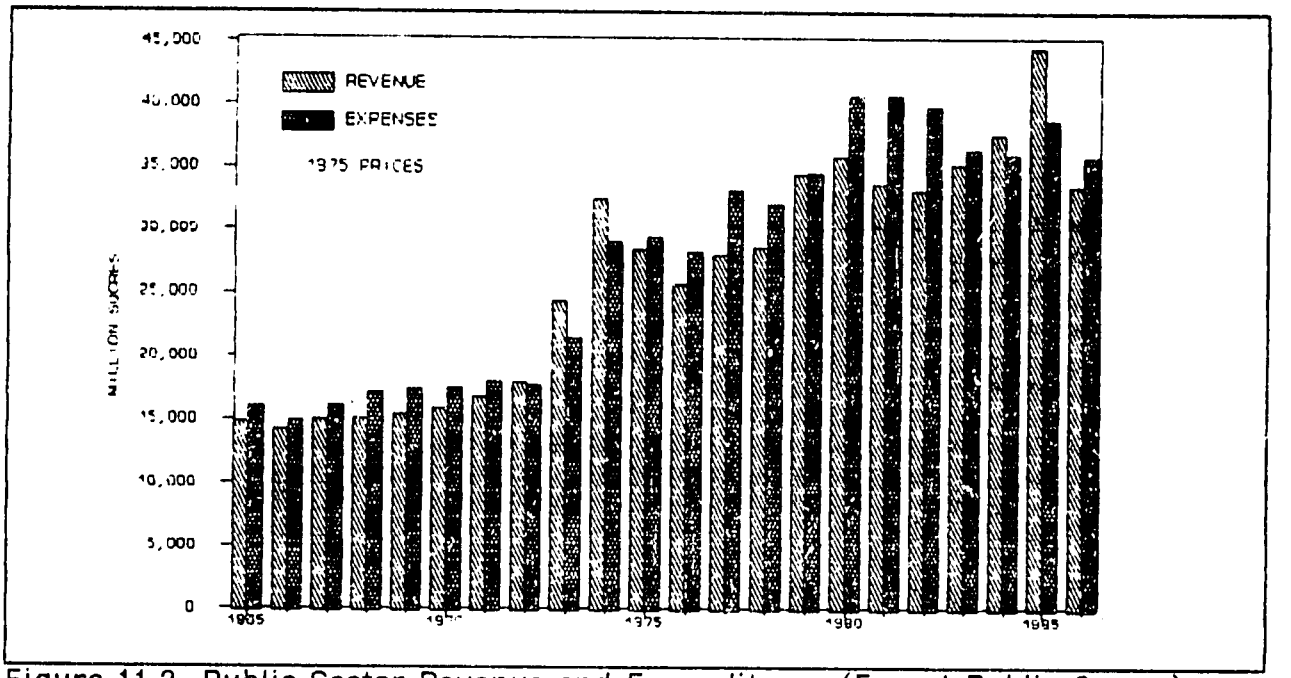

Figure 11.2 Public Sector Revenue and Expenditures (Except Public Corps.)
Source: BCE 1974c-1987c.

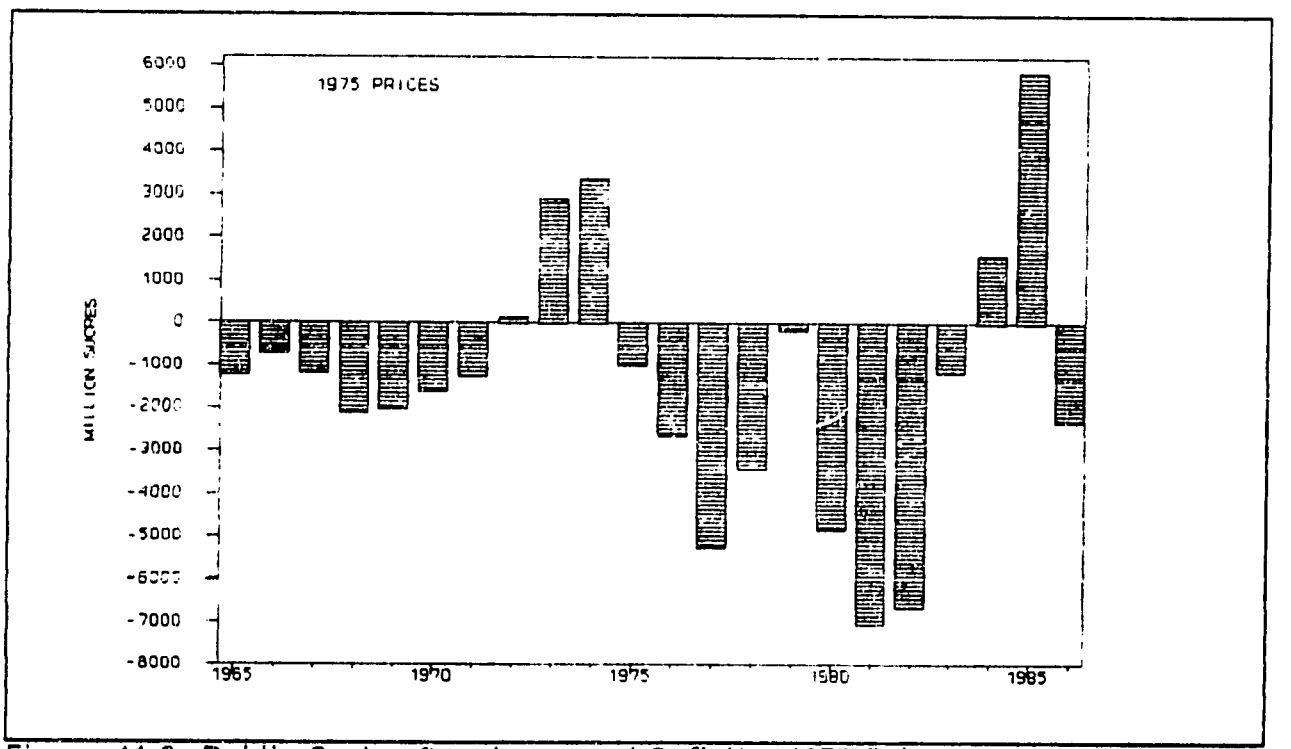

Figure 11.3 Public Sector Surpluses and Deficits, 1975 Prices
Source: BCE 1974c-1987c.

Table 11.1 Ecuador: Public and Private External Debt (millions of U.S. dollars)

Year	Public	Private	Total
1975	456.5	56.2	512.7
1976	635.8	57.3	693.1
1977	1,173.8	89.9	1,263.7
1978	2,078.4	496.2	2,574.6
1979	2,847.8	706.2	3,554.1
1980	3,530.3	1,121.5	4,651.8
1981	4,415.9	1,542.3	5,868.2
1982	4,558.6	1,628.5	6,187.1
1983	5,164.8	1,523.8	6,688.5
1984	6,804.0	177.0	6,981.0
1985	7,343.1	96.9	7,440.0
1986	8,241.9	58.1	8,300.0
1987	9,187.0	43.0	9,230.0
1988-Est.	9,454.0	39.0	9,493.0

Source: *El Comercio.*

Table 11.2 Ecuador: Budget Deficits and Sources of Finance (millions of sucres, current prices)

Year	Surplus + Deficit -	Amount Financed[a] Internal	Amount Financed[a] External	Percent External
1970	- 1,545.0	1,534.9	11.1	0.7
1971	- 1,733.0	1,641.6	55.8	3.2
1972	- 893.4	-61.1	954.5	100.0
1973	- 227.5	196.0	31.5	13.8
1974	- 21.3	21.3	0.0	0.0
1975	+ 609.4	-802.2	-235.6	NA
1976	- 2,160.4	1,874.7	385.7	17.8
1977	- 4,292.8	3,211.5	1,081.3	25.2
1978	- 3,765.7	3,862.5	-96.8	0.0
1979	- 1,607.3	2,716.4	-1,109.1	0.0
1980	- 4,148.5	2,771.0	1,553.3	37.4
1981	-16,835.8	9,177.3	7,658.5	45.5
1982	-17,866.9	7,878.6	9,988.3	55.9
1983	-14,047.3	16,313.0	-2,265.7	0.0
1984	- 6,784.8	10,843.0	-4,058.2	0.0
1985	+21,970.5	-18,185.8	-3,784.7	NA
1986	-29,641.8	7,073.1	22,451.3	76.1
Totals	105,568.2	61,397.2	44,171.0	41.8

Source: BCE 1984b, 1987b.

[a] Some data adjusted to obtain correct totals. Negative numbers for amounts financed indicate net repayments.

foreign sources to help overcome the deficit produced by the drop in oil revenues. A similar situation occurred when the March 1987 earthquake destroyed some 16 miles of the oil pipeline and interrupted exports for several months.

Public Expenditures On Agriculture

Real total public expenditures, current outlays and investments for agriculture rose during the first years of the oil boom but began to decline after 1974 and reached an oil era low in 1983 (Figure 11.4). Expenditures increased slightly after 1983 but were only 57 percent of the 1974 peak in 1985. The 1974 peak was very high in comparison to expenditure levels both before and after that year but real expenditures in the 1980s have been considerably less than in the 1970s.

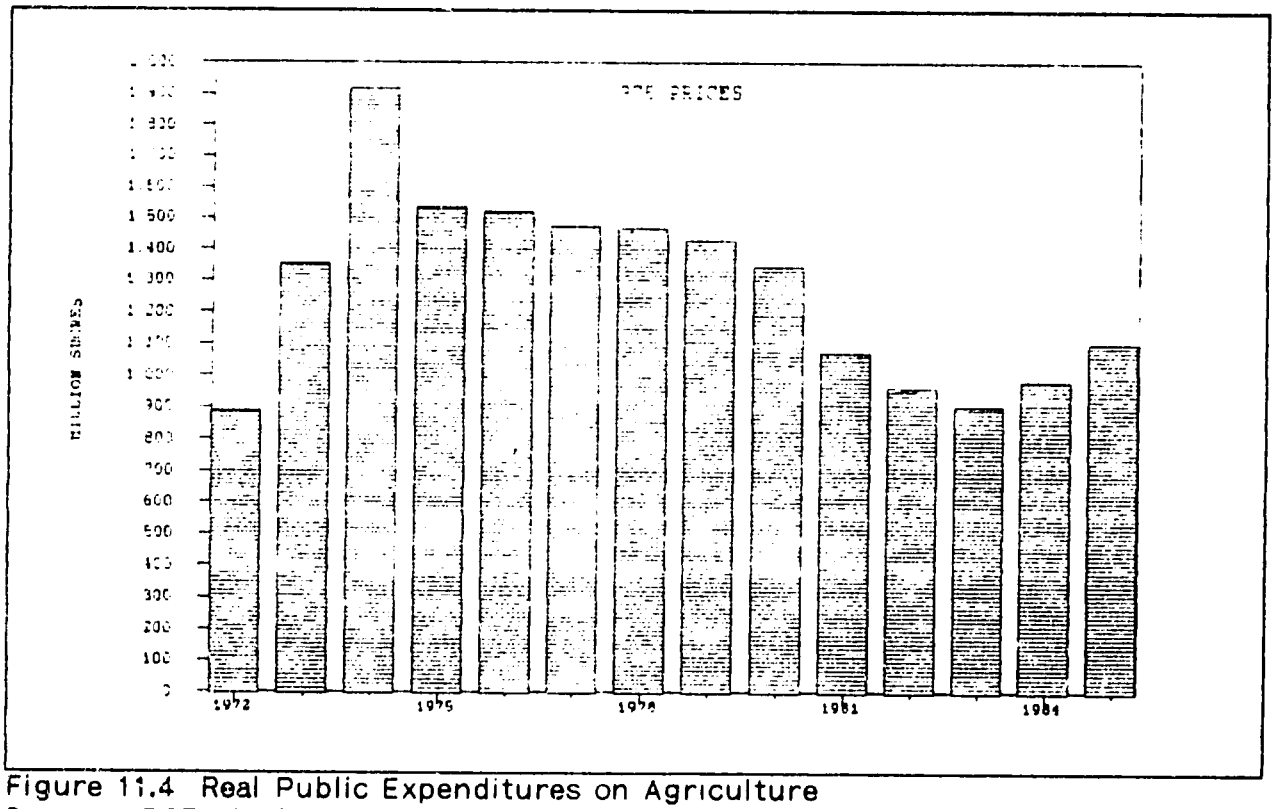

Figure 11.4 Real Public Expenditures on Agriculture
Source: BCE 1983b-1987b.

The proportion of total agricultural to total public expenditures declined substantially between 1974 and 1982 (Figure 11.5). Government expenditures continued to rise through 1981 and were substantially higher in 1985 than in 1974, while expenditures on agriculture declined. The total economy of the country grew more rapidly than the agricultural sector during the 1970s and it could be expected that the proportion of expenditures on agriculture also would decline. However, public expenditures on the sector dropped relatively more than the participation of agriculture in the country's economy.

Expenditure trends have affected the various agencies of the MAG differently. The magnitudes of the changes for the MAG and its adjunct agencies are shown in Table 11.3, where average real expenditures for the years 1973-81 are

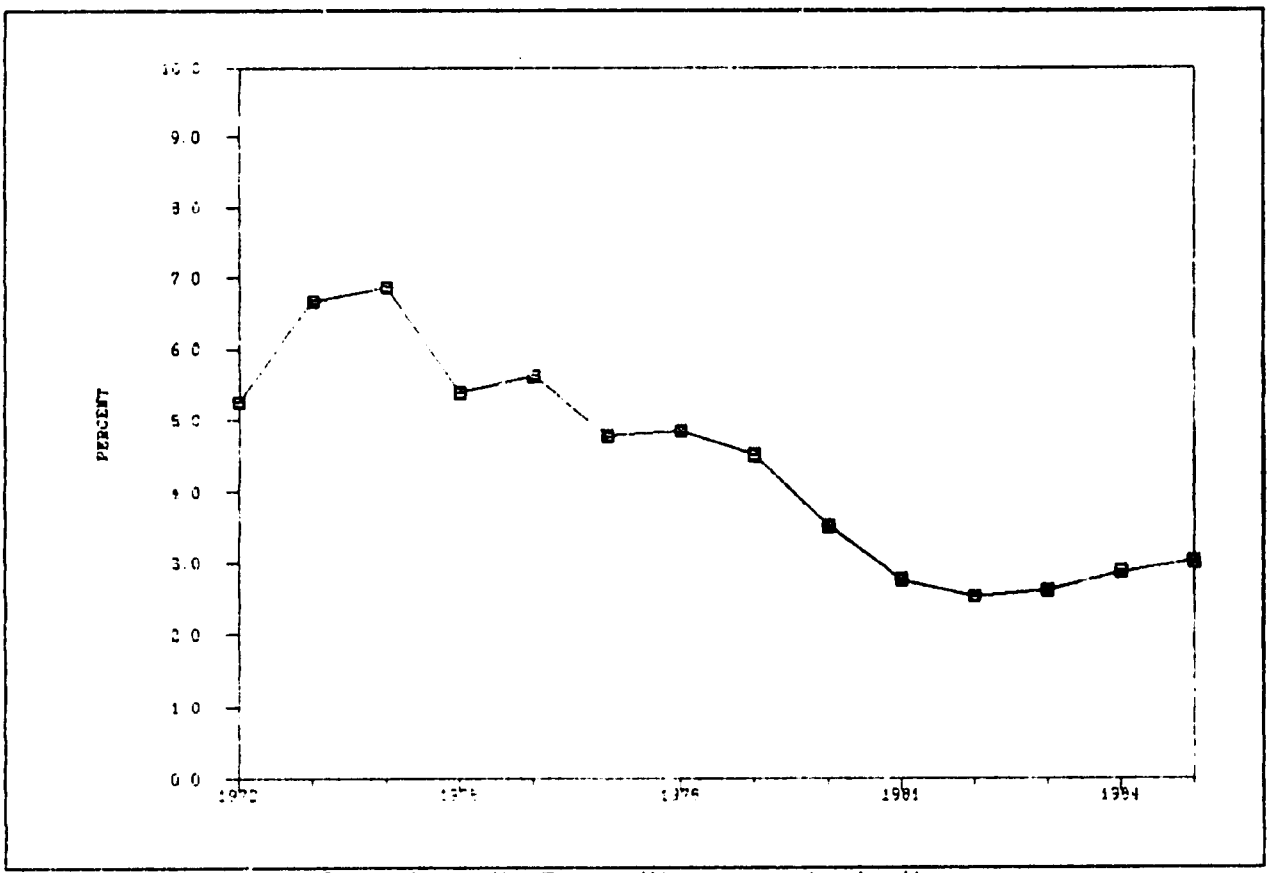

Figure 11.5 Share of Total Public Expenditures on Agriculture
Source: BCE 1983b-1987b.

compared with those for 1983-86. There was an increase in 1985 but the sharp drop in oil prices in 1986 and the loss of oil due to the interruption caused by the 1987 earthquake have caused additional reductions. The average decline for the Ministry and its adjunct agencies combined was 23.5 percent but with considerable variation between the units, from a 12.8 percent increase for CEDEGE to a 46.6 percent decrease for CRM. Expenditures for INIAP, the research agency fell by 32.7 percent, at a faster rate than the average.

Declines in real expenditures of the magnitudes shown in Table 11.3 have very significant impacts on the ability of MAG and its agencies to function effectively. The impacts, however, have been more severe since few of the cuts were made by personnel reductions, although a decline in real wages appears to have occurred as wage increases were kept below the rate of inflation. Minimum wages, for example, have not kept pace with the rate of inflation (CORDES; Spurrier). The maintenance of personnel levels means that a significant share of the cuts were in operating funds, reducing the capacity to implement programs.

Expenditures on agriculture by the public sector are relatively low in Ecuador when compared to those of other Latin American countries (Table 11.4). This is based on a comparison of Ecuadorian expenditures in 1980 with those for nine Latin American countries in a study by the International Food Policy Research Institute (IFPRI) reported by Elías. Public expenditures on agriculture per hectare of cropland were substantially lower than for any of the other countries except Argentina and were the lowest per person employed in agriculture. A conclusion

Table 11.3 Average Real Public Expenditures on the Agricultural Sector (1975 prices)

Unit	Average '73-81	Average '83-86	Percent Change
Ministry	618.8	388.4	-37.23
INIAP	113.9	96.7	-15.11
IERAC	152.5	113.7	-25.45
INERHI	205.2	138.0	-32.73
CEDEGE	76.1	85.9	12.85
CRM	111.8	59.7	-46.62
CREA	72.5	49.8	-31.33
PREDESUR	103.6	100.1	-3.46
INCRAE	14.8	14.4	-2.29
All Units	1436.3	1098.7	-23.50

Source: BCE 1974c-1987c.

Table 11.4 Government Expenditures On Agriculture for Selected Latin American Countries, 1980 (current dollars using official exchange rates)

Country	Per Hectare of Cropland	Per Person Employed
Argentina	9[a]	279
Bolivia	181	136
Brazil	169	485
Chile	163	393
Colombia	195	373
Costa Rica	119	143
Ecuador	76[b]	72
Mexico	296	663
Peru	177	137
Venezuela	538	1,004

Sources: Ecuador - Calculated from Central Bank and Ministry of Agriculture data.
Other Countries - Elías.

[a] Includes "cultivated pasture".

[b] Based on acreage cropped. If the "potential cropland is used the expenditures decline to US$25 per hectare.

of the IFPRI study, based on statistical analyses of 1950-1980 data for the nine countries was that growth in agricultural output was positively related to public expenditures on agriculture (Elías p. 44). Thus, the low level of expenditures in Ecuador appears to have contributed to the slow growth of the sector.

Public Investment in Agriculture

Total real public sector investments (capital expenditures) in the agricultural sector increased during the early years of the oil boom (Figure 11.6). They increased markedly in 1980 and 1981 with the restoration of democratic rule but decreased in 1982 and the subsequent years of economic crisis. However, the proportion of public expenditures used for investments fluctuated around a downtrend during the years 1965 to 1986 (Colyer 1988a, pp. 48, 70). Relatively large shares of the investments were for infrastructure built by the MOP as well as for schools by the MEC and irrigation through the MAG.

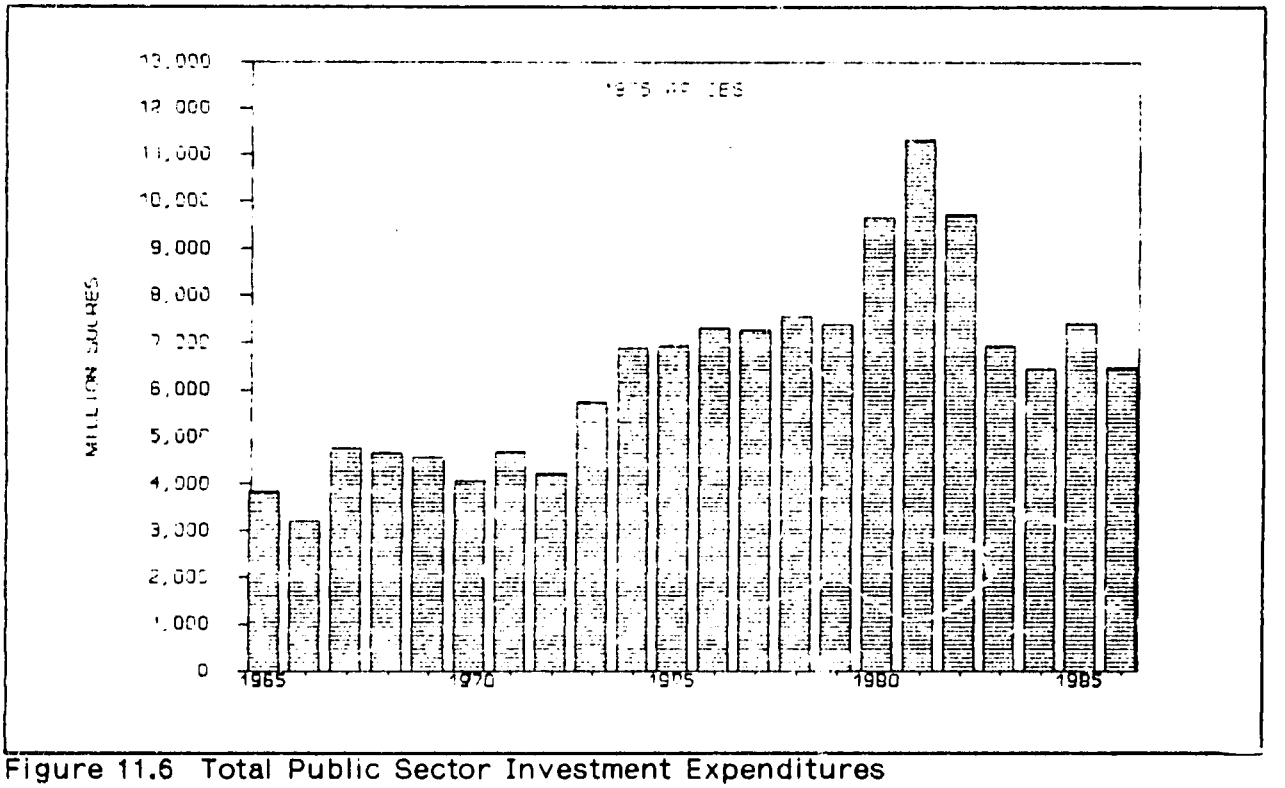

Figure 11.6 Total Public Sector Investment Expenditures
Source: BCE 1983b-1987b.

The proportion of total public investment in the agricultural sector has varied considerably over the years of analysis. During the period 1973-81 the average proportion of the public sector investment budget going to agriculture, through the Ministry of Agriculture and its adjunct agencies, averaged about 11.3 percent but varied from 5.9 in 1976 to 15.9 in 1979 (Figure 11.7). Investments in the sector remained at about the same proportion through 1983 but declined sharply in 1984 and have remained below five percent since then. About three fourths of the agricultural investments are made through the adjunct agencies with the largest proportion being for the irrigation activities of two of the agencies, INEHRI and CEDEGE. Around three percent of the agricultural investments are

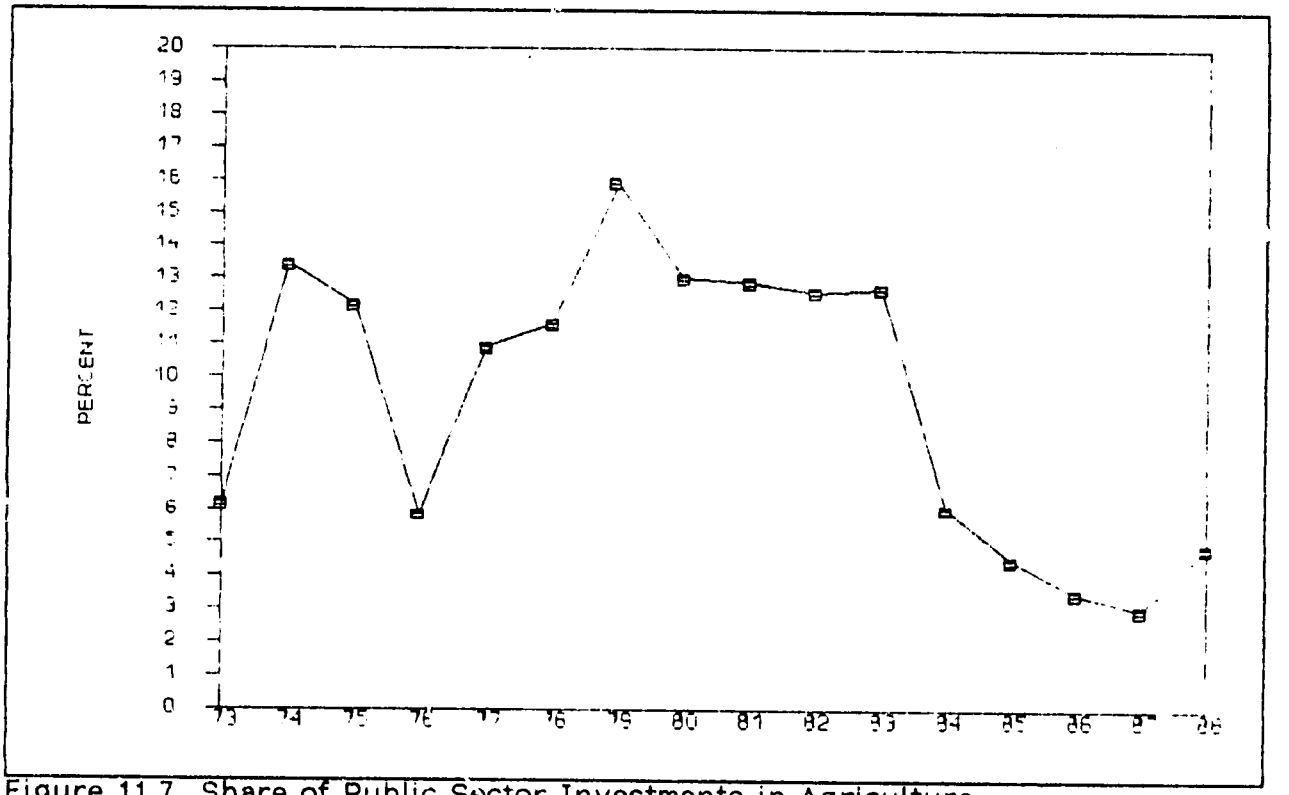

Figure 11.7 Share of Public Sector Investments in Agriculture
Source: BCE 1983b-1987b.

made in INIAP, with a similar amount going to the four MAG-owned state enterprises. However, relatively more was invested in ENAC in the 1970s when most of its storage facilities were being constructed.

VII. Foreign Assistance Programs

Prior to the oil era Ecuador was one of the poorer nations in South American and was the recipient of a wide variety of assistance from the international donor community. With oil revenue and the rapid growth in the country's economy in the 1970s there was a slackening in the volume of aid. The benefits of the oil revenues were not evenly distributed and poverty remained as a characteristic of large segments of the population. Thus, many donor programs were continued to assist the many disadvantaged groups. Other assistance was solicited to help meet the gaps between planned development activities and oil revenues that did not increase as rapidly as projected. The country also borrowed extensively from commercial sources to carry out its ambitious consumption and investment activities. This massive indebtedness and its costly servicing combined with a worldwide economic recession, natural disasters and declining oil prices produced a series of economic crises in the country and there has been a resurgence in assistance activities in the 1980s (Colyer 1988b).

Foreign Assistance Participants

Economic aid to Ecuador includes assistance from a large number of the array of multilateral, bilateral and private voluntary donor agencies that have evolved

since World War II. Net flows of official, non-private sector, development grants and loans from Development Assistance Committee (DAC) countries for the years 1980 to 1986 are shown in Table 11.5 (OECD 1988, 1984).

Table 11.5 Official Development Assistance to Ecuador (millions of U.S. dollars)

DAC Country	1980	1981	1982	1983	1984	1985	1986
Grants:							
Australia	-	-	-	-	-	-	-
Austria	0.2	0.2	0.2	0.1	-	-	-
Belgium	0.6	0.5	0.7	1.1	0.8	0.9	1.5
Canada	-	0.3	0.1	0.7	-	0.3	-
Denmark	0.1	0.1	0.1	0.1	0.1	0.1	-
Finland	-	0.0	-	0.0	0.0	0.0	-
France	2.1	1.7	1.0	1.2	2.5	1.5	3.2
W. Germany	11.1	10.2	9.2	8.3	7.2	7.7	12.7
Ireland	-	-	-	0.0	0.0	0.0	0.0
Italy	0.1	1.3	2.7	2.3	9.5	4.9	4.9
Japan	0.8	1.4	2.3	1.2	0.8	1.8	3.3
Netherlands	1.5	1.7	1.1	1.2	1.4	1.7	2.4
New Zealand	-	-	-	-	-	0.0	0.0
Norway	0.1	0.4	0.0	0.0	0.1	0.0	0.0
Sweden	-	-	0.1	0.1	0.2	0.2	0.2
Switzerland	0.3	0.2	0.6	0.4	0.4	0.3	0.2
United Kingdom	2.0	1.5	1.2	1.0	0.7	0.8	1.2
United States	1.0	2.0	4.0	4.0	8.0	8.0	14.0
Total DAC	19.7	21.5	23.2	21.9	31.8	28.2	43.6
Multilateral	8.4	8.7	6.2	7.0	6.4	5.5	8.3
EEC	1.0	3.9	1.1	6.6	0.3	0.8	0.8
Net Loans							
Belgium	-	-	-	-	3.5	-	-
Canada	-	-	-	-0.4	-0.2	-0.2	-0.2
Denmark	-	-	-	0.0	0.0	0.0	-0.1
Finland	-	-	-	0.9	-	0.3	-
France	-	-	-	-	-	0.1	1.8
Germany	1.7	3.4	4.8	0.2	0.3	0.9	0.6
Japan	3.8	0.5	-	-0.5	0.4	-0.1	-0.4
Netherlands	-	0.3	0.3	-	-	-	0.0
United Kingdom	0.2	-	-	-0.4	-0.1	0.0	-0.1
United States	-	-	1.0	1.0	4.0	22.0	10.0
Total DAC	5.7	4.2	6.1	0.8	7.9	22.9	11.6
Multilateral	15.7	27.4	14.9	13.1	65.3	53.9	43.0

Source: OECD.

In 1986, a year when Ecuador suffered a severe economic blow due the decline in the average price of oil from US$28.50 to US$12.90 per barrel, net assistance from the international agencies increased by US$445.5 million (BCE 1987c p. 360). Most of this was in the form of loans from the World Bank, US$127 million, the Inter-American Development Bank (IDB), US$113.3 million, and the Andean Reserve Fund, US$175 million. United Nations agencies contributed over US$16 million in technical assistance distributed among 16 sectors but with the majority going to agriculture, health and transportation and communication (UNDP 1988, 1987, 1986).

The governments of over 20 countries have had official economic assistance programs in Ecuador. Fourteen DAC countries with assistance programs in Ecuador are listed in Table 11.5 and at least 7 non-DAC countries have or have had recent programs in the country. A report for 1986 listed nine countries which had provided US$18.8 million in assistance (UNDP 1987, p. viii). The United States provided 41 percent of that total followed by West Germany with 21.1 percent and Italy with 16.8 percent. The report also lists contributions from Belgium (6.2 percent), Canada (5.4), Sweden (4.6), France (3.6), Korea (0.4) and Chile (0.1). In addition the two Chinas, Great Britain, Holland, Japan, Israel and Spain have provided support. Over one third (US$6.8 million) of the assistance listed by United Nations Development Program (UNDP 1987) was for agriculture.

Although assistance to Ecuador increased in the 1980s, the level remained low on a per capita basis when compared to most other Latin American countries that also were major recipients of U.S. assistance (Table 11.6). During the period 1982-85 of seven Central and South American countries only Guatemala received less assistance per capita than Ecuador's average of US$10.70, from a combination of assistance from DAC countries, multilateral agencies and OPEC countries.

Table 11.6 Official Development Assistance to Selected Countries

Country	(millions of U.S. dollars)					(U.S. dollars)	
	1982	1983	1984	1985	Average 1983-85	Per Capita GNP	Per Capita Assistance
Bolivia	147.4	173.6	171.9	282.1	193.8	410	31.2
Costa Rica	80.3	252.1	217.6	280.1	207.5	1,160	82.0
Ecuador	**53.0**	**63.7**	**136.2**	**135.8**	**97.2**	**1,220**	**10.7**
El Salvador	223.1	295.0	262.8	345.1	281.5	710	52.0
Guatemala	63.7	75.8	65.4	82.8	71.9	1,120	9.3
Honduras	158.1	191.6	289.6	276.2	228.9	710	54.2
Panama	41.0	47.0	72.1	69.2	57.3	2,100	26.9
Peru	187.9	297.1	310.1	316.4	277.8	990	15.2

Source: OECD.

A large number and variety of private voluntary organizations (PVOs) operate in Ecuador. The individual programs tend to be small in terms of the amounts of money involved and the efforts generally are directed at the more economically disadvantaged groups. The PVOs operating in Ecuador can be classified into three broad groups. One consists of purely charitable groups such as CARE, the Red Cross, Foster Parents Plan and Save the Children. Another is composed of religious organizations including Catholic Church organizations, those from several protestant churches, and the Mormon Church. Another category is a miscellany of business/labor/foundation associated groups, such as the International Executive Service Corps, Farmer to Farmer Program and American Institute for Free Labor Development (AIFLD).

There are numerous activities from academic, scientific and business organizations that provide various forms of technical and financial assistance to Ecuador. Among these are the academic institutions which have contributed to research through faculty and graduate students financed by various means, as, for example, the U.S. Fullbright program which provides grants to U.S. university faculty for research and teaching in Ecuador and for Ecuadorians to go to the United States to study or participate in other academic endeavors. Cooperative efforts with institutions in Ecuador and have helped to strengthen generally weak institutional research capabilities.

Multilateral Assistance Programs

The agricultural sector has been the recipient of a very significant share of the multilateral assistance extended to Ecuador, including many of the larger loans by the two development banks (World Bank and IDB). The sector also has benefited from assistance extended to other sectors such as education, health, energy, transportation and communications, aid that spills over to agriculture due to general impacts or from projects that were implemented in rural areas where most of the population has agricultural interests. In terms of volume of assistance for development, multilateral bank loans dwarf the amounts made by other multilateral agencies. Most of the multilateral agencies have sponsored or financed a wide variety of programs related to agricultural needs, from strengthening central institutions to direct assistance to individual farmers.

The World Bank, officially the International Bank for Reconstruction and Development (IBRD), has been involved in Ecuador for many years. Through June 30, 1987 the World Bank and its associated agency, the International Development Association (IDA), had made Ecuador a total of 46 loans for US$1,149.8 million (World Bank 1987a, p. 160). This total includes three loans for US$159 million approved in the Bank's Fiscal Year 1987 (July 1, 1986 - June 30, 1987). The value of loans in existence on June 30, 1987 was US$884 million of which US$242 million had not been disbursed. A recent (FY 1987) loan for the agricultural sector, the Second Agricultural Credit Project for US$48 million, was approved in September 1986. This loan was to increase farm employment, farmers' incomes and agricultural production, especially the production of exportable products.

As a result of the debt crisis in Latin America and the problems faced by many countries the World Bank has increased its adjustment lending activities vis-à-vis project lending. In Ecuador this took the form of a US$100 million Agricultural Sector Loan primarily for imports of agricultural inputs. The loan was dispensed in two disbursements, about half in 1986 and the remainder in 1987. The second tranche was conditioned on the country making a number of policy adjustments in the agricultural area. Although the GOE did not meet all the

conditions for release of the second tranche, it was released because of the overall progress of reform in the country and in light of the problems caused by the drop in oil prices, the setbacks in the 1986 elections and the March 1987 earthquake.

The IDB, established in 1959, made its first loan to Ecuador in 1961 (IDB p. 71). The total value of the loans made to the country through 1987 was US$2,304 million with US$817 million (35 percent) going to the agricultural, forestry and fishing sectors. Over half the total loans have been made in the five years, 1983-1987. Of the total, US$1,220 million had been disbursed by the end of 1987. In 1988, there were loans for 32 projects with a total value of US$1,674 million, of which 42 percent (US$701 million) had been disbursed (Eguez, p. 1.) In addition to the loans, technical and other assistance grants of over US$21 million (US$493,000 in 1987) have been provided to Ecuador (IDB p. 74).

In 1987 a US$200 million agricultural credit loan was approved by the IDB, as the third stage of the Global Agricultural Credit Program and following loans of US$54 million and US$120 million in 1983 and 1985, respectively. These are channeled through the National Development Bank (BNF) for lending to the farm sector. The purpose is increase the production of food for domestic use and of agricultural products for export through the financing of farm investments, operating capital and technical assistance. Agricultural credit depends on external financing combined with credit from the Central Bank of Ecuador since interest rates charged on farm loans are negative in real terms, less than the rate of inflation (see Chapter 9). Consequently, savings for agricultural lending are not mobilized.

One of the larger activities financed by IDB in Ecuador has been the Daule-Peripa dam built in Costa area north of Guayaquil. In 1979 IDB approved loans for US$165 million for the project, which was inaugurated in 1987. Total IDB funding for the project and associated works is US$457.2 million. The main purposes of the project are generation of electricity, irrigation, drainage and flood control. Its reservoir will hold around 6 million cubic meters of water and cover 50,000 hectares when filled. It is expected to provide water for irrigating 50,000 hectares when all the associated infrastructure is completed. Crops that will be irrigated include rice, bananas, corn and soybeans (see Chapter 7).

IDB also has a fund to assist low income and small project activities. Under this a small loan (US$500,000) was made in 1987 to a federation of organizations for low income farmers from Baba and Vinces in Guayas Province to enable them to construct a processing plant for coffee, cacao and rice. Some 2,600 low income farmers belong to the member organizations of the federation. In addition to the loan, a grant US$125,000 was made to provide administrative assistance to the company that will operate the processing plant.

Several United Nation's agencies conduct assistance programs for the agricultural sector. UNDP (1987) reported a total of US$16 million of assistance by U.N. agencies in 1986, with nearly one third of the total used for agricultural programs. The U.N. agencies and their agricultural contributions for 1985-87 are shown in Table 11.7. The largest contributions were by the World Food Program (WFP) with US$3.5 million each year. These funds are used for food for work programs administered by MAG's Rural Development Division. The work is carried out in low income rural areas, primarily in indigenous communities, and involves constructing rural infrastructure such roads, bridges, community buildings and schools.

The U.N.'s Food and Agricultural Organization (FAO) has an extensive program in Ecuador, although its total funding is limited and has been reduced due, in part to a reduction in U.S. support of U. N. organizations. Its ongoing

Table 11.7 United Nations Assistance for Ecuadorian Agriculture

United Nations Agency	Amount Contributed (dollars) 1985	1986	1987
UN Development Program (UNDP)	726,246	758,735	520,235
Food & Agricultural Org. (FAO)	1,232,655	627,806	70.806
Educ., Culture & Sci. (UNESCO)	13,100	12,400	72,300
Atomic Energy Org. (IAEO)	69,510	143,788	491,686
World Food Program (WFP)	2,187,934[a]	3,500,000	3,500,000
UN Children's Fund (UNICEF)	276,600	119,000	120,300
Environmental Program (PNUMA)	2,798	--	2,109
Totals	4,508,843	5,162,529	4,777,436

Source: UNDP 1986, 1987, 1988.

[a] The WFP total contribution in 1985 was US$3.5 million with the remainder being handled through the Ministry of Health.

(1987-88) activities include projects for the management and conservation of soils in the Paute River Basin, monitoring land use in the Amazonian region, food production assistance to 4-F clubs in the Santo Domingo area, administrative assistance to BNF, irrigation assistance at the farm level, extension training and integrated rural development. In 1986, the UNDP contributed to integrated rural development projects (US$497,582), for improving the administration of agricultural credit programs (US$105,553) and to conduct small rehabilitation activities (US$150,600), all jointly with FAO. Other FAO programs were for small dairy farm development, soil management in the Guayas River Basin, support for planning in the southern area of the country, training trips and consulting.

The Interamerican Institute for Cooperation on Agriculture (IICA), part of the Organization of American States (OAS) and headquartered in Costa Rica, conducts technical assistance programs in Ecuador in cooperation with a variety of Ecuadorian and international institutions. The Ecuadorian institutions include the MAG, MBS, University of Guayaquil, CREA, FUNDAGRO, CONADE and PETROECUADOR. International agencies include the World Bank, Inter-American Development Bank, Andean Development Corporation (CAF), the Cartagena Accord, USAID and Canada's International Center for Development Research (ICDR). The Institute supports policy analysis activities of MAG, research and extension, integrated rural development (SEDRI), animal and crop health programs and marketing of agricultural products. IICA also supports Andean subregional activities in animal health and agricultural research with the latter including the international agricultural research centers.

The three Latin American based international agricultural research centers, the International Potato Center (CIP), International Center for Wheat and Corn (CIMMYT) and International Center for Tropical Agriculture (CIAT) provide research services. They help the gap between research needs and what the country can afford. These three Latin American centers provide new plant varieties, assist the Ecuadorian research agency, provide training and help maintain genetic variability. INIAP and CIP have joint projects for controlling potato diseases and for

maintaining potato germplasm through in vitro means. There is a cooperative program with CIAT for increasing the production and use of cassava as an ingredient in livestock feed. CIMMYT's activities in Ecuador encompass research on wheat, barley, triticale and corn. Ecuador also cooperates with the International Board for Plant Genetic Resources (IBPGR) in the collection and maintenance of germplasm for potatoes, oca, melloco, other Andean root crops, amaranta, quinua and capulí. Research from other international centers also contribute as, for example, rice varieties from the International Rice Research Institute (IRRI).

The Organization of American States (OAS) has funded scholarships and the Intergovernmental Committee on Migration. The latter was provided US$36,500 for training in agricultural production techniques, research on technology and its cultural foundations, pork production in the Otavalo area and rice, corn and cacao processing and marketing in the Vinces and Baba area of Guayas Province. In 1987 OAS also contributed funds for work on cattle diseases, production of legumes for human consumption, evaluation of marine resources and for scholarships for study in the areas of mechanization, nutrition and the environment.

Bilateral Assistance to Agriculture

Bilateral assistance encompasses loans and grants or technical assistance from the government of a foreign country to Ecuador. Generally these are government to government activities but the aid may go to non-government organizations, as permitted by bilateral agreements. Agriculture, forestry and rural areas have been the recipients of a large proportion of assistance provided by other governments. Historically, the U.S. has been the principal provider of bilateral aid for Ecuador but a substantial number of other countries have supplied significant quantities of assistance for the agricultural sector. Some have provided more aid than the United States in given years, especially in the last half of the 1970s and first half of the 1980s.

U. S. Programs

The United States has provided assistance for Ecuador's agriculture since World War II when it helped establish the county's first agricultural experiment station. The amounts were small but increased under President Truman's Point Four program and under PL 480 food aid after that law was passed in 1954. Assistance received another boost under President Kennedy's Alliance for Progress in the 1960s when the U.S. assistance program was renamed, becoming the U.S. Agency for International Development (USAID). Programs declined during the seventies after the large increases in oil revenue and the emergence of the reformist military regime. With restoration of democratic rule in 1979 assistance levels increased and the economic crisis of 1982 and the 1982-83 El Niño floods led to additional assistance. With the election of the market-oriented Febres Cordero government in 1984, additional funds, including a resumption of Title I, PL 480 food aid, was provided for both agricultural and other activities. The sharp drop in oil prices in 1986 and the impacts of the 1987 earthquake also resulted in additional assistance. Funding levels were maintained after the election of Rodrigo Borja in 1988.

The agricultural portfolio of the USAID/Ecuador mission is substantial and varied.[9] The Mission's 1988 projects for agriculture, rural development and natural resources are listed in Table 11.8. The funding levels represent life of project funding with major projects lasting 3 to 5 years, although they are often extended

Table 11.8 1988 USAID Agricultural Assistance Programs in Ecuador

Project	Funds: Grant US$1,000	Loan US$1,000	PL 480 S/.1,000
Rural Technology Transfer Systems	5,300	2,600	210,000
Sheep Improvement Subproject			148,000
Integrated Pest Control Subproject			23,500
Dairy Production Improvement			19,000
Cattle Production & Marketing			37,000
Agricultural Sector Reorientation	7,100	1,700	356,000
Land Titling Project	3,300	7,000	
Integrated Rural Development	300		30,000
Promotion of Nontraditional Exports	2,400	8,000	
Agr. Research, Extension & Education	7,000		1,752,000
Wilson Popenoe Foundation (Scholarships)	680		
Coastal Resources Management	650		
Forestry Sector Development	1,600	6,500	
Environmental Education	900		
Promotion of Rural Youth Training	448		15,000
PL 480 Financed Projects:			
Technology Transfer Program			52,000
Agr. Sector Development Promotion			50,000
Agroecological Survey			20,000
Dairy Control & Registration			20,000
Andean Region Cooperative Research			16,000
Rural Water Projects			250,000
Calf Milk Replacer Project			45,000
Credit Institutional Improvement			24,000
Agricultural Commodities Exchange			100,000
Marketing Systems Promotion			13,000
Yuca (cassava) Production			78,500
Totals	29,678	19,800	3,308,500

Source: USAID/Ecuador 1988.

or renewed. Funding includes grants and loans made at very favorable rates. The total amount of funding for agricultural activities was expanded considerably after 1984 through the use of PL 480, Title I, and the Agricultural Adjustment Act, Section 416, funds, both derived from the sale of surplus U.S. agricultural products. Wheat, nonfat dry milk, vegetable oil and sorghum have been imported and sold, producing large amounts of local funds that are programmed for development activities by a joint GOE/USAID committee. The agreements under which the products are imported provide broad guidelines for the use of the funds. Table 11.9 summarizes the food aid imports that have been monetized for support of agricultural development. Funds from food aid sales have been used to provide counterpart funds for several of the USAID-funded projects and fund a number of smaller projects.

Table 11.9 Monetized Food Aid for Ecuador, 1985-88

Product	Program	Value: Dollars		Sucres	Uses Permitted
		Year	US$1,000	Millions	
Wheat	Title I	1985	15,000	1,424.7	Agr. & Rural Devel.
Wheat	Title I	1986	5,000	750.0	Agr. Development
Wheat	Sugar Quota	1986	1,500	185.1	Agr. Development
Wheat	Section 416	1987	4,350	826.5	Agr. Development
Wheat	Sugar Quota	1987	2,900	557.0	Agr. Development
NFDM	Section 416	1987	1,740	330.6	Agr. & Dairy Dev.
Soy Oil	Emerg. Food	1987	4,496	867.7	Earthquake Area
Sorghum	Section 416	1988	5,500	2,750.0	Agr. Development

Source: USAID/Ecuador.

Major USAID projects include activities to promote the development and transfer of agricultural technology, agricultural policy analysis, improvements in agricultural information, land titling, forestry sector development, promotion of nontraditional agricultural exports and development and protection of the country's Costa resources (Table 11.8). Many smaller projects of both the private and public sectors have been funded including those under PL 480 programs. These have included grants for environmental education activities, improvements in rural youth training through the establishment of 4-F (4-H) clubs, dairy sanitation and registration, rural water projects, development of a locally produced calf milk replacer, improvement of credit institutions, establishment of an agricultural commodities exchange and cassava production and processing.

The Peace Corps has been in Ecuador since its founding in 1962. It conducts development activities through the use of volunteers who receive a small salary and a small amount of support. The volunteers' activities are in response to requests by Ecuador, of which a substantial share is for agriculture, forestry and rural development. Over 3,000 volunteers have served in Ecuador since its founding with current levels of around 200 per year. Its agricultural and rural development activities include: support of 4-F club activities, integrated rural development, agricultural extension for small and low-income farmers, animal production in tropical areas, and fish culture. Natural resource activities embrace: forestry,

eforestation, silviculture, soil conservation, environmental education, and assistance to the National Parks.

Other Countries

Most of the Development Assistance Committee (DAC) countries have provided assistance to Ecuador, including agricultural programs (Table 11.6). Assistance also has been provided by a several non-DAC countries, Egypt, Israel, Korea, the Chinas and Latin American countries (Chile, Brazil and Honduras). Although the levels of assistance have been small, several countries have provided significant amounts for agricultural programs in the last few years.

Belgium has had recent projects supporting irrigation, forestry, rural development and fishing, with life of project funding of over US$5 million. Its irrigation activities have been through INEHRI and were directed to irrigation districts and assistance for small-farm irrigation. Reforestation, agro-forestry and related activities are financed in Chimborazo Province. Rural development activities encompassed a number of small projects to assist communities develop their agricultural, artisan and other activities. These activities also utilized Belgian volunteers to carry out the technical assistance activities.

Canada has several relatively small projects, most in support of agricultural research and some through other agencies. Support of research through INIAP, in 1987, included production and processing of quinua, production and utilization of corn and cassava (yuca) for small farms in Manabí Province, virus-free seed potato multiplication, potato marketing in Latin American and tropical forages for the Amazonian region. Canada has funded research with IICA to conduct research on crops to substitute for sugar cane, participated in integrated rural development financing and, through Fundación Ciencia, sponsored research on the Chame, a fresh water food fish.

French assistance in Ecuador is conducted through its Office of Overseas Science and Technology Research (ORSTOM). It began in 1974 with a collaborative effort with PRONAREG to study and map the country's natural resources and to provide a better basis for their use and protection. This highly successful cooperative program, with its emphasis on natural resources, has continued and in 1987-88 there were agriculturally related activities with life of project funding of over US$10 million. France has related agreements with the Ecuadorian Center for Geographic Research (CEDIG), National Polytechnic School, Remote Sensing Center (CLIRSEN), Economic Research Institute (IIE) and Military Geographical Institute (IGM).

The Federal Republic of Germany, primarily through its Agency for Technical Cooperation (GTZ), has provided both grant and loan funds, with the agricultural activities being grant-funded. The active German agricultural and forestry projects in 1988 were a forestry development program, a major Livestock Development Project (PROFOGAN), a coffee disease and pest control effort and a project for the development and rational use of fuelwood. According to the MAG (1987b) and UNDP listings of assistance projects these have a total life of project funding of over US$9 million.

The Italian assistance program has concentrated on agricultural machinery, irrigation and marketing of perishable products. The Mechanization Program of the MAG was provided with US$3 million worth of equipment and technical assistance under a project that ended in 1987. Major activities currently underway or ready to implement are an irrigation project with CEDEGE (US$5.2 Million), a development project for Northwestern Esmeraldas Province (US$2 million) and one to determine

and solve marketing problems for perishable products in Tungurahua Province.

The Japanese have been increasing their level of assistance to Ecuador in recent years. In 1988 they have projects dealing with forestry management in Napo Province and forestry development in Bolívar Province. They also are financing the development of activities to produce shrimp larvae.

Switzerland has had a long association with Ecuador and in 1987 had ten active projects with length of life funds of US$4.7 million. The two largest are to support research in fruit production, primarily apples (US$1.139 million) and reforestation activities (US$1.1 million). Others are to improve agricultural implements, to assist small rural cheesemakers, irrigation, food self sufficiency, rural development, the reintroduction of vicuñas to Ecuador and the donation of funds for rice mill for the Union of Campesinos of Vinces and Baba, Los Rios Province. Although the current cheese project is not large it is part of a US$12 million effort that started in 1979.

Three other DAC countries, Great Britain, Denmark and Holland, have made recent contributions to agriculture. The Dutch projects reported by MAG are for a study of the lower Guayas River Basin and for the study of oil palm disease problems. Denmark contributed for equipping an agricultural technical institute. Great Britain has had a long-term research program with INIAP at the Pichilingue Experiment Station to improve cacao varieties with emphasis on disease resistance.

Non-DAC countries contributing to agricultural development activities are Chile, both Chinas, Egypt, Honduras, Korea and Spain. Chile and Egypt have contributed scholarships for the study of agricultural subjects. Honduras is supporting genetic research on bananas and plantains. The Republic of China (Taiwan) provides technical assistance for rice, vegetables, fruits and pork production, including programs for horticultural products in the Galápagos and assistance for food production by indigenous groups in Napo Province. Korea has contributed agricultural machinery for use on small farms and Spain is supporting projects for integrated rural development, forestry, irrigation and the environment. Israel has supported irrigation activities in the Costa but has no current project with the MAG. The Peoples Republic of China (mainland) provides or has agreed to provide technical assistance for various types of projects, an interest free line of credit for project purposes and equipment for mini-hydroelectric generation projects. Activities by other socialist-block countries have been minor in recent years although some educational activities have continued. The recent changes in Eastern Europe undoubtedly will affect these programs, especially the types and extent of the educational programs which were communist in nature.

Private Voluntary Organizations

The Technical Assistance Clearing House Directory listed 55 PVOs that had reported programs in Ecuador (Boynes). Of that total 32 were religious organizations, 12 were charitable groups and 11 were in the business/labor/foundation categories. The listing is incomplete and it is not feasible to determine the precise number working in the country. The objectives of the PVOs are to provide relief, promote development and conduct missionary activities. The activities of those involved in Ecuador include agriculture, nutrition, health, family planning, education, culture, community development and proselytizing. They tend to work with lower income, economically disadvantaged groups including indigenous communities. Since a large proportion of the needy population lives in rural areas, a substantial portion of PVO activities have in agricultural or rural areas.

One of the major activities has been food and feeding programs. CARE and

Catholic Relief Services (CRS) have been the major PVOs involved with those activities which were initiated in the 1950s. In recent years feeding programs have been criticized as being ineffective from the viewpoint of improving the overall nutritional status of the recipients. They also have been criticized for causing production disincentives. As a consequence several agencies, including CARE in Ecuador, have discontinued feeding programs. CRS, however, has continued its program which receives food from the U.S. PL 480 Title II program, milk from the European Economic Community and support from other sources including the Catholic Church of Ecuador and contributions received by CRS. Development activities are promoted under a food-for-work program, although the CRS program is very small compared to that of the U.N.'s World Food Program.

The CARE program has evolved into more development-oriented activities which are viewed as having greater long impacts that do not create dependencies. In Ecuador this includes agricultural development with programs to promote soil conservation and improved farming techniques in farm communities with limited resources. One project, financed by USAID, is to assist farmers in an Integrated Rural Development (IRD) project in Chimborazo Province to effectively utilize irrigation facilities that were built under the IRD project. Other related CARE projects are: promotion of production of fruits and vegetables in both the Sierra and Costa regions; soil use, conservation and management in the Sierra; and reforestation, jointly with the Peace Corps, in Cañar Province.

Other PVOs also are involved in agricultural development. Foster Parents (*Plan Padrinos*), for example, operates a demonstration farm, works with an IRD project to promote citrus production and helps construct rural infrastructure in Bolivar Province. Several PVOs have programs to provide technical assistance on a short term basis. The International Executive Service Corps has an office in Ecuador and has had a number of projects including some with agricultural interests (Elton). The Farmer to Farmer program has financed U.S. farmer visits to Ecuador to assist with problems and also has sponsored visits by Ecuadorian farmers to the United States. Organizations such as American Cooperative Development International (ACDI) and American Cooperative League United (ACLU) have provided technical assistance for cooperatives. The American Institute for Free Labor Development (AIFLD), an organization of the AFL-CIO has a project to assist farm worker organizations in Esmeraicas Province. Several religious organizations provide technical and financial assistance for agricultural development as well as carrying out missionary activities. This has included substantial efforts by several evangelical groups in rural areas.

Donor Assistance Problems

It is common for donor-funded projects in Ecuador to be delayed for lengthy periods of time and for serious problems to develop in implementation that imperil the achievement of project objectives. Some of the apparent delays are due to unrealistically optimistic scheduling in project design, some are due to unforseen and unforeseeable circumstances, others are caused by the nature of the development process or the institutional structure within which the projects must be carried out. Project failure can be caused by poor design, unrealistic objectives or implementation problems.

A major constraint to implementation of many projects is a requirement for counterpart funding by Ecuador. This has been a particularly difficult problem in the last few years because of the severe economic situation, especially if the counterpart funding is for investment or even additional operating funds. Projects

for which the counterpart consists of in-kind support such as office space and the assignment existing personnel to work on the project have fewer problems. USAID partially solved the problem by agreeing to accept funds derived from monetized food aid as counterpart for some of its agricultural projects.

Other frequent constraints are the bureaucratic delays in processing the documentation to implement a project. The GOE consists of an extensive bureaucracy which operates under a complex set of rules and procedures. Most jobs have very well defined specifications as to duties and responsibilities. It is often difficult to change a position or transfer an individual employee. Rules dealing with contracting, purchasing and employment can cause undue delays. Implementation may be affected by jurisdictional disputes, organizational jealousies or the failure of key personnel to carry out assignments. The are frequent shifts in leadership positions in many government agencies, due at least in part to low pay levels and a new agency head may not be supportive of ongoing efforts in which he had no input. The new leadership may want to revise the procedures or may change personnel. There may be conflicts with counterpart personnel because of pay differences between foreign technical assistance and government employees. Importation of project supplies and equipment can be held up in customs, although the agreements usually call for free imports. At times goods are delayed by inadequate transportation or strikes, or they may be damaged due to inadequate handling or poor storage. They may be diverted from their intended uses or "lost" before reaching the project.

Some implementation problems are caused by the donors. The laws, rules and regulations under which they operate also can cause delays, may contribute to project design flaws or cause problems in procurement of project resources. Requirements to obtain project equipment or supplies in the donor country (tied aid) may result in products which are inappropriate or incompatible with existing equipment in Ecuador. Conditions for undertaking a project may be unacheivable or unrealistic, especially if they involve changing laws, regulations or customs. The tendency of the World Bank, USAID and other donors to promote economic reform as an integral part of their programs has exacerbated the problem. Political requirements of foreign assistance laws, such as the Bumpers Amendment that prohibits assistance that would result in competition for U. S. agricultural exports, can also reduce the utility of assistance programs.

Another problem is a lack of coordination among the various donor agencies. CONADE has the function of coordinating foreign assistance activities but it is not particularly effective and its authority varies from government to government. Furthermore, there is no formal or consistent mechanism for the donor agencies to coordinate or even exchange information on activities, although the UNDP attempts to collect and provide information about assistance activities. As a consequence the GOE may deliberately or unknowingly ask more than one agency to undertake similar activities which can result in unnecessary duplication and a waste of limited development resources. At times two donors may be attempting to accomplish opposing objectives in a similar activity or the same area. For example one may be funding colonization in an area where another is attempting to prevent intrusions that will damage an environmentally sensitive region.

NOTES

1. Previously the President could not succeed himself but could be reelected at a later time. The new provision was probably in reaction to the election of Velasco Ibarra at four different times.

2. This approach gives a somewhat stronger representation for the smaller more rural provinces since they have a representative for each 100,000 of population, whereas larger provinces get an additional deputy only for each additional 300,000 people.

3. This regional separation is due largely to the long existing conflict between the Costa and the Sierra and the desire of each region to have its own units and facilities and be independent of the other. The Costa area is quite different and needs to have specialized programs and local services, but the separation complicates administration where there are common interests or problems that affect both areas.

4. Triticale is not native to the Andean region but is included in this group for purposes MAG programs.

5. The largest state enterprise is PETROECUADOR, the petroleum corporation, and the Electric Company (INECEL) is the second largest. The state also owns the railroads, two airlines (Tame and Ecuatoriana), the telephone company (IETEL), and several smaller enterprises.

6. CFN, at the end of 1986, owned shares in 50 companies including agroindustrial (9), cement (5), wood and furniture (4), metals (6), chemicals (2 including fertilizer), finance (9), paper (1), fishing (1), industrial parks (3), services (1) and others (4) (CFN).

7. *Comuna* is a Spanish word that can be translated as commune, community or municipality with commune as the more common translation. That word, however, is not an accurate representation of the meaning of comuna as used in the Ecuadorian context for a community of indigenous people whose resources may be, but are not necessarily, collectively owned and farmed. Therefore, the Spanish word will be used to maintain the distinction.

8. The government took over the debts at what turned out to be very favorable conditions for the private sector debtors. The debts were converted to Sucre values at official exchange rates which were considerably lower than open market rate, giving the debtors a windfall gain of considerable proportions.

9. The USAID program in Ecuador is relatively small in comparison to those in countries such as Guatemala and Honduras, which had 1988 annual U.S. economic and military assistance obligations of US$181 million and US$255 million, respectively, compared with about US$21 million for Ecuador (USAID p. 23).

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CHAPTER

12

THE HUMAN CAPITAL AND SCIENCE BASE

MORRIS D. WHITAKER

I. Introduction

Production of an agricultural surplus is of critical importance to achieving more rapid economic growth in developing countries, especially those with large agricultural sectors. Past models of economic development recognized the importance of the surplus for sustained economic growth but failed to identify the conditions and factors necessary to produce it. They did, however, recognize the need for increases in agricultural productivity in order to increase supply and shift the internal terms of trade against the sector (see Chapter 1).

Efficient Technical Change

The principal challenge for any country attempting to produce a sustained agricultural surplus is to attain an efficient path of technical change through time (Hayami and Ruttan Chapter 3). Efficient technical change is defined as that which permits the substitution of the abundant for the scarce factor of production, given the original resource endowment. If agricultural land is limited and labor is abundant, as is the case in Ecuador and most developing countries, then efficient innovations will facilitate the substitution of cheap labor for expensive land. In this case, a path of chemical-biological innovations permits modern, technical inputs such as improved seeds and fertilizer to be substituted for scarce land thus increasing its productivity (yields) and the utilization of abundant labor. If land is relatively abundant and labor is in limited supply then innovations must save the scarce labor. A path of mechanical innovations permits machinery and other equipment to be substituted for labor in this case, thus increasing the use of land and raising the productivity of labor. Hayami and Ruttan theorize that market forces induce efficient technical changes by causing farmers, businessmen and public employees to resolve constraints to agricultural growth imposed by limited

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land or labor.[1] Government interventions in product and factor markets, such as fixed, overvalued exchange rates, direct subsidies to industry, controlled prices and trade barriers, discriminate against agriculture and reduce and distort incentives to resolve resource constraints in the sector. Ecuador's macroeconomic policy matrix discriminated heavily against agriculture during the 1970s and, while it has improved in the 1980s, still favors internal growth based on import-substitution industrialization (Chapter 2). The macroeconomic policy matrix thus constrains efficient technical change in agriculture by reducing and distorting the prices of agricultural products and factors relative to their scarcity prices.

Sources of Increased Productivity

It is now widely accepted that three principal sets of variables explain most of the differences in agricultural labor productivity between developed and developing countries and are investment targets for increasing the agricultural surplus (Hayami and Ruttan Chapters 5 and 6). These are: (a) capital accumulations internal to agriculture including the original endowment of land and improvements to it (e.g. clearing, leveling and irrigation), livestock and perennial plants; (b) human capital including general education of farmers and technical and scientific education for a science base; and (c) modern technical inputs (machinery, fertilizers, improved seeds, etc.) that substitute directly for the limiting factor of production.

These three sets of variables each explained roughly one-fourth of the 10-fold gap in agricultural labor productivity between 21 developed and 22 developing countries in 1980 (Hayami and Ruttan p. 152) Most of the balance was explained by scale economies associated with larger farm size in the developed countries, with a small unexplained residual. These results are a basis for optimism that developing countries such as Ecuador can substantially increase agricultural productivity. Investments in general education for rural people, a science base for agriculture and the provision of modern, technical inputs can increase productivity by several times, even if population pressure causes decreases in land or livestock per worker. Market forces play a critical role in efficiently allocating public and private sector resources among these three broad, interrelated sets of investment targets.

Focus of This Chapter

This chapter analyzes the human capital and science base for Ecuadorian agriculture as one of the principal sets of inputs necessary for sustained increases in agricultural productivity. Human capital is defined to include the level of general education of rural people and of scientific and technical education. The term "science base" is broadly defined to include agricultural education, research and extension institutions and their sine qua non human capital. It is used throughout this chapter to mean the set of people and associated institutions involved in training agricultural scientists and technicians, and in accessing, adapting, generating and diffusing new and improved technical practices for agriculture. The science base is synonymous with the concept of a research, extension and education (REE) system, which often is used to describe it. General education institutions for rural people contribute directly to improvements in agricultural productivity through improving the literacy and basic skills of farm families and are complementary to the science base.

Section II considers the nature of the problem--limited agricultural land and

low agricultural productivity--and the interrelatedness of the three investment targets discussed above. Section III presents empirical evidence from Ecuador and other countries about the relatively high economic returns from investments in human capital and a science base for agriculture. Section IV reviews Ecuador's educational system and human capital formation for agriculture, including general education of rural people and technical and science education as part of the science base. Ecuador's research and extension programs are reviewed and analyzed in Sections V and VI, respectively. Section VII reviews major current efforts to strengthen the REE system while Section VIII contains the summary and conclusions.

The expansion of land area was considered in Chapter 6 and the extent of improvements to the land through investments in irrigation was treated in Chapter 7. Nevertheless, the interrelationship between investments in the science base and irrigation works are considered briefly in Section II. The general macroeconomic conditions and sectoral policies necessary for inducing efficient technical change and assuring a supply of modern, technical inputs either through trade or domestic production were considered in Chapters 1 and 2.

II. Nature of the Problem

Ecuadorian agriculture is afflicted by two closely related problems. First, all its good agricultural land is in production and exploiting new lands entails relatively high and increasing social and private costs. Second, productivity is low which makes it difficult to absorb relatively abundant labor at higher real wages and to compete internationally. Investments in internal capital accumulations, the science base and human capital and modern, industrial inputs tend to be highly interrelated, with some minimum critical mass needed in each in order to make investments profitable in the others. Limited investments have been made in the science base and in primary education for rural people. Investments in improvements to the land through irrigation have been substantial but are relatively unproductive because the investments in the science base have been inadequate.

Limited Agricultural Land

Almost all of the available agricultural land is now in production (Chapter 4). Labor is increasingly abundant relative to land, given Ecuador's burgeoning labor force which is growing at 3.4 percent per year (Chapter 5). An efficient path of technical change focused on chemical-biological innovations will increase the productivity of land and its capacity to support more and more people. Increases in yields provide the basis for increased employment and incomes of those who derive their livelihood from the land. A general path of chemical-biological innovations does not, however, obviate the need for complementary mechanical innovations.

Emphasis on chemical-biological innovations will reduce pressure for agricultural expansion into new-lands areas with their very fragile soils and ecology. Such investments will facilitate the increasingly urgent need for the GOE to protect fragile lands, reduce soil erosion and environmental degradation and maintain the rich genetic diversity of the flora and fauna found in Ecuador.

Low Agricultural Productivity

Agriculture in Ecuador is characterized by relatively low levels of productivity as measured by yields. Yields are low relative to those achieved by neighboring countries, and also to experimental results in Ecuador (Table 12.1). Ecuador generally has lower yields than the weighted average for 12 other South

Table 12.1 Comparison of Yields Between Ecuador and South America, 1986-1988 (Weighted Averages) [a]

Crops	Ecuador	South America	Gap with South America (%)	Highest Yield Country in South America			Colombia	Peru
				Country	Yield	Gap		
Wheat	972	1,815	-46.5	Chile	2,878	-66.2	1,740	1,275
Rice, paddy	2,302	2,571	-10.5	Peru	4,809	-52.1	4,697	4,809
Corn	1,369	2,360	-42.0	Chile	7,109	-80.7	1,360	1,962
Barley	889	1,625	-45.3	Chile	3,113	-71.5	1,908	1,170
Soybeans	1,890	1,815	+4.1	Argentina	2,128	-11.2	1,995	1,795
Peanuts	893	1,896	-52.9	Argentina	2,204	-59.5	1,442	1,892
Milk	1,672	1,303	+28.3	Argentina	2,213	-24.5	958	1,236
Eggs	8	7	+11.9	Colombia	14	-40.5	14	6

Source: USDA.

[a] Crop yields in kg/ha/year and yields of livestock products in kg/animal/year.

American countries and is especially deficient in the cereals. For example, Peru's rice yields were over two times greater than those of Ecuador. Yields of milk, eggs and soybeans were above the average but even for these products Ecuador still was substantially below its neighbors with the highest yields (e.g., Argentina had milk yields one-third higher). These averages mask some important variations within and among crops (see Chapter 6). Thus, one must be careful not to conclude that low productivity affects all farmers and all crops equally.

Yields, or production per unit of land, are only a partial measure of productivity. An equally important measure is output per worker but data limitations preclude a careful analysis of trends in this important, partial productivity index. Data presented in Chapter 5 revealed that agricultural GDP per worker was only one-half that of the next lowest sector (services) and was only one-third the national average. These GDP data are consistent with the general perception of low levels of wages and incomes in rural areas and strongly suggest that the productivity of labor in agriculture is relatively low.

Interrelationships Among Investment Targets

The three investment targets which increase agricultural productivity--land

improvements and other internal capital accumulations, human capital and a science base and modern technical inputs--are interactive and improvements in one tends to enhance investments in another. For example, investments in general education for rural people enhance the capability of farmers to understand and adopt new technologies, while investments in the science base make literacy and technical education more valuable to farmers and their children. Investments in technical inputs make the science base more viable and profitable, while the availability of modern inputs increases the demand for cost-reducing technologies which utilize the modern inputs. Thus, all of these variables must be addressed at some minimal level if significant progress is to be made in moving toward a science-based agriculture and substantial increases in productivity.

Longer-term investments which augment land area and improve land quality, such as irrigation and drainage projects, explained about 9 percent of the differences in labor productivity between developed and developing countries in the Hayami and Ruttan study (p. 152). Such investments are highly complementary to those in human capital and a science base and in modern technical inputs and are very important given Ecuador's limited agricultural land. Chemical-biological innovations involving high-yielding varieties require timely and adequate applications of water in order to respond optimally to fertilizers. Consequently, irrigation can be an important element of improved packages of technology when land is the limiting factor and there is sufficient investment in the science base and human capital.

Irrigation Infrastructure and Potential Increases in Agricultural Productivity

Ecuador has made substantial investments in irrigation infrastructure with approximately one of every four hectares under private or public irrigation (see Chapter 7). Several major public projects are under construction and others are in the final stages of design. These projects will nearly double the irrigated area when fully implemented and will cost nearly US$2.2 billion. Investments in public irrigation infrastructure generally have been uneconomic. Existing irrigation systems are highly subsidized and inefficiently operated, with large land-owners reaping most of the benefits. On-farm water management also is very inefficient and yields are relatively low even in irrigated agriculture. Only about 65 percent of irrigable area was irrigated in 1987 because of inefficient operations of irrigation systems and poor on-farm water management.

The disappointing economic performance of public irrigation projects is at least partially due to extremely limited complementary investments in the science base and especially in research, documented in Section V below. The relatively large past and continuing investments in irrigation infrastructure provide an important basis for potentially large increases in agricultural productivity. To realize the potential benefits of investments in irrigation infrastructure will require, however, major investments in complementary human capital and a science base for the sector and in macroeconomic and sectoral policies that will assure efficient technical change and a supply of modern, technical inputs. Such complementary investments and policy reforms will make irrigation projects much more economically viable by increasing efficiency of water use, yields and net farm income.

III. Economic Returns to a Science Base

There is a large and growing body of empirical evidence that economic returns to investments research, extension and associated education programs are relatively high around the world, compared to other social and private investment alternatives. Returns range commonly from 20 to 110 percent per year in 34 studies in various developed and developing countries (Evenson, Waggoner and Ruttan). A similar review of 10 studies of returns to agricultural research in South America found returns ranging from 11 to 119 percent (Scobie Table 16).

Ecuador has experienced some limited success in its efforts to generate, access and diffuse improved technologies even though average yields still are relatively low. Yields have increased, rapidly in some cases and technical changes explained an important part of the increases in production for most major crops during the past two decades (Chapter 6). A recent study found a benefit-cost ratio of 2.46 for expenditures on agricultural research in Ecuador between 1971 and 1981 (Posada Torres p. 67).

Thus, Ecuador's science base has made a modest contribution to agricultural development. It is interesting to speculate how much larger the contribution of the REE system might have been if the constraints discussed below had been addressed on a more adequate, sustained basis.

IV. The Education System and Human Capital Formation

Ecuador's educational system has not made the contribution to agricultural and economic development that is necessary. It is characterized by anachronistic structures and rigidities that are increasingly outmoded and irrelevant to the needs of a modern society and especially to agricultural development. Education in the rural primary schools emphasizes basic literacy, with little emphasis on problem-solving skills or vocational education related to agriculture, home economics, or natural resources. Learning is largely by rote and drop-out rates are high. Attrition also is relatively high in the secondary schools where students must select areas of specialization by grade 10 (age 15) and then start over again if they wish to change areas of study. Very few students opt to study agriculture with most enrolled in humanities programs that lead toward the study of law, economics and medicine at the university level. Higher education is in chaos, especially public universities and institutes. Public universities are free and there are no entrance exams or standards. As a result they are overcrowded with many marginal students. They also are each administratively autonomous, governed by the students and are highly politicized. Their graduates are poorly trained and consequently are unable to contribute much to economic growth and development.

Structure and Organization

The education system is comprised of four basic components, pre-primary school, primary school, secondary school and higher education (Figure 12.1). Kindergarten is the entrance point in formal education at age five but in practice is not always offered, especially in rural areas. Students enter the first grade at age six and are awarded a certificate for graduating from primary school after successfully completing grade six which qualifies them to enter secondary school.

Secondary school is divided into two three-year cycles. The first, or basic cycle (grades 7-9) consists of a general-education curriculum which all students

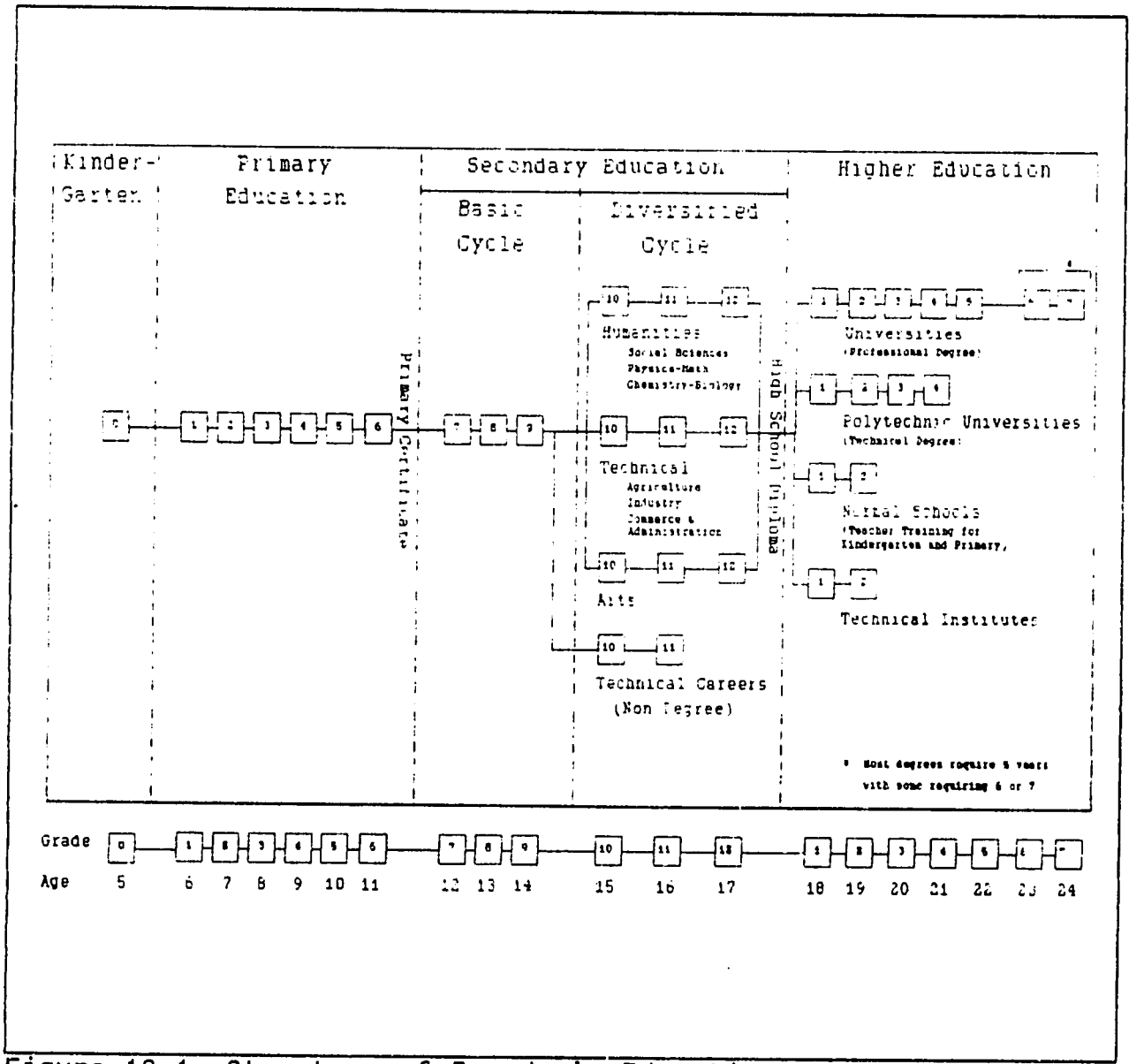

Figure 12.1 Structure of Ecuador's Education System
Source: Prepared by Author.

are required to take. The second, or diversified cycle (grades 10-12) consists of specialized courses of study. Students must pick their area of specialization at the beginning of the second three-year cycle. General areas of specialization include: (a) humanities (social sciences, physics-mathematics and chemistry-biology); (b) technical areas (agriculture, industrial and commercial-administrative); and (c) the arts. Within the area of agriculture students may specialize in agronomy, livestock or food science. There also is a two-year program following the basic cycle which is called "technical careers" which provides non-degree training and is the exit point from formal education for those that complete this program. Once students begin an area of special study they can only change to another area by completing the required courses for that area of specialization. Changing the major area of study also requires revalidation, through formal testing, of any required courses that have been previously taken. Students who complete the two three-year cycles

are granted a graduation diploma (*Diploma de Bachiller*) which permits them to enter into higher education.

Higher education consists of four kinds of schools: two-year technical institutes, two-year normal colleges for training primary school teachers, universities and polytechnic universities. The polytechnic universities generally offer four-year technical degrees and the universities offer 5-7 year professional degrees depending on the course of study and the university. Most universities offer fields of study leading to the degree of agricultural engineer (*Ingeniero Agrónomo*). Attainment of this degree requires five to six years of study, including a thesis and an additional year of practical work in rural areas (*Año Técnico Rural*). Other specialized degrees in agriculture also are offered but no graduate programs at the MS or PhD level are available.

All education in Ecuador is under the jurisdiction of the Ministry of Education and Culture (MEC). MEC is directly responsible for all primary and secondary schools and two-year normal colleges and technical institutes. The universities and polytechnic institutes are each autonomous entities but their budget support is channeled through MEC. The National Council of Agricultural Science Faculties (CONFCA) coordinates the disparate activities of the various faculties of agriculture.

Primary Education

Primary education appears to have much less value to rural than urban people as revealed by relatively high drop-out rates in rural primary schools (Table 12.2, Appendix Table 12.1). These drop-out rates were calculated by following each first-grade class through the six grades of primary school, based on matriculation at each grade. The desertion rate for the sixth grade for rural and urban primary schools can not be clearly determined by comparing 6th and 7th grade enrollment. This is because many rural children attend secondary schools in urban areas after completing the 6th grade, due to lack of rural secondary schools. Comparing enrollments for sixth grade with those for the first year of secondary school (7th grade) would overestimate the desertion rate of rural children and underestimate urban desertion rates. Moreover, data on graduates from primary school are not available. For these reasons, attrition rates for primary school were estimated by comparing first through sixth grade enrollments and are consequently somewhat underestimated.

The cumulative drop-out rate was 52.5 percent for rural students who started the first grade during 1983-1984 and began sixth grade during 1988-1989, compared to only a 22.3 percent drop out rate for urban areas for the same period. The rural cumulative drop-out rate declined steadily to this 52.5 percent level, down from 60.1 percent attrition between the first grade of 1980-1981 and the sixth grade of 1985-1986. The cumulative urban rate remained constant over this four-year period. Even though the retention rate in rural primary schools has improved somewhat, one out of two rural primary students still leave school by the start of the sixth grade, compared to only one out of five urban students. Thus, the desertion rate from rural primary schools is almost three times that in urban areas.

Most of the attrition in rural primary schools occurs during the early grades and primarily during first grade. Of children who started primary school in 1980-1981, 29 percent had left school by the beginning of second grade, accounting for almost half the total attrition of 60.1 percent by the beginning of the sixth grade. Another 12.9 percent left by the beginning of third grade and 5.4 percent by the fourth grade for a total of 47.3 percent, or nearly four-fifths of total attrition of

Table 12.2 Enrollment and Desertion Rates for Each First Grade Class During Six Years of Primary School by Area and Year, 1980-1981 through 1987-1988 [a]

Year		Grade						
		First	Second	Third	Fourth	Fifth	Sixth	Seventh [b]
Enrollment								
1980-81	U [c]	159,391	139,093	134,850	132,897	128,433	123,732	149,898
	R	229,224	162,677	133,257	120,805	101,667	91,482	26,828
1981-82	U	162,650	143,232	138,430	138,343	132,355	126,153	152,242
	R	222,119	161,217	150,019	118,962	105,424	95,778	27,728
1982-83	U	173,255	147,404	142,806	141,252	134,978	131,151	146,291
	R	222,728	164,397	134,870	122,876	107,220	99,832	26,898
1983-84	U	177,607	153,010	148,697	145,181	139,721	138,026	
	R	217,395	153,030	139,090	124,356	112,255	103,255	
1984-85	U	182,392	159,113	152,623	152,214	145,604		
	R	210,990	161,689	141,004	129,125	117,591		
1985-86	U	194,554	164,435	159,312	158,647			
	R	221,703	167,742	147,792	133,990			
1986-87	U	206,540	170,995	166,861				
	R	220,652	173,875	153,085				
1987-88	U	204,293	176,689					
	R	222,621	173,198					
Desertion Rates (%)								
1980-81	U	100.0	12.7	15.4	16.6	19.4	22.4	6.0
	R	100.0	29.0	41.9	47.3	55.6	60.1	88.3
1981-82	U	100.0	11.9	14.9	14.9	18.6	22.4	6.4
	R	100.0	27.4	32.5	46.4	52.5	56.9	87.5
1982-83	U	100.0	14.9	17.6	18.5	22.1	24.3	15.6
	R	100.0	26.2	39.4	44.8	51.9	55.2	87.9
1983-84	U	100.0	13.8	16.3	18.3	21.3	22.3	
	R	100.0	29.6	36.0	42.8	48.4	52.5	
1984-85	U	100.0	12.8	16.3	16.5	20.2		
	R	100.0	23.4	33.2	38.8	44.3		
1985-86	U	100.0	15.5	18.1	18.5			
	R	100.0	24.3	33.3	39.6			
1986-87	U	100.0	17.2	19.2				
	R	100.0	21.2	30.6				
1987-88	U	100.0	13.5					
	R	100.0	22.2					

Source: Appendix Table 12.1.

[a] Each row presents the succeeding enrollment of the first grade class for that year. For example in 1980-1981 there were 229,224 first graders in rural schools. Of these only 162,677 registered in the second grade, and 133,257 in the third grade, etc.

[b] First year of secondary school.

[c] U=Urban and R=Rural.

60.1 percent by the end of third grade. This same pattern persists for all of the first grade classes between 1980-1981 and 1987-1988. The rate of attrition in the early grades did exhibit a decreasing tendency during the 1980s but most of the attrition still occurs during the first three years of school. A similar pattern exists in drop-out rates in urban areas.

The relatively high drop-out rates in rural areas and especially in the early grades is a cause for serious concern. Rural families place less value on primary education and basic literacy than on their children's labor. In economic terms, the present value of future family income streams is perceived to be greater with little or no primary schooling for children in about half of rural families. In essence, the costs of going to school (including foregone family income) are perceived by family decision-makers to be greater than the value of any future benefits of primary education. Moreover, these perceptions result in very high attrition in the early grades suggesting that even basic literacy skills are viewed as conferring very little economic or social benefit.

The low value placed on primary schooling by many rural Ecuadorians is a general indictment of primary rural education. The curriculum is too abstract and remote from problems affecting rural people and does not provide practical skills to solve every-day problems. Facilities and complementary supplies, audio and visual aids and library materials are seriously deficient. The relatively low levels of investment in a science base for agriculture, documented below, also reduce the value of primary education. There is little incentive to become functionally literate in the absence of sustained opportunities to gain from these skills. If there were continual flows of new technical knowledge being produced by the REE system, incentives to acquire the basic skills necessary to understand, adopt and benefit economically from improved technologies would be greatly enhanced. The benefits from a primary education in rural areas will increase as the science base serving agriculture is improved. Conversely, improvements in primary education will facilitate the adoption of new technologies and enhance opportunities to increase productivity and incomes and thereby make social investments in the science base more profitable.

Secondary Education for Agriculture[3]

Most secondary schools are located in urban areas and educate a high proportion of Ecuador's high school students. For example, during the 1988-1989 school year there were 650,369 students in urban secondary schools, or 88 percent of the total compared to 92,858 in rural secondary schools, with only 12 percent of the total (Table 12.3, Appendix Table 12.2). Attrition also is relatively high in rural secondary or high schools (*Colegios*). In rural schools, this rate was 41.5 percent by the ninth grade for students who started the seventh grade in 1980-1981, compared to only 26.6 percent for urban schools. The cumulative rate was 79.3 percent by the 12th grade in rural schools compared to 52 percent for urban schools. This rate probably overestimates desertion of rural youth from high school because some go to urban areas to begin the diversified cycle in grade 10, just as they do to begin the basic cycle in grade seven.

As noted above 52.5 percent of rural primary school children who start the first grade drop out by the sixth grade. Assuming another 5-6 percent drop out in the sixth grade, a little more than 40 percent start the three-year basic cycle of secondary school (seventh grade) in either rural or urban high schools. The attrition rates in rural secondary schools suggest that roughly 15 percent of rural youth who started school in the first grade begin the second, three year cycle of

Table 12.3 Enrollment and Desertion Rates for Each Seventh Grade Class During Six Years of Secondary School by Area and Year, 1980-1981 through 1988-1989 [a]

Year		Grade					
		Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth
Enrollment							
1980-81	U [b]	135,368	110,425	99,317	103,117	78,361	64,982
	R	24,225	17,695	14,173	8,612	6,228	5,003
1981-82	U	142,294	114,593	104,187	104,361	81,114	71,073
	R	26,575	20,271	16,175	9,779	7,233	6,441
1982-83	U	148,034	117,791	102,387	104,333	87,127	74,109
	R	28,369	20,076	15,826	9,927	7,620	6,899
1983-84	U	148,995	116,347	103,915	109,278	88,013	72,247
	R	25,658	19,168	15,170	10,572	8,599	6,582
1984-85	U	146,695	117,553	112,327	114,625	88,095	
	R	27,267	20,010	17,463	11,567	8,317	
1985-86	U	145,732	124,390	115,379	110,201		
	R	26,450	21,356	18,241	11,408		
1986-87	U	149,898	126,063	111,780			
	R	26,828	21,866	17,948			
1987-88	U	152,242	121,755				
	R	27,728	21,705				
1988-89	U	146,291					
	R	26,898					
Desertion Rates (%)							
1980-81	U	100.0	18.4	26.6	23.8	42.1	52.0
	R	100.0	27.0	41.5	64.4	74.3	79.3
1981-82	U	100.0	19.5	26.8	26.7	43.0	50.1
	R	100.0	23.7	39.1	63.2	72.8	75.8
1982-83	U	100.0	20.4	30.8	29.5	41.1	49.9
	R	100.0	29.2	44.2	65.0	73.1	75.7
1983-84	U	100.0	21.9	30.3	26.7	40.9	51.5
	R	100.0	25.3	40.9	58.8	66.5	74.3
1984-85	U	100.0	19.9	23.4	21.9	39.9	
	R	100.0	26.6	36.0	57.6	69.5	
1985-86	U	100.0	14.6	20.8	24.4		
	R	100.0	19.3	31.0	56.9		
1986-87	U	100.0	15.9	25.4			
	R	100.0	18.5	33.1			
1987-88	U	100.0	20.0				
	R	100.0	21.7				

Source: Appendix Table 12.2.

[a] Each row presents the succeeding enrollment of the seventh grade class for that year. For example in 1980-1981 there were 24,225 seventh graders in rural schools. Of these only 17,695 registered in the eighth grade, and 14,173 in the ninth grade, etc.

[b] U=Urban and R=Rural.

high school, where specialized study of agriculture may begin. Finally, about 10 percent of those who started rural primary school are enrolled in the last year of high school, so that less than one in ten rural youth graduate from high school. In contrast, about four out of ten urban youth graduate from high schools.[4] The relatively higher drop out rate from rural high schools reflects the same economic realities for rural youth as for rural children discussed above. For most rural students and a surprisingly high number of urban students, a high school education has less value than alternative uses of their time. This reality reflects the poor quality of high school education and lack of complementary investments that make additional education more valuable.

There were 272 high schools offering specialization in agriculture in the diversified cycle during 1988-1989 distributed geographically as follows: Costa, 114; Sierra, 127; and Oriente, 31.[5] Agriculture is not a popular option according to enrollment data. During the five years 1981-1982 through 1985-1986 there were an annual average of 1,956 students registered in agricultural fields in the last year (12th grade) of the diversified cycle (Table 12.4). Students specializing in agriculture were only 3.1 percent of total students in the 12th grade. Thus,

Table 12.4 Enrollment in Last Year of Secondary School, Five Years Annual Average by Area, 1981-1982 through 1985-1986

Specialization	Urban		Rural		Total	
	Number	Share (%)	Number	Share (%)	Number	Share (%)
Humanities	38,721	65.7	2,103	54.3	40,824	65.0
Technical	19,119	32.5	887	22.9	20,006	31.9
Agricultural	1,075	1.8	881	22.8	1,956	3.1
Total	58,915	100.0	3,871	100.0	62,786	100.0

Source: Unpublished data from MEC, Division of Statistics.

specialization in agriculture among high school students is low compared to the relative importance of the sector, which accounts for 16.8 percent of GDP, 55 percent of foreign exchange earnings and 44 percent of employment (see Chapters 3 and 5). The most popular area of study in the diversified cycle is humanities with 65.0 percent of 12th grade students on average during the five-year period. Humanities and other technical areas each had more students enrolled than agriculture even in rural high schools, although agriculture is relatively more popular than in urban high schools (Figure 12.2).

The low number of students trained in technical agriculture in high school reflects the relatively poor quality of such training, limited and low-paying employment opportunities and the generally low esteem associated with agricultural training in Ecuador. The faculty that teaches the technical courses in agriculture is dominated (70 percent) by high-school graduates in technical agriculture, often from the same school (Joint Subcommittee p. 52). The lecture method is widely used with little in the way of library material, visual aids or practical experience.

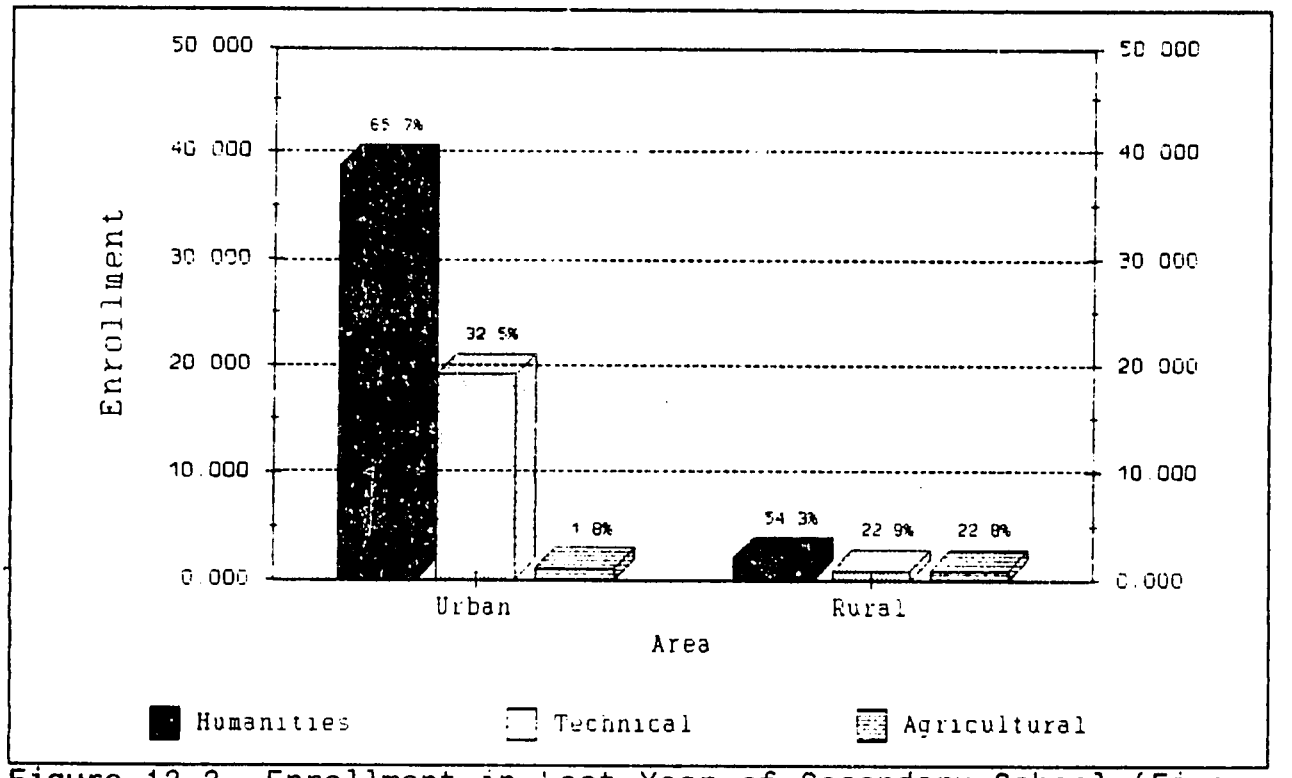

Figure 12.2 Enrollment in Last Year of Secondary School (Five-Year Annual Average, 1981-1982 through 1985-1986)
Source: Table 12.4

Laboratory and field experience tend to be extremely limited. Most high school graduates in agriculture obtain low-paying jobs in agriculture and the degree usually is terminal.

Thus, there is a huge gap between the very small number of poorly trained high school graduates in agriculture supplied by the secondary school system and the needs of agriculture--Ecuador's most important economic sector. The number of graduates per school is relatively small and entails a substantial per student cost which appears to be far beyond the value of the three years of technical training. It appears that Ecuador has substantially overinvested in too many schools and poorly-trained professors.

Higher Education[6]

Higher education for agriculture includes four two-year technical schools and 21 of 22 general and polytechnic universities which offer technical and professional degrees in agricultural fields. The four technical schools provide two years of specialized training to high school graduates in agriculture in specific areas such fruit culture. These schools suffer from the same deficiencies as the agricultural specialty in high schools.

Fifteen universities offered a combined total of 39 professional degrees in agriculture in 1989, with nine in agronomy, seven in veterinary medicine, six in forestry, five in animal science or livestock management, three in agricultural engineering, two in management of agricultural enterprises and seven in a variety of other specialties (Table 12.5).[7] Graduates must study from 5-7 years, depending

Table 12.5 Universities with Professional Agricultural Degrees, 1989

University	Enrollment 1988	Location & Type	Major	Professional Title	Time [a]
1. Polytechnic School of Chimborazo	[illegible]	Riobamba (Public)	Animal Science	Ing.Zootécnico	10 S
			Agronomy	Ing.Agrónomo	6 Y
2. Catholic University of Cuenca	[illegible]	Cuenca (Private)	Agronomy	Ing.Agrónomo	5 Y
			Veterinary Medicine	Doctor	6 Y
3. Central University of Quito	[illegible]	Quito (Public)	Vet.Medicine/Animal Science	Doctor	6 Y
			Rural Development	Ing.Agrónomo	6 Y
			Livestock Production	Ing.Agrónomo	6 Y
			Agricultural Engineering	Ing.Agrónomo	6 Y
			Plant Science	Ing.Agrónomo	6 Y
4. University of Cuenca	9,336	Cuenca (Public)	Agronomy	Ing.Agrónomo	10 S
			Vet.Medicine/Animal Science	Doctor	10 S
5. University of Guayaquil	50,985	Guayaquil (Public)	Agronomy	Ing.Agrónomo	10 S
			Vet.Medicine/Animal Science	Doctor	5 Y
			Agribusiness Administration	Ing.Admin.de Empr	5 Y
6. Vicente Rocafuerte Laic University	3,901	Guayaquil (Private)	Agronomy	Ing.Agrónomo	5 Y
7. National University of Loja	7,385	Loja (Public)	Agronomy	Ing.Agrónomo	5 Y
			Forestry	Ing.Forestal	5 Y
			Agricultural Engineering	Ing.Agrícola	5 Y
			Vet.Medicine/Animal Science	Doctor	5 Y
8. Technical University of Ambato	4,837	Ambato (Public)	Fruit Production	Ing.Agrónomo	6 Y
			Ornamental Horticulture	Ing.Agrónomo	6 Y
			Horticulture	Ing.Agrónomo	6 Y
9. Technical University of Babahoyo	5,742	Babahoyo (Public)	Agronomy	Ing.Agrónomo	5 Y
10. Technical University of Quevedo	802	Quevedo (Public)	Forestry	Ing.Forestal	6 Y
			Animal Science	Ing.Zootécnico	6 Y
			Farm Management	Ing.Admin.de Empr	6 Y
11. Technical University of Esmeraldas	2,567	Esmeraldas (Public)	Forestry	Ing.Forestal	5 Y
			Animal Science	Ing.Zootécnico	5 Y
12. Technical University of Manabí	5,814	Portoviejo (Public)	Agronomy	Ing.Agrónomo	5 Y
			Forestry	Ing.Forestal	5 Y
			Agricultural Engineering	Ing.Agrícola	5 Y
			Veterinary Medicine	Doctor	5 Y
			Animal Science	Ing.Zootécnico	5 Y
13. Technical University of Machala	6,694	Machala (Public)	Vet.Medicine/Animal Science	Doctor	5 Y
			Agronomy	Ing.Agrónomo	5 Y
14. Northern Technical University	2,140	Ibarra (Public)	Forestry	Ing.Forestal	5 Y
			Agroindustry	Ing.Agroindustrial	5 Y
15. Private Technical University of Loja	2,350	Loja (Private)	Forestry	Ing.Forestal	10 S
			Agroindustry	Ing.Agroindustrial	10 S

Source: CONUEP.

[a] S = Semester; Y = Years.

on the university and degree and complete a thesis in order to receive their professional title. They also are required by law to complete one year of professional service in rural areas (Año Técnico Rural) before practicing as a professional. Those who complete only their classes, without doing the thesis are recognized formally as *egresados* but without the title. Most agricultural students come from urban areas with specialization in humanities in high school. Few of the high school graduates with degrees in agriculture go on to university.

The most popular areas of study at the university include medicine, law and economics, while study of agriculture is relatively limited. There were 186,672 students enrolled in all of Ecuador's universities during 1988 based on preliminary, unpublished data from the National Council of Universities and Polytechnic Schools (CONUEP). These data are not yet available by college or department but the share of agricultural students can be inferred from earlier data. Enrollment in the 30 agricultural degree programs in 1983-1984 was 4,500 and had been growing at about 15 percent per year (Joint Subcommittee p. 55). At that rate, agricultural students would comprise about 4 percent of all university students in 1988. There were 261 graduates during 1983-1984 out of 393 egresados (Joint Subcommittee p. 55). The number of graduates may have increased slightly but still is very small relative to the importance of the agricultural sector.

Higher education in agriculture suffers from many of the same problems as technical training in the secondary schools. In 1984 the faculties were comprised mainly of part-time teachers, with only 20 percent working full-time and another 12 percent half-time. Salaries were relatively low and most professors had other employment. The majority of teachers had terminal degrees from Ecuadorian universities with 47 percent being *Ingenieros Agrónomos* and 21 percent veterinarians. Only 18 percent had Master's degrees and there were only a few PhDs. (Joint Subcommittee pp. 55-56). Consequently, there is substantial inbreeding among the faculties of Ecuador's agricultural universities, with resultant stagnation of knowledge and inherent resistance to new ideas and concepts. The situation has probably worsened since 1984 although more recent data are not available.

Ecuador's agricultural universities are mainly teaching institutions with little involvement in research or extension activities. The research that is carried out is done almost exclusively through thesis work, with some guidance from the major professor.[5] The quality of thesis research varies widely depending on funding support and related guidance from outside entities such as the National Institute of Agricultural Research (INIAP) and foreign technical-assistance programs. Library and other research facilities are deficient and linkages to the international network of agricultural science are extremely limited. Resource constraints and poorly-trained faculty result in little laboratory or field work. Classroom lectures dominate student-teacher contact and most of the largely urban-raised students graduate with little or no practical experience in agriculture.

While the general assessment is pessimistic, some universities have become more involved in research over the last few years, with research contracts with INIAP, the Foundation for Agricultural Development (FUNDAGRO) and others (Venezian and Moncada pp. 44-45). These institutions are beginning to become a more integral part of the agricultural science network in Ecuador, although their contributions still are relatively small.

As a result of the in-bred faculties and very limited research experience most agricultural graduates have little appreciation or understanding of research methods or the scientific process. Consequently, graduates have little to offer to REE institutions without additional training and experience. Most graduates of the agricultural universities find employment in public sector agencies in agriculture,

usually in a major urban center, where they live and spend most of their work-time in administrative and bureaucratic functions.

Thus, there is an extremely limited number of university graduates in agriculture and the quality of their training is relatively poor. Universities are not developing the requisite human capital needed to move quickly from a resource-based to a science-based agriculture and exploit the opportunities for economic growth inherent in Ecuador's relatively large agricultural sector. Resources for higher education are spread too thin, just as they are in the secondary system. What is needed is a more focused effort with substantial upgrading of a few key faculties. Careful attention needs to be given to hiring young, well-trained faculty at the MSc and PhD levels in order to introduce hybrid vigor and break the cycle of inbreeding which assures mediocrity. The higher education system needs to be linked into the international science network for agriculture and more completely integrated into the national REE system, especially in research.

V. Agricultural Research

Ecuador's agricultural research system has been the subject of more detailed review and analysis over the last decade than perhaps any other part of the agricultural sector. Principal studies include: Venezian and Moncada; International Service for National Agricultural Research (ISNAR) and the Interamerican Institute for Agricultural Cooperation (IICA); Whitaker and Alzamora; U.S. Agency for International Development (USAID); IICA and the Ministry of Agriculture (MAG); Joint Subcommittee; Posada Torres; Dow and Soliz; and the Ministry of Agriculture (MAG) and the U.S. Agency for International Development (USAID). While most of the studies focused broadly on the science base for agriculture, including education, research and extension, they emphasized agricultural research and especially the role of INIAP. Most studies blurred the distinction between the science base and the research system as one component of the science base; the term "research system" was used synonymously with "science base" or with "REE system."

The conclusions of these diverse studies are quite uniform and consistent. The research system was found to be underfunded, overextended and understaffed, with too few senior scientists and well-trained technicians and with similar constraints in education and extension. The research, education and extension functions operated independently, with little coordination and did not comprise a systematic science base for agriculture.

This section summarizes the major problems and constraints in the research system. While the above studies are the principal sources for most of the conclusions which follow, some additional data are provided and analyses are made. The research system is described only in general terms, given the excellent studies that are available.

The Research System

Educador's agricultural research system is dominated by INIAP, with very limited involvement of other complementary agencies. It was approved as an autonomous institute in 1959 and began to function in 1961.[9] It lost its autonomy in 1973 when it became an adjunct agency of the MAG during a reorganization. INIAP still has budget and administrative autonomy but the Minister appoints INIAP's Director and serves as president of its Administrative Council (see Chapter 11). It also is subordinate to the policies and strategies of MAG. It has undergone

three major reorganizations during the last 10 years.

INIAP carries out almost all the agricultural research in the country. It has the usual array of executive, advisory and support services which have grown so rapidly that they now comprise most of the staff and offices (ISNAR and IICA pp. 16-25). At the operational level is an office for agricultural research, which is divided into two regional directorates, one for the Costa and a second for the Sierra and Oriente. Each regional directorate is further divided into experiment stations and experimental farms.

INIAP has seven experiment stations and nine experimental farms located in the principal agro-ecologic zones of the country (Table 12.6). The major share of

Table 12.6 Experimental Centers of INIAP

Name & Region	Province	Elevation (meters)	Area (hectares)	Climate	Principal Activities
Coastal Region					
Experimental Stations:					
Pichilingue	Los Rios	75	1,100	Humid Tropical	Laboratories, Corn, Cacao, Forrages
Boliche	Guayas	17	200	Humid Tropical	Laboratories, Rice, Cotton, Soybeans
Portoviejo	Manabi	25	262	Dry Tropical	Laborat., Coffee, Cotton, Beans
Santo Domingo	Pichincha	300	332	Wet Tropical	Laborat., Oilpalm, Forrage, Corn
Experimental Farms:					
La Margarita	Manabi			Dry Tropical	Cattle, Forrages
El Rosario	Guayas			Humid Tropical	Rice seed production
Sierra					
Experimental Stations:					
Santa Catalina	Pichincha	2,950	950	Humid Temperate	Laboratories, Potatoes, Wheat, Barley
Chuquipata	Azuay	2,570	11	Dry Temperate	Corn, Fruits, Beans
Experimental Farms:					
Tumbaco	Pichincha			Dry Temperate	Citrus, Apples, Other fruits
Pillaro	Tungurahua			Dry Temperate	Fruits
Nagsiche	Cotopaxi			Dry Temperate	Fruits
El Anuacoto	Bolivar	2,650		Dry Temperate	Wheat, Barley, Beans
La Pradera	Imbabura			Dry Temperate	Wheat seed production, Fruits
Bullcay	Azuay			Dry Temperate	Fruits, Vegetables
Oriente					
Experimental Stations:					
Napo-Payamino	Naco	300	350	Wet Tropical	Cattle, Forest management
Experimental Farms:					
Palora	Morona			Wet Tropical	Naranjilla

Source: INIAP.

INIAP's research work is carried out in four experiment stations: Santa Catalina, Pichilingue, Boliche and Portoviejo. The experiment stations are organized by programs focused on crops and livestock and by departments focused on disciplines which support research in the various programs. The programs of each station vary and emphasize the most important crops and livestock in the area where the station is located. The departments are more standardized among stations and include Plant Science, Entomology, Weeds, Soils and Fertilizers, Seed Production and Laboratories. There are substantial differences in departments among stations in terms of their size and quality. The research programs are coordinated closely with production research programs (*Programas de Investigación en Producción--PIPs*) which are carried out on cooperating farms and provide a feedback system from farmers to researchers as well as involving researchers more directly in outreach activities.

Despite the serious problems and constraints which are discussed below, INIAP has been a relatively productive institution. Through 1988 it generated 105 improved varieties of wheat, barley, oats, rice, potatoes, soft corn, sorghum, hard corn, soybeans, african palm, rice, cotton, beans, lentils, cacao, coffee, peanuts, pasture grasses and castor beans (IICA and MAG p. 39). The selection of these improved varieties and multiplication of basic and certified seeds by INIAP is an important basis for increases in production through increased yields of both Sierra and Costa crops during the last two decades (see Chapter 6). INIAP also has developed improved cultural practices for both crops and livestock which have contributed to increased productivity. These research results were reported to farmers through more than 500 seminars and 300 field days and 1,000,000 copies of diverse bulletins and other publications. In 1988 INIAP researchers carried out 1,487 experiments (*ensayos*) in 71 products, an average of 10 per researcher (ISNAR and IICA pp. 21-23).

One reason for its modest successes is its program of identifying and training university students for its research staff. INIAP selects students in their last year from various university faculties and provides them with scholarships as part of the Año Técnico Rural program (see above). In return, the students work at INIAP experiment stations where they learn basic research skills and do their thesis as part of an INIAP research project, under close supervision and guidance of INIAP scientists. The numbers of students trained under this program have ranged from 15-40 per year, depending on the number of positions assigned by MAG (ISNAR and IICA p. 37). INIAP hires the most capable of these graduates into its research staff. Thus, INIAP identifies a select corps of advanced university students and trains them in research methodology and applied agricultural sciences. In essence, it provides the closest thing there is to post-graduate training in agriculture science in Ecuador. It also has had a fairly good program of advanced training for its staff in various degree and nondegree programs abroad. Unfortunately, INIAP has had major difficulty in retaining its scientists, because of relatively low salaries in the civil service.

Low Levels of Investment in Research

Investments in research declined steadily in real terms at 7.3 percent per year between 1975-1988 and fell to the lowest level in 1988 since 1968 (Figure 12.3, Appendix Table 12.3). Research expenditures as a share of agricultural GDP also declined steadily after 1975 and were only .17 percent of GDP in 1988 compared to a high of .85 percent in 1975. The decrease was especially rapid after 1985 with research expenditures averaging only S/.67,179,000 during 1985-1988, compared to

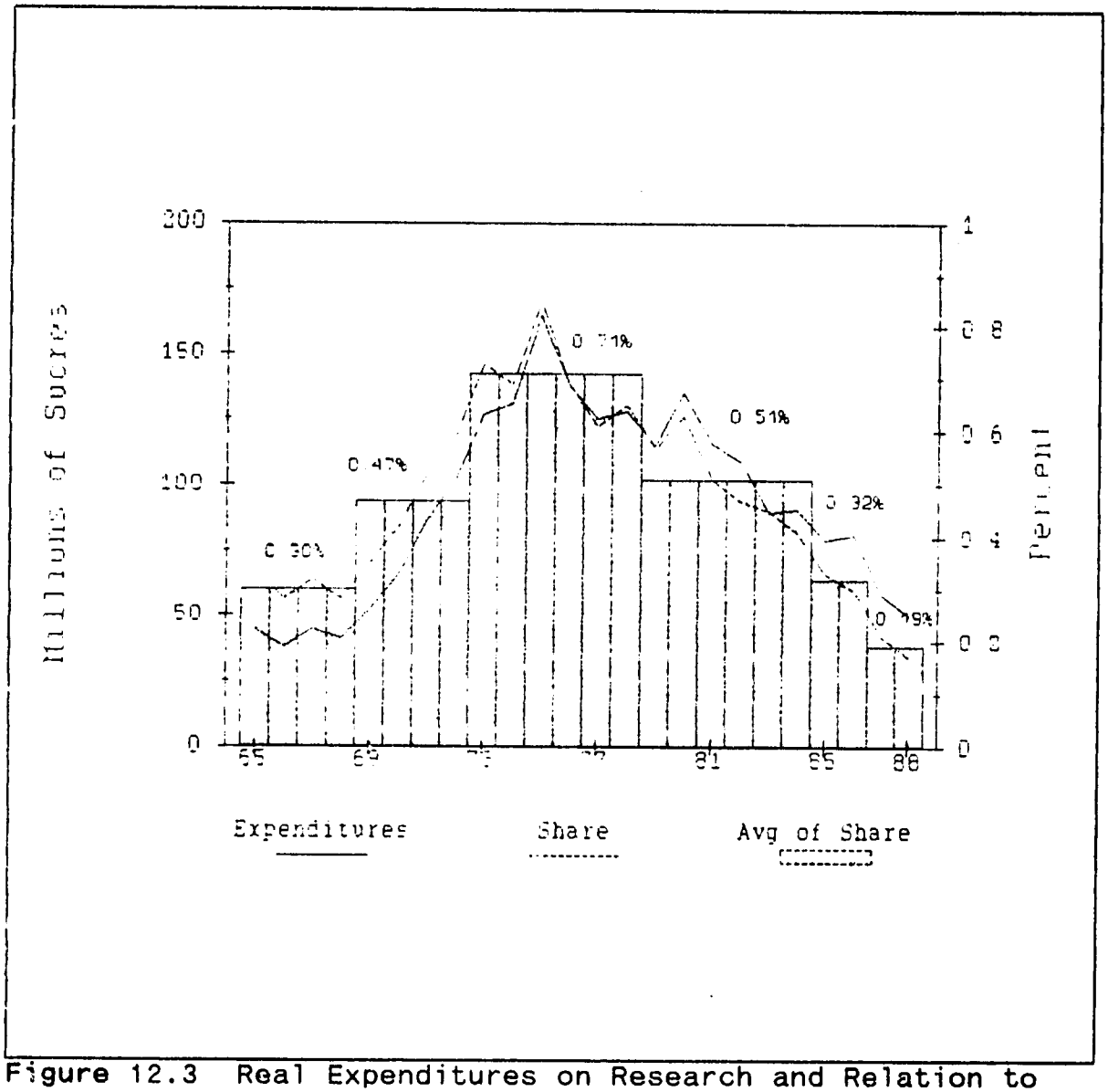

Figure 12.3 Real Expenditures on Research and Relation to Agricultural GDP, 1965-1988
Source: Appendix Table 12.3.

S/.109,103,000 during 1979-1984 and S/.135,452,000 during 1973-1978. The rapid erosion of investments in research during 1975-1988 stand in sharp contrast to INIAP's first 14 years. The real level of funding increased in almost every year between 1961-1974 at an annual average rate of 17.4 percent. During the same period research expenditures as a share of GDP also increased steadily to the all-time-high in 1975.

The pattern of rapid decreases in investments in INIAP research during 1975-1988 after substantial growth in the earlier period is exactly the opposite of the experience of most of the developing world. Preliminary data for 52 developing countries showed an average investment in agricultural research of .94 percent of GDP during 1980-1985, up from .69 percent during 1970-1979 (ISNAR and IICA p. 47). Not only did Ecuador reduce investments in research while the rest of the

developing world was increasing its investments but it spent substantially less than the average, at only .47 percent of agricultural GDP during 1980-1985.

The 1988 level also is much lower than the standard recommended by ISNAR and the World Bank of between 1 and 2 percent of GDP (ISNAR and IICA p.45). For Ecuador to catch up from its 1988 level of .17 percent (S/.865 million) to the average of .94 percent achieved by the 52 developing countries during 1980-1985 would require an INIAP budget of S/.4,784 million, nearly six times greater than in 1988. This is an increase of roughly US$9.0 million on a base of US$2.0 million (at the 1988 average free market exchange rate of S/.436/US$1). Achieving the mid-range recommended by ISNAR and the World Bank of 1.5 percent of GDP will require nearly a nine-fold increase in INIAP's budget or US$15.5 million more.

A recent article suggests that low fiscal capacity rather than political will is the reason for low expenditures on agricultural research in most developing countries (ISNAR). It argues that standard of 2 percent of agricultural GDP for agricultural research may not fairly reflect the actual priority accorded agricultural research in developing countries. It disaggreagates the standard into four components (agricultural research expenditures as a share of expenditures on agriculture, agricultural expenditures in all public expenditures, public expenditures as a share of GDP, and GDP as a share of agricultural GDP). It presents data that show that developing countries are doing relatively as well as developed countries in terms of support for agriculture and agricultural research. This data, along with the assertion that developing countries even borrow to finance agricultural research is cited as evidence of political will and priority for agricultural research. The problem, according to the article, is the much lower fiscal capacity of developing countries and their heavy dependence on agriculture. The implication is that the international donor community should continue to help national research systems while countries undertake structural and fiscal reforms.

The argument is tautological since political will is clearly expressed in the pattern of public expenditures. All countries face a budget constraint so that priorities (political will) are directly reflected in the way a country chooses to collect and expend public funds. The reality is that most developing countries have engaged in profligate public spending for elaborate, protected industrial sectors; bloated, inefficient public bureaucracies; uneconomic irrigation and other infrastructure; modern arms and military and other similar goods. Concomitantly, the public treasury is used to provide extensive subsidies which are captured mainly by various interest groups constituting the political power base. Most developing countries have followed policies for several decades that have discriminated against agriculture and rural people while subsidizing industry and urban people, who largely control political power (Krueger, Schiff and Valdés). They have depreciated the role of science and human capital in agricultural development which have largely been accorded low priority relative to other investments and expenditures. These have been and continue to be the priorities and political will of many developing countries. Thus, the problem is not low fiscal capacity per se but lack of political will or priority given the fiscal constraint.

Evidence from Ecuador suggests that there is little political will or priority for agricultural research even based on the disaggregated ISNAR measures. Ecuador spent only 6.6 percent of its public sector budget for agriculture on research compared to 10-11 percent on average for other developed and developing countries. And it spent only 3 percent of its total budget on agriculture relative to 9-10 percent on average in other developing countries. The conclusion is clear: agriculture is very low priority in the public sector and research is relatively low priority within agriculture. The Ecuadorian government has opted instead to

wastefully spend its scarce resources on a variety of other higher-priority but relatively unproductive investments and subsidies (see Chapter 2).

Some have interpreted the ISNAR article to suggest that the target of 2 percent of agricultural GDP in agricultural research is too high. Others have concluded that expenditures on research can not increase until fiscal capacity is greater. Both are erroneous conclusions. Expending 1 to 2 percent of agricultural GDP on agricultural research is the necessary investment range for building a viable science base for agriculture on the basis of experience in developed and developing countries; as the ISNAR article indicates 2 percent has become the accepted target. Investments in the science base are fundamental to overall economic growth and development and are one of the two principal bases for greater economic growth and fiscal capacity rather than a product of it. What is needed is a change in priorities by governments in developing countries away from outmoded macroeconomic and development policies and the abolition of privilege through structural reform.

Certainly the donor community should continue to help strengthen national science bases for agriculture and on a longer-term basis. But it does not follow that they should do so blindly while governments continue with ineffective, outmoded macroeconomic policies, incur fiscal deficits to sustain large recurring subsidies and make unproductive investments. Donor support should be conditioned on clear evidence of increased funding and priority for an agricultural science base from host governments, along with more responsible fiscal policy.

The annual INIAP budget of US$17.5 million necessary to reach the 1.5 percent target could be generated with an endowment of roughly US$175 million at 10 percent yield. While this amount may appear relatively large, it is only about one-tenth of the amount already committed to new irrigation infrastructure and can be expected to yield much higher social returns. A reallocation of US$175 million to endow Ecuador's agricultural research capacity would greatly increase the returns on the balance of relatively unproductive irrigation investments and significantly enhance international competitiveness and economic growth.

Too-Few Senior Agricultural Scientists

Ecuador has significantly underinvested in senior agricultural scientists (ISNAR and IICA pp. 39-43; Venezian and Moncada pp. 29-30). The number of senior scientists with post-graduate degrees in INIAP is inadequate to produce the level of new technical knowledge needed for rapid, sustained increases in agricultural productivity. The research system had only one PhD and 49 MS crop scientists on its roster in 1989, along with 170 other more junior scientists with professional degrees at the undergraduate level (Ingenieros Agrónomos and equivalent) (Table 12.7). Several areas are especially deficient in terms of senior scientists, including natural resources, animal sciences, agricultural economics and rural sociology. Moreover, the ratio of research assistants to all researchers is about .25 compared to a norm of 1.0, so that researchers do not have adequate support (ISNAR and IICA p. 40). Despite these deficiencies, INIAP has contributed to the modest increases in yields noted above, primarily because of its training program for new staff. A freeze on hiring in effect since 1988 has drastically reduced recruitment of promising young researchers.

The "Brain Drain" and Inadequate Salaries

Attracting and maintaining a minimum critical mass of agricultural scientists

Table 12.7 Research Staff in INIAP, 1974-1989

Years	PhD	MSc	BSc [a]	Total
1974	5	38	114	157
1975	5	38	115	158
1976	5	38	117	160
1977	5	39	134	178
1978	5	36	147	188
1979	6	51	119	176
1980	4	49	147	200
1981	5	54	117	176
1982	5	55	117	177
1983	5	28	169	202
1984	5	67	163	235
1985	4	67	162	233
1986	5	67	153	225
1987	4	67	160	231
1988	3	58	153	214
1989	1	49	170	220

Source: Personnel Office, INIAP.

[a] Ingeniero Agrónomo and equivalent degrees in other areas, which are roughly the same as a BSc in the U.S. system.

has been a continuing problem for INIAP and appears to have worsened during the late-1980s (ISNAR and IICA p. 38-39). INIAP lost four out of five PhDs and 18 of 67 MScs between 1986 and 1989, or nearly one-third of its senior scientists in a three year period (Table 12.7). While numbers of scientists increased gradually during the 1970s and remained relatively constant until 1986, INIAP has been plagued with constant turnover of senior and experienced junior scientists. The principal constraint to attracting and retaining agricultural scientists is the relatively low salaries offered in the civil service system to which INIAP belongs. Salary differentials are especially great for agricultural scientists with postgraduate training and for experienced, proven undergraduates with professional diplomas. The result has been a continuing "brain drain" from INIAP. Ecuador's private sector has attracted the majority of experienced undergraduates and some MScs who have left the system in the last few years; senior scientists usually have found employment with international agencies in Ecuador or have gone to other countries. While these scientists may continue, in some cases, to make a contribution to agriculture, most are lost to the science base. Given the increasing internationalization of Ecuador's economy, the salary differential likely will widen without remedial action. A secondary problem is the limited funding which also

would limit retention of scientists even if the salary problem were resolved.

Limited International Linkages

A large number of formal agreements with various entities in the international network of agricultural science exist but these have not been institutionalized and the actual linkages are very tenuous and weak. As a result, Ecuador's science base for agriculture tends to work in isolation compared to many other national systems (Posada Torres; Joint Subcommittee). There is ample evidence that national research systems substantially increase their productivity as they become fully articulated into other national systems, international and regional research centers and foreign agricultural universities (Hayami and Ruttan; Arndt, Dalrymple and Ruttan). Such linkages eliminate duplication of effort and save scarce resources as the national science base exploits research results from the international agricultural science network. Such results from one country may have the potential of conferring large benefits in other countries but must be accessed and then adapted by the national research system to fit different agroclimatic and ecologic conditions in the new location. The principal constraints to improved and sustained linkages are not enough senior scientists and limited financial resources (Posada Torres pp. 28, 31). Ecuador's national science base must improve its capacity to access research results from the international science system, adapt them to the unique socioeconomic, agroclimatic and ecologic conditions of Ecuador and generate additional new knowledge as requisite, if growth in agricultural productivity is to be maximized.

Lack of Focus and Priorities

The science base has diluted its effort and taken on more than it can be expected to do given the mix and size of its staff and its financial resources. For example, research is organized into nine research support programs (e.g. plant pathology) which interact with eighteen crop and livestock commodity programs and four production systems programs (e.g. multiple-crops). Several professionals must handle multiple product programs simultaneously and even in varietal improvement cases have existed of a single researcher attempting to handle more than one crop (Posada Torres). The problem has become even more difficult with the rapid loss of senior scientists since 1986, as inexperienced junior scientists have had to fill positions for which they are not prepared. A recent study by Espinoza and Norton is being utilized by INIAP as a more objective basis for setting research priorities in production agriculture.

Research programs are spread across a wide variety of crops and livestock but almost exclusively in production activities. Post-harvest handling and storage, processing, marketing and consumption are largely ignored in the design of research and extension programs. The extremely important set of natural resources issues affecting agriculture are not addressed by INIAP at all. They are dealt with on a sporadic and ad hoc basis by private foundations such as *Fundación Natura* and in a few university faculties of biology.

Research tends to be confined to research stations and demonstration farms, especially since the program of on-farm research (PIPs) has been reduced because of budget constraints. Results tend to remain "bottled up" on the stations and to be less relevant to farmers and especially to other entrepreneurs in the food system. Ecuador's research system needs to focus on fewer crops and livestock, cover priority problems over the entire range of the food system, strengthen the

PIP research effort of on-farm trials and feedback from farmers and more fully integrate and include natural resource, economic and social concerns into research design and recommendations.

Discontinuity of Effort and Short Term Focus

Agricultural research suffers from discontinuity of policies, personnel and leadership. For example, there have been six Directors General of INIAP since 1981. Each new administration of INIAP has resulted in changes in the emphasis, organization, key personnel and allocation of funds (Posada Torres). Even though INIAP is an autonomous agency, INIAP's Director must meet political as well as technical criteria and the agency thus has become subject to short-term political pressures. The result is a relatively short-term horizon and a tendency toward centralized planning and management of research, with changes in priorities as the government changes. Agricultural research, however, requires a longer gestation period than the four-year term of any administration. Because research results tend also to be location specific even within a country, a decentralized system is more efficient (Hayami and Ruttan Chapter 12). In South American countries the trend is toward autonomous, decentralized systems, such as Brazil's public corporation, the Brazilian Agency for Agricultural Research (EMBRAPA).

VI. Technology Transfer

The studies of Ecuador's research system generally also have reviewed the status of extension and technology transfer services but in less detail than for research (see especially Venezian and Moncada; ISNAR and IICA; Joint Subcommittee; and MAG/USAID). This is likely due to the reality that extension efforts are much more disparate, with no dominant institution carrying out the extension function, similar to INIAP in the research arena. In fact, Ecuador does not have an national agricultural extension system, per se. There are a large number of public and private sector agencies at the national, regional and local levels that separately and independently provide technology transfer services to a variety of target groups. There is practically no coordination among them. Also, linkages between extension entities and the research system are weak and very tenuous. Consequently, there is no systematic diffusion of improved technologies to Ecuador's farmers, which constitutes another major deficiency in the science base.

This section reviews the historical evolution of technology transfer institutions, drawing mainly on the ISNAR and IICA and Joint Subcommittee studies and describes the main agencies currently providing extension services. Principal problems constraining technology transfer are then set forth.

Brief History

A significant effort was mounted in the early 1950s to develop an extension service focused on the education of farm families. Prior efforts by the government to assist farmers, dating from 1901, had focused on provision of technical services. The Division of Agricultural Extension was established in 1952 under a bilateral agreement between Ecuador and the U.S, with assistance from the Interamerican Cooperative Agricultural Service (SCIA). In 1954 the Agricultural Extension Service was organized under the joint auspices of the Ministry of Development and SCIA. The Service was based on the philosophy of farmer education rather than provision of technical services and extension personnel were trained accordingly. Extension

offices were established throughout the country and home economics and youth (4-F) programs were established in 1956. Extension efforts were focused on increasing productivity and programs were established for bananas, rice, coffee, cocoa, wheat and sheep, among others.

With the establishment of the Alliance for Progress in 1961, U.S. support for SCIA ended and the Agricultural Extension Service became part of the Ministry of Development. In 1964 the Ministry of Development was separated into the Ministries of Agriculture (MAG) and of Industry, with the Agricultural Extension Service belonging to MAG. In 1968 MAG concentrated all its extension-related programs into the General Board of Agriculture and Livestock Extension. In 1970 MAG, along with its agricultural extension program was recombined with the Ministry of Industry into the Ministry of Production. Then in 1973 agriculture and industry again were separated and reorganized as separate ministries.

The 1973 reorganization of MAG had profound impacts on the nature and philosophy of agricultural extension as it had existed from 1952-1973. The Ecuadorian Andean Mission sponsored by the United Nations, which was concerned with rural development, was joined with the agricultural extension program to become the Office of Rural Development in MAG. In this new model of extension, the focus was on technical assistance to groups of small farmers organized in communes, associations or cooperatives and on provision of credit, inputs and other technical services via these organizations.

Current Extension Services

In 1985 the structure of MAG was again modified, with Regional Subsecretariats established for the Costa and the Sierra (see Chapter 11). The primary purpose of the Regional Subsecretariats was to provide technical assistance to farmers and to improve agricultural productivity in each of the principal regions. Each Regional Subsecretariat was organized into Provincial and Technical Directorates and five National Crop Programs in the Costa Subsecretariat (bananas, coffee, cocoa, rice, corn and soybeans, and cotton and oil crops). Each Provincial Directorate was further divided into Agricultural Service Agencies (ASAs) located in each *Cantón* or County. The Regional Subsecretariats carry out their extension programs via the ASAs.

MAG also has National Programs for Crops, Livestock, Rural Development, Mechanization and Animal Health, plus the Campesino Training Institute and the Regionalization Program. These National Programs directly provide technology transfer services through both producer organizations and the ASAs. Concomitantly, many of the technical personnel from these National Programs are assigned to the Regional Subsecretariats to assist in carrying out their programs of technical assistance.

There are a number of other national and regional public agencies, most administratively adjunct to MAG, that also are engaged in a wide variety of extension and outreach activities. National level agencies include the Ecuadorian Institute of Water Resources (INERHI), the National Seed Company (EMSEMILLAS), the National Fertilizer Company (FERTISA), the Ecuadorian Institute of Agrarian Reform and Colonization (IERAC), the Subsecretariat of Integrated Rural Development (SEDRI) of the Ministry of Social Welfare and the Fund for Marginal Rural Development (FODERUMA) of the Central Bank. Several important regional development agencies also carry out technology transfer activities, including the Study Commission for the Development of the Guayas River Basin (CEDEGE), the Regional Program for the Development of Southern Ecuador (PREDESUR), the Center

for the Rehabilitation of Manabí (CRM) and the Center for the Economic Recovery of Azuay, Cañar and Morona-Santiago (CREA). The magnitude and range of services varies from institution to institution but can be relatively large. For example, INERHI provides farmers in each of its major projects with technical assistance; training; subsidized inputs including machinery pools, improved livestock and nursery stock; and demonstration plots.

Many other private organizations both at the producer and processor level and among philanthropic and charitable organizations are involved in their own technology transfer efforts and also serve as mechanisms for public sector programs.[10] Principal among these are four regional Chambers of Agriculture which are comprised of representatives from Agricultural Centers (*Centros Agrícolas*) in each Cantón.

No System of Agricultural Extension[11]

There is no system of agricultural extension in Ecuador but rather a large number of public and private sector entities that each engage in technology transfer activities on an ad hoc basis with little or no coordination. As a result, efforts to diffuse improved technologies are inadequate and relatively ineffective. Extension programs are designed and administered independently, with no common criteria or sense of priorities in the allocation of resources. Technology transfer programs tend to be disparate and scattered, with overlapping programs and substantial duplication of effort. For example, SEDRI and MAG's National Rural Development Program both focus on integrated rural development projects especially in poorer areas of the Sierra and both rely on support from other MAG agencies such as INERHI, IERAC and INIAP. The commodity approach of MAG leads to specialization at the extension agent level, with the possibility of different agents working with the same farmer. Also INERHI duplicates many of the same services provided by MAG; e.g., the machinery pool belonging to INERHI's Pisque irrigation project is only a few kilometers from that of MAG's National Mechanization Program (PRONAMEC). Many similar examples could be cited. The public sector could play a much more positive role in coordinating and rationalizing public and private efforts into a national extension system. It is constrained by especially serious deficiencies in the organization of pubic extension programs and in its capacity to conceptualize, plan, manage and evaluate a national extension program as one element of a science base for agriculture.

Unclear Extension Philosophy

There is no clear approach to technology transfer, which further limits the effectiveness of the various extension efforts. There was a clear philosophy of farmer education in the 1950s when SCIA provided assistance to Ecuador's extension program. This was altered radically in 1973 when the military government opted for focus on organization of small farmers and provision of subsidized inputs. This model has evolved through time and there is not a clear approach or philosophy of agricultural extensi n. Each agency has its own objectives, with little sense of a common philosophy r understanding of who comprises the target groups, or methods to be used.

Inadequate Linkages Between Extension and Research

The linkages between the research system (INIAP) and the ad hoc extension

entities are weak and tenuous. The large number of independent and uncoordinated extension entities places a major burden on the research system and INIAP. Each entity must rely almost exclusively on INIAP for improved technical information. INIAP maintains agreements with a relatively large number of uncoordinated, independent extension agencies, which further stretches its very limited human and financial resources. Consequently, effective communication between the two functions is constrained and limited. The research that is done tends to stay on the experiment stations, for want of an efficient diffusion system and because of INIAP's tendency to limit on-farm and regional research (Posada Torres p. 33). One critical constraint is the general absence of well-trained subject matter specialists in the extension agencies. There is little capacity in the extension agencies to interact professionally with INIAP's researchers in interpreting research results or in providing feedback from farmers to the researchers.

Farmers Isolated from the Science Base

There are very limited and tenuous linkages between the majority of Ecuador's farmers and the science base that is supposed to serve them. The problem is especially serious for resource-poor farmers generally, although many medium and larger commercial farms have little or no contact with the science base and also have relatively low yields. This reflects, to a large extent, the deficiencies in technology transfer noted above. Extension workers usually are the primary and continuing contact with farmers and the linkage between farmers and researchers. To the extent that linkages between the extension and research functions are weak, researchers are less likely to understand and focus on resolving critical production problems. Scientists and technicians in the research system also need to have direct communication and feedback from farmers in order to direct human and financial resources toward the most urgent problems. The reductions in INIAP's PIP program and regional trials because of resource constraints further isolates researchers from the real world of agriculture. The workers in the science base should feel that the farmers are their clients and establish effective channels of communication to assure that valued customers are well served. In return, they should be rewarded when they make substantial contributions to production agriculture. Unfortunately, such an incentive system does not exist both because of institutional constraints and distortions in agricultural prices caused by the macroeconomic policy matrix.

VII. Special Efforts to Address Constraints

There are three significant efforts financed by foreign donors which are addressing various of the constraints set forth above, in addition to on-going programs in research, extension and education. Included are the Program for the Development of Agricultural Technology (PROTECA), the Foundation for Agricultural Development (FUNDAGRO) and the Rural Technology Transfer Project (RTTS).

PROTECA

The Interamerican Development Bank (IDB) has provided US$46.3 million of loan funds, along with US$15.4 million of local currency from the GOE to finance PROTECA (BID). This program has four components: technology generation via

INIAP, technology transfer through MAG's provincial offices and national crop programs, production of improved seeds through EMSEMILLAS and INIAP and strengthening all of the involved institutions. The project has been under implementation since March 1987, with very little progress after nearly three years of effort. The project has suffered from changes in leadership with resultant changes in priority areas and crops and much slower implementation than planned. PROTECA is designed to establish a revitalized system of technology generation and transfer by restructuring from within MAG. It is reported that PROTECA priorities are often different from those of INIAP and of MAGs' provincial offices and National Programs which has further constrained and confounded implementation. The project also appears to suffer from a flaw in design. Most of the budget is allocated to physical capital (infrastructure, vehicles, equipment, etc) when human capital clearly is the greatest constraint in the science base. It now appears unlikely that PROTECA will realize its objectives by 1992 when the project ends, without major redefinition and restructuring, probably with BID intervention. Moreover, it is unlikely that the project can produce the higher yields and productivity necessary for Ecuador to repay the US$46.3 million it borrowed from BID without such changes.

FUNDAGRO

The U.S. Agency for International Development (USAID) and the government approved the five-year Research, Extension and Education Project in May 1988 to provide US$9.0 million to FUNDAGRO (USAID). One innovative feature of the project is the establishment of a US$2.0 million endowment for FUNDAGRO which provides for its continuation after grant funds are expended. The purpose of the project is to develop FUNDAGRO's capacity to serve as a catalyst for improving, strengthening and integrating diverse research, education and extension efforts. The project focuses on fortifying and expanding existing public and private efforts to develop and deliver improved technologies especially to farmers with small and medium farms.

The original concept underlying FUNDAGRO involved setting up INIAP as a non-profit foundation in order to address the constraints discussed above. However, political resistance resulted in INIAP remaining in MAG, with FUNDAGRO being established amid substantial political controversy.

FUNDAGRO has been relatively successful at assembling a competent staff, organizing itself and attracting outside grants from the Kellogg Foundation, the International Center for Development Research of Canada (ICDR) and the Andean Development Corporation (CAF). It has funded research and extension programs in a few selected commodities (coffee, dairy, cassava and potatoes) with INIAP and various other agencies. It has entered into formal agreements with several important public and private Ecuadorian entities and foreign agencies involved in agricultural science, including INIAP. It also has supported strengthening of several agricultural technical schools and university faculties and has provided scholarships for the Año Rural program.

An important and innovative feature of FUNDAGRO's programs is its "Research-Extension Linkage Units" (RELU's). Each of its programs has such a unit which seeks to strengthen ties between farmers and researchers by developing a cadre of extension specialists. Its programs link researchers, extension workers and farmers into an integrated, science-based system focused on releasing the constraints farmers face. FUNDAGRO's programs also link the national science base into the international science network serving agriculture, with direct support from

international science institutions such as the Interamerican Center for Tropical Agriculture (CIAT) and the International Pototo Center (CIP).

One fundamental issue facing FUNDAGRO is its capability to achieve its primary objective as a catalyst for the science base in the face of INIAP's debilitated state and relatively small and decreasing public investments for agricultural research. FUNDAGRO clearly can help exploit improved technical knowledge from the international science network and the small amount that is produced in Ecuador's universities for a few years. But FUNDAGRO's longer-term success depends on a viable and efficient research system. Unless the current problems facing INIAP are effectively addressed, FUNDAGRO's potential contributions will be constrained, given INIAP's dominance in agricultural research.

Another question concerns the evolving division of labor in Ecuador's science base for agriculture. INIAP's role is to carry out research for agriculture, with limited support from the agricultural universities, while FUNDAGRO has no research role per se. FUNDAGRO has carried out its planned catalytic role by providing funds for linking research, extension and education institutions and the international science network in a few product programs; strengthening selected REE institutions; and providing scholarships for the Año Rural. FUNDAGRO should consider devoting some resources to assuring that INIAP becomes a well-funded, viable research institution. It also should consider the critical need to expand the concept of "Research-Extension Linkage Units" beyond its few crop programs and the emerging role it might play nationally in that regard.

RTTS

USAID and the GOE also have financed the Rural Technology Transfer System (RTTS) project, at a level of US$9.8 million, plus significant levels of local currency. The project helps farmers' associations to directly access new technologies and links them to the international science network and to the national science base, with technical assistance and training from two U.S. universities. The private associations serve as mechanisms for accessing and adapting new technologies and for extending them to their members and to other farmers, with emphasis on reaching groups of smaller farmers, such as cooperatives. There are four subprojects: Sierra dairy, sheep, short-cycle crops, and dual-purpose cattle. The project terminates in August 1990.

There are a variety of other projects financed with foreign assistance which address constraints in Ecuador's science base (see Chapter 11 for a more complete list and discussion). One of the more important is the Cooperative Agricultural Research Program for the Andean Subregion (PROCIANDINO) of BID-IICA which focuses on developing regional research linkages among the Andean countries. Another is the Livestock Development Project (PROFOGAN) financed by the Federal Republic of Germany which provides technical assistance and funding to MAG for livestock improvement and is highly complementary to the RTTS project.

VIII. Summary and Conclusions

Ecuador still relies heavily on its natural resources as the basis for its agricultural growth and is struggling to make the transition to a science-based agriculture. The country is faced with two closely related problems: all its good agricultural land is in production and productivity of land and labor is relatively low. Substantial investments in improvements to the land, especially in irrigation have been relatively unproductive because of extremely low investments in

complementary human capital and a science base for agriculture. Past investments in irrigation provide the basis, however, for potentially very high returns to such complementary investments.

There is substantial evidence that investments in education, research and extension functions yield high social returns and that these functions must be integrated if the product of the system is to be maximized (Hayami and Ruttan, Chapters 3 and 12). Accessing, adapting, generating and diffusing new technical knowledge is an integral, systematic process which requires a minimum critical mass of inputs from research, extension and education institutions and personnel; the system is no stronger or more productive than the weakest of its parts. Unfortunately, there is only the semblance of a science base in the country; in reality there is no systematic process of research, extension and education.

Education, research and extension programs serving Ecuadorian agriculture are seriously deficient, with four major interrelated constraints to a more productive, dynamic science base. First, Ecuador has significantly underinvested in agricultural research; it is spending about one-fifth the average for 52 developing countries. The level of investment has been declining in real terms since the mid-1970s, with precipitate declines since 1986, while the rest of the developing world has increased its investment. Second, there is not a system or philosophy of extension with a large number of independent entities involved in uncoordinated programs. The result is duplication of effort and waste of resources, especially scarce human capital. Third, technical and professional education for agriculture is seriously deficient both in terms of numbers and quality of graduates vis-à-vis the demands of a modern, science-based agriculture. Resources are scattered among too many schools, faculties are too inbred with little graduate training, involvement in research is minimal and facilities are inadequate. Fourth, the research, extension and education institutions tend to work in relative isolation from each other, from sister institutions internationally and from the farmers they are supposed to serve.

One pervasive problem in the science base which affects all the principal components of the system is the scarcity of human capital. Ecuador has significantly undervalued the human capital in its REE system and especially senior scientists, with subsequent inefficiency and low productivity. This appears to be the single most serious restriction to improving the productivity of the REE system and facilitating more rapid increases in agricultural productivity and farmers' incomes. All elements of the system--education, research and extension--are characterized by a paucity of well-trained, experienced scientists and technicians. The brain-drain from public sector institutions is notorious; a significant number of young, promising scientists have been trained over the years and then lost to the science base because of grossly inadequate salaries and operations support and limited opportunities for career development and advancement. A minimum critical mass of scientists and technicians is needed for each of the three components of the science base in order to release the constraints to growth and productivity imposed by increasingly scarce and degraded natural resources, especially land. Without such trained personnel (imported or local) it will be nearly impossible for Ecuador to increase agricultural productivity.

The constraints in the science base combine to reduce the value of primary education to rural people. More than half of rural children do not finish primary school with 80 percent leaving by the third grade. A related problem appears to be the irrelevance of the curriculum to the needs of rural families.

Resolution of the constraints and establishment of a viable science base will require major changes in policies and priorities. Perhaps the most fundamental

need is to substantially increase investments in research and in senior scientists, given the importance of increased agricultural productivity for Ecuador's economic development. Funding for research must be increased by ten times in order to reach 1.5 percent of agricultural GDP, the mid-point of the range recommended by ISNAR and the World Bank (ISNAR and IICA p. 45). This will require an increase of US$15.5 million in the relatively small 1988 INIAP expenditures of US$2.0 million, or US$17.5 million in total. Concomitantly, the institutional constraints to paying competitive salaries in INIAP and indeed throughout the REE system, must be removed in order to attract and retain a critical mass of senior scientists. The research system must focus its scarce resources on fewer, higher priority research programs and invest substantially more in linking into the rest of the national science base. Priority also must be given to establishing continuing relationships with the international network of agricultural science and in accessing and utilizing knowledge generated outside Ecuador. FUNDAGRO is playing a key role in helping to strengthen the research system by providing key funding and generating political support for the needed changes.

Two important, complementary changes are required. First, the hodge-podge of disparate, independent public and private institutions now involved in technology transfer must be integrated into a streamlined, more efficient extension system with a common philosophy and mechanism for coordination. Careful attention must be given to developing a cadre of extension specialists who can interface with researchers in INIAP and provide the vital linkages between the two functions. After this consolidation, remaining human capital and funding requirements can be more easily identified and addressed. Second, the technical and higher education system must be focused and strengthened, with resources concentrated on fewer technical high schools and university faculties. Special funding should be provided to strengthen the research capability of key agricultural universities and to integrate their faculties into the national research system. Finally, the quality and relevance of primary education in rural areas must be improved.

Macroeconomic policies which still discriminate against agriculture, such as an overvalued exchange rate and subsidies to industry, need to be changed, in order to provide greater incentives for technical change in the sector (see Chapter 2). Growth in agricultural productivity is seriously constrained when macroeconomic policies discriminate against agriculture because agricultural profitability and incentives are reduced (Timmer, Falcon and Pearson). Ecuador's macroeconomic policy regime discriminated against agriculture and swamped the effects of sectoral policies intended to increase agricultural production and productivity during the 1970s and early 1980s (see Chapter 2). While the macroeconomic policy matrix has improved during the 1980s it still favors industry and urban people at the expense of agriculture. Achievement of short-run social objectives through discriminatory macroeconomic policies is inherently antagonistic to a dynamic food policy which attempts to increase rural productivity and incomes while simultaneously reducing urban hunger.

This conundrum is aggravated by the reality of an increasingly interdependent world economy and powerful economic forces that induce painful adjustments in any country whose macroeconomic policies become distorted. Analysts of food policy for the government need to carefully analyze and define the reductions in agricultural productivity caused by various scenarios of food consumption and other subsidies. These trade-offs must be taken into account in the design and implementation of macroeconomic policies, if rapid increases in agricultural productivity are to be realized.

Establishing a viable science base for agriculture and complementary

macroeconomic policies is critical to more rapid and sustained growth and economic development in Ecuador. A revitalized science base, founded on a strong, productive INIAP, is the principal mechanism for releasing the constraints to growth imposed by limited supplies of agricultural land and related natural resources. Failure to invest in the REE system and make the transition from a natural-resource-based to a science-based agriculture will doom Ecuador to a much lower path of overall economic growth than is otherwise possible.

NOTES

1. The Hayami-Ruttan synthesis of agricultural development theories hypothesizes that technical changes are endogenous within the agricultural sector and are induced by market forces. See Chapter 1 for a more detailed description of the Hayami-Ruttan induced innovation model and how market forces influence various public and private agents to work independently on improved technologies which can substitute for scarce land or labor.

2. Drop-out rates by sex also were analyzed but there was practically no difference either in rural or urban areas or by grades. It appears that the forces that cause children to leave primary school do not impact the sexes differentially.

3. See Joint Ecuadorian/North Carolina State University Subcommittee, referred to hereafter as the Joint Subcommittee (pp. 50-57) for a more detailed analysis and history of secondary and university education for agriculture in Ecuador.

4. These are rough approximations which may overestimate the degree of attrition of rural children from high school because some rural children attend urban secondary schools. The orders of magnitude are thought to be reasonably accurate.

5. Unpublished data obtained from MEC/Division of Statistics

6. This section draws on the report of the Joint Subcommittee which provides additional background on the historical development of Ecuador's higher education system for agriculture.

7. These fifteen universities, plus another six universities also offer four-technical degrees in 21 majors in the same general areas as the professional degrees.

8. Some professors accept consulting assignments or other employment that may involve research activities; these are usually divorced completely from their academic activities.

9. See ISNAR and IICA (pp. 12-16) for more information on INIAP's history.

10. See Joint Subcommittee (pp. 41-46) and ISNAR and IICA (pp. 77-79) for more detail about private institutions involved in technology transfer in Ecuador.

11. Extension efforts suffer from the same constraints that affect research, especially low salaries, inappropriate mix of scientists and lack of focus. These constraints are not discussed separately for extension.

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CHAPTER

13

FACTORS AFFECTING AGRICULTURAL GROWTH

MORRIS D. WHITAKER

I. Introduction

Previous chapters reviewed and analyzed the role of agriculture in Ecuador's economic development in great detail and from a variety of perspectives. The general conclusion that emerges is that agriculture, a key sector of the economy, has been undervalued and depreciated by past policies. Ecuador has not taken full advantage of opportunities for more rapid and equitable economic development inherent in production agriculture and related economic activities. It has continued to rely mainly on an internally-oriented development model long after many developing countries opted for more outward-oriented policies. Economic growth has been based largely on import-substitution industrialization with inherent constraints on the rate of progress. Much of the substantial windfall gains from the petroleum boom were expended on a relatively large, unproductive public sector bureaucracy and a variety of other recurring subsidies. They might have been invested more prudently, especially in human capital and a science base for agriculture and natural resources. The consequence has been a stagnant economy for most of the 1980s, with real gross domestic product (GDP) per capita in 1989 at lower levels than at the beginning of the decade.

This chapter summarizes and integrates the results of the analyses in the previous chapters. Section II reviews the principal findings of the assessment which expose commonly held myths about the agricultural sector. Several factors that have contributed to agricultural development and which collectively serve as a foundation for building a more productive, robust agricultural sector are set forth in Section III. Section IV then reviews the principal constraints to more rapid agricultural growth. Section V presents an interpretation of the political economy of subsidies, which generally arise from the constraints discussed in Section IV and which are another pervasive constraint to agricultural growth and economic development. The chapter closes with a perspective in Section VI on the

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emerging scenario of agricultural and econc nic development during the 1990s.

II. Myths About Agriculture

This section reviews the principal findings of earlier chapters. The convention employed is to expose the fallacy of commonly held myths or conventional wisdom about Ecuadorian agriculture in the light of results of this study. The discussion is necessarily abbreviated; the reader should review the relevant chapters for more detail. The approach is to contrast popular notions about agriculture with the findings of the sector assessment; the distinction is highlighted to generate debate and discussion. The findings listed in this section are closely interrelated with the analyses of positive and negative factors affecting agricultural growth and development set forth in Sections III and IV.

Macroeconomic Policies and Incentive Structure

Myth: The macroeconomic and development policies of the past have provided special incentives to agriculture and especially to the small farm sector and rural people. Reality: The structure of incentives inherent in macroeconomic and sectoral policies associated with import-substitution industrialization has subsidized industry and urban dwellers and has discriminated against agriculture, especially against the small farm sector and rural people, for the last three decades. The negative effect of the macroeconomic policy matrix on agriculture completely swamped the positive effects of sectoral policies and artificially shifted the internal terms of trade against agriculture. One econometric study found that GDP in agriculture would have been three times greater than it was in 1986 had a more neutral macroeconomic policy matrix been utilized since the early 1970s. Other studies have found that employment growth has been severely constrained by such policies which have most seriously affected rural and unskilled urban people. Total GDP probably is smaller and the distribution of income is likely more unequal than it would have been with more neutral macroeconomic policies.

The Oil Boom and Petroleum

Myth: The oil boom and the petroleum sector have generally been good for the Ecuadorian economy and have provided substantial additional resources for modernizing the agricultural sector. Reality: A large share (79 percent) of the proceeds of the oil boom were expended on salaries for a burgeoning public sector bureaucracy and subsidies for various special interest groups, which imposed a major, recurring fiscal burden on the economy. Thus, only 21 percent was left for productive investments from direct oil revenues. The oil boom led to a spending spree of unprecedented proportions as the government went into debt for physical infrastructure in transportation, communications, utilities, education and health care while private investors imported capital equipment, raw materials and consumer durables on credit. Public and private purchases abroad contributed substantially to the large foreign debt which now is so burdensome. When the boom ended in 1981 and foreign credit dried up, the economy was left nearly bankrupt, with large foreign debts and little investment from oil revenues in increased productive capacity. The oil boom shielded Ecuador from having to address the distortions inherent in the import-substitution industrialization model of development until 1981 by providing a source of funds for subsidies to industry and urban people. The very limited amounts of petroleum revenue that were

expended on agriculture provided subsidies to larger farmers through low-interest loans, price supports, preferential access to foreign exchange and highly subsidized irrigation water. Investments in research did increase until 1976 when they began a precipitous decline that has not yet been reversed.

The Importance of Agriculture

Myth: Petroleum and industry are the most important economic sectors. Reality: Agriculture is the most important of any of the economic sectors on the basis of a number of indices. It generated more foreign exchange reserves than petroleum during 1886-1988 and will generate almost as much during 1989. While petroleum is a non-renewable resource which will be exhausted by the early 2000s, agriculture can continue to produce indefinitely under an appropriate policy regimen. The sector increased its relative importance in the 1980s after declining in the 1970s and was tied with industry in 1988 as the most important sector at 16.8 percent of GDP, even though industry has been highly protected and subsidized while agriculture has been penalized by discriminatory macroeconomic policies. Agriculture employs more of the labor force than any other sector by a large margin, although labor productivity is very low.

Agricultural Growth

Myth: Agriculture has been relatively stagnant during the 1980s, just as it was in the 1970s. Reality: Agriculture grew very rapidly in the 1980s compared to slow growth in the 1970s. Agricultural GDP grew at an average annual rate of 6.2 percent per year in real terms between 1982-1988 and 8.1 percent between 1984-1988, compared to only 2.5 percent during 1973-1981. Agriculture has led economic development in every year since 1984 with the fastest rates of growth of any of the major economic sectors, except for 1988 when it was in second place behind petroleum (which had an abnormally high growth rate as it recovered from a major pipeline rupture). The emergence of agriculture as the leading economic sector during the 1980s was part of a major reversal in the structure of economic growth relative to that of the petroleum-boom era of 1973-1981. The industrial sector stagnated during 1982-1988 with growth of only .2 percent per year, after increasing at the very rapid annual average rate of 10.2 percent during 1973-1981. Agriculture responded to incentives inherent in the structural reforms of 1981 and subsequent policy improvements. The industrial sector suffered after 1981 from saturation of internal markets as import substitution opportunities were exhausted and from substantial reductions in petroleum revenues which made it increasingly difficult to maintain the large subsidies.

The Public Sector and Agriculture

Myth: Agriculture receives relatively high levels of government support for operation of public agencies serving the sector and for investments in supporting infrastructure. Reality: Public expenditures on agricultural programs have always been relatively low and have declined substantially since the peak reached during the oil boom. Agriculture now receives about 3 percent of total public expenditures and only about 5 percent of public investments in capital and infrastructure, compared to highs of 7 and 16 percent during the oil boom. The level of real expenditures on public programs for agriculture was nearly 40 percent less during the 1983-1987 than during 1973-1981, while total government expenditures increased

substantially. Agriculture not only receives a much smaller share of government expenditures than its importance would suggest but it has been relegated to continually lower priority in the allocation of scarce public funds. Favored sectors include education, transportation and communications, and health with 20, 8 and 6 percent, respectively of total public expenditures. During 1983-1987, service on the public debt accounted for over one-fourth of expenditures. The military also is high-priority, accounting for three times more public expenditures than agriculture, and has nearly one-third of petroleum revenues earmarked for its use.

Agricultural Subsidies

Myth: Subsidies to agriculture benefit mainly resource-poor farmers with small holdings. Reality: The greatest share of subsidies to agriculture are captured by well-to-do farmers with large holdings. For example, most of the benefits of subsidized credit and price support programs are captured by larger landowners, who usually are organized into formal associations with substantial political leverage. Subsidies on irrigation water are capitalized into land values and the present value of all future subsides are realized upon sale of the land, in direct proportion to the amount of land owned. Several public agencies and businesses provide services to farmers in competition with the private sector but at lower-than-market prices. These services are supposed to benefit primarily resource-poor small farmers. In fact, larger, more influential farmers derive most of the benefit from such subsidies. These businesses usually operate at a loss, which contributes directly to fiscal deficits and inflation. Inflation, in turn, is a regressive tax which impacts the poor most heavily and who thus bear most of the burden for the subsidies.

Agriculture and Trade

Myth: Imports of food, unprocessed food and fiber, capital equipment and other inputs for agriculture exhaust most of the foreign exchange earned from agricultural exports, primarily bananas, coffee, cacao and shrimp. Reality: Agriculture has generated a relatively large trade surplus for decades that now is approaching one billion dollars per year. Agricultural exports averaged US$1,166 millions during 1986-1987. Imports of processed food, capital equipment and inputs for agriculture and raw materials of agricultural origin for industrial processing (such as wheat, barley, unrefined vegetable oils and wood) were US$309 millions for the same period. After paying for these imports there was an agricultural trade surplus that averaged US$857 millions each year during 1986 and 1987. This huge trade surplus covers about three-fourths of the rest of industry's very large import requirements.

Food and Agriculture

Myth: Agriculture is unable to feed the population because production for domestic consumption falls short of meeting demand. Reality: Ecuadorian agriculture more than meets the country's food needs through a combination of domestic production and trade. Agriculture produces most of Ecuador's food requirements and generated enough foreign exchange during 1984-1987 to import almost four times the amount of food that was imported after paying for all inputs and capital equipment used in agriculture. A corollary of this myth is that Ecuador needs to be self-sufficient and to produce all its food domestically, with increased

emphasis on Sierra crops. In fact, Ecuador is completely self-reliant (as opposed to self-sufficient) and enjoys a higher standard of living by trading agricultural products than if it were to attempt to produce all its food needs domestically.

Nutrition and Diet

Myth: There is not enough food available to meet the minimum average dietary requirements of the population. Reality: Apparent consumption per capita in 1985 was 117 percent of the minimum standard for energy (calories), and 125 percent for protein. Past studies of apparent consumption that found food deficits utilized minimum requirements that are too high for Ecuador. These requirements were based on too-high body weights and too-pessimistic assumptions about the quality of protein in the diet. While average availability exceeds minimum requirements, many do not have economic access to a nutritious diet. However, malnutrition among children, especially ages six months to three years, appears to be as much a function of poor feeding and health care practices, as a lack of food. The diet shifted over the last three decades from a "rural" diet toward an "urban" diet. Consumers substituted bread and noodles (from imported wheat), rice and animal proteins for traditional soft corn, domestic wheat, barley, potatoes and legumes. These changes were caused by price subsidies, increased incomes and rapid urbanization. Even rural people tended to consume a more "urban" diet.

The Small Farm Sector and Subsistence Agriculture

Myth: Farmers with small holdings, who comprise the majority of rural people, are largely engaged in full-time subsistence farming and have little to do with the market economy or urban areas. Reality: Most farmers with small holdings sell the majority of their agricultural production commercially and are part-time farmers who earn most of their family income from non-farm and largely urban sources. Subsistence agriculture does not accurately describe very much, if any, of Ecuadorian agriculture in the 1990s and is largely a romanticized notion from the distant past. The largest share of family income of small farmers in the Sierra came from non-farm sources according to household surveys in the late 1970s. Moreover, significant amounts came from urban employment and other nonagricultural sources. Most of the production of the farm was sold commercially to satisfy increased demand in the large and rapidly growing urban centers, with only a very small proportion of family income based on subsistence consumption. This scenario likely did not change much in the 1980s although more recent data are not available. Farm families continue to be closely tied to urban centers where some members of the family work and return to the farm regularly in a commuting process referred to as circulation. Other members of the family carry agricultural and artisan products for sale in urban centers and act as middlemen for other families. The cost of these permanent, continuing flows between small farms and the urban centers is subsidized substantially by low gasoline and diesel prices.

The Agricultural Frontier

Myth: Ecuador has abundant agricultural land that remains to be exploited. Reality: All the good and marginal agricultural land is now in production. Agricultural land use in the Sierra and Costa exceeded prime cropland by 45 percent and the sum of prime and marginal cropland by 2 percent on average during 1980-1985. Land use has expanded since then into ever more marginal

areas. Soil erosion is a major and increasingly serious problem, especially in the Sierra. There are extensive virgin lands in the Oriente and Northwest but they are fragile, covered with tropical forests and generally not suitable for sustained agricultural production. The costs of bringing such land into production will be very high, both privately and socially.

Natural Resources

Myth: There are abundant tropical forests, coastal mangrove swamps, fisheries, water and other natural resources that can undergird Ecuador's economic development for decades. Reality: While Ecuador was endowed with abundant natural resources, degradation is occurring at increasingly faster rates, with the high likelihood that some of its most important natural resources will be destroyed or depleted within another 10-15 years. Most Ecuadorians act as if these resources are so abundant that they can be used at current rates indefinitely as the principal basis for economic growth. The facts are, however, that agricultural and economic growth already are being constrained by degraded natural resources, with very serious limitations in clear view.

Sources of Growth in Agricultural Production

Myth: Increases in agricultural production during the 1970s and 1980s have been mainly due to increases in land under cultivation. Reality: Increases in yields also have been important in explaining increases in crop production or in cushioning decreases due to reductions in area under cultivation. Most of the principal crops of both the Costa and the Sierra experienced moderate to rapid increases in yields during the last two decades. Increased yields in the Sierra generally helped to sustain production by offsetting the effect of decreases in cultivated area. In the Costa, increases in yields generally were associated with concomitant increases in land area for most crops. The Costa appears to have benefitted from sectoral policies which subsidized new import-substitute crops, while the Sierra was penalized.

Agricultural Productivity

Myth: Agricultural productivity is about the same in Ecuador as in neighboring countries in Latin America, although it is low when compared to developed countries such as Japan or the United States. Reality: Productivity in agriculture is relatively low even in comparison with neighboring countries, despite the modest increases in yields noted above. For example, yields for principal cereal crops are from 11 to 47 percent lower than the average for 12 other South American countries. While soybeans, milk and egg yields are modestly higher than the average for South America, they are from 25 to 60 percent lower than the South American countries with the highest yields. Low productivity is highly correlated with insufficient investments in research and extension, and limited human capital (especially senior scientists) which are primary constraints to greater productivity.

Irrigation and Agriculture

Myth: Public irrigation projects are an efficient way to increase agricultural production and productivity and to help resource-poor farmers. Reality: Existing irrigation projects are highly subsidized and very inefficient with more than half

of the subsidy being wasted and a large share of the modest benefits being captured by a few large landowners. There is substantial evidence that actual economic returns to most public irrigation projects are much lower than projected in feasibility studies and many are probably negative. Principal problems are very low levels of efficiency in the irrigation systems and in on-farm applications of water and relatively low yields due to the general absence of improved technologies and modern factors of production. The state absorbs 96 percent of the combined capital and operating costs of public irrigation projects at an annual cost of $22.7 million. Economic benefits of these projects are estimated to be only $8.4 million so that most of the subsidy is wasted. Irrigation projects are very expensive. Existing projects and those under construction have a cost of nearly US$1.4 billion and represent nearly 12 percent of the public foreign debt. Projects under final design or under serious study will cost another $1.1 billion and increase the share of such projects to 20 percent of the foreign debt.

Agricultural Credit

Myth: Subsidized interest rates increase investments in agriculture and help small farmers as they are intended to do. Reality: Savings and investments are reduced by subsidized interest rates and loans are concentrated among the most influential borrowers who capture most of the subsidies. Interest rates in Ecuador have not only been subsidized for most of the last three decades, they have been negative in real terms much of the time. Public financial intermediaries have been decapitalized as the real value of loan repayments is much less than the value lent, while borrowers have received large windfall gains. There is substantial excess demand for loans at negative real rates of interest and non-market mechanisms have been used to allocate credit principally to larger farmers. Small farmers receive only a small share of subsidized loans because they lack influence and pay higher transactions costs. Thus, subsidized loans for agriculture generally are substituted for more expensive credit by influential borrowers without increasing investments or are diverted to other uses including foreign savings. Savers are unwilling to save at negative real interest rates and seek alternatives to hedge against inflation such as investments in real estate. The international capital market provides a very viable option which has led to significant capital flight and a very low savings rate in Ecuador. Finally, high rates of inflation have created a major liquidity problem and have practically eliminated long term lending.

Agricultural Research

Myth: Improved technologies for agriculture can be imported easily by the private sector and therefore a strong national research capacity is unnecessary. Reality: Improved technologies are very location-specific depending on soils, rainfall, temperature, pests and diseases among other variables and require a strong research system. Technologies brought from other locations almost always must be adapted to the new environment in order to produce the same levels of yields as in the old. Moreover, research results tend to be public goods so that private investors usually cannot capture benefits from investments in research. Therefore, a strong, publicly supported research capacity is necessary to access, import and adapt new knowledge generated in other countries and to simultaneously develop improved, in situ technologies.

Controlled Prices

Myth: Support prices for producers and maximum prices for consumers for the few basic food items still being controlled are necessary in order to increase agricultural production and benefit poor consumers. Reality: Increased production and productivity have been constrained and most of the benefits of controlled, low prices have been realized by influential consumer groups and intermediaries. Prices at both the producer and consumer levels have generally been below market prices as measured by border prices in Colombia and Peru. Excess demand at the low prices has resulted in non-market allocation of the products. Intermediaries vie for access to the products at the official prices and then reap large profits from black market operations including clandestine exports at substantially higher external prices. Only the most influential consumers are able to purchase at the official price, usually through group affiliation. Less-influential, poor consumers receive little benefit from controlled prices. These people either face shortages caused by the illegal exports, pay bribes, accept lower quality products, or purchase at much higher prices on the black market. Farmers have less incentive to invest in agriculture and less is produced than would be at the market price. Incentives to modernize the sector also are reduced and improvements in productivity are constrained. The few cases where producer prices have been above market prices have resulted in excess supply, widely fluctuating market prices and large public purchases to support the price that later have had to be sold at a loss.

Gender and Farming

Myth: Most farmers in Ecuador are men who spend full-time in agricultural pursuits. Reality: Feminization of farming, especially of small farms in the Sierra and parts of the Costa, accelerated during the late 1970s and early 1980s as males increasingly worked off the farm and often in urban areas. While women sometimes also work off the farm the trend has been for them to operate the farm and engage in complementary marketing and artisan activities while the men work for large farmers or in urban areas in construction or low-skill services. Women usually manage the farm jointly with their husbands, are responsible for day-to-day decisions and provide most of the labor. Most such "feminized" farming is largely commercial and, along with related activities, generates roughly 20-25 percent of family income. It is on the basis of the source of income that such farmers are described as part-time in the discussion of the small farm sector above. The economic stagnation of the 1980s has resulted in fewer off-farm jobs and may have forced some males back onto farms, although conclusive data are not available.

Poverty

Myth: Poverty is much more prevalent in urban areas where low-skill migrants are forced to eke out a marginal existence in the informal sector than in rural areas where subsistence needs can be more easily met. Reality: The incidence of poverty is greater in rural than in urban areas. It is estimated on the basis of data from the late 1970s that about 25 percent of rural and 20 percent of urban people are in a state of critical poverty (not having enough income to provide minimum dietary requirements). Another 20-30 percent of urban dwellers and 50-60 percent of rural people are in a state of relative poverty (enough family income for basic food but not enough for other basic necessities). The GDP per

worker in the low-skill services and construction sectors which are located mainly in urban areas is about twice as high as in agriculture. Also, urban people have access to health, education and other social services not available to rural people. These facts help to explain why the indices of absolute and relative poverty are higher in rural than urban areas and why rural to urban migration continues at fairly rapid rates. More recent data are not available to determine if the situation has changed during the last decade.

Population Growth

Myth: Population growth has slowed to the point where it is not a serious impediment to improved standards of living during the next decade. Reality: The population still is projected to grow at the high annual average rate of 2.6 percent between 1990 and 2000 even though the rate has declined from the very high 3.3 percent observed between 1962-1974. There will be nearly 3.2 million people added to the population during the next decade, for a total of almost 14.0 million in the year 2000. The high rate of population growth places special demands on agricultural development. Agriculture must grow faster than the relatively high rates of growth in the population if there is to be an increase in availability of food per capita. Since food is the principal wage good for most people, improvements in their well-being will depend largely on how well the agricultural sector performs. Urban population growth is projected to continue at relatively high rates while rural population will grow much more slowly at an average of about 1 percent per year with slower growth in the Costa provinces. The rural population is projected to grow absolutely and will add another 275,000 people by 1995 for a total of 5.1 million. These trends are expected to continue throughout the 1990s.

Migration Patterns

Myth: Migration is primarily from rural to urban areas with little other migratory movement. Reality: Migration patterns are very complex and census data also reveal large migration from urban areas to other urban areas, from urban to rural areas and among rural areas. For example, there were over 1.0 million people who reported in the 1982 census that their last migratory movement was from urban areas, with 716,00 moving to other urban areas and 355,000 to rural areas. Nevertheless, the end result of these complex migration patterns has been relatively large net rural to urban migration (estimated at about 630,00 between 1974 and 1982). Quito and Guayaquil have absorbed the greatest numbers of migrants and are the principal urban centers of Ecuador. Other secondary cities also have absorbed significant numbers of migrants with county seats in the Costa provinces experiencing the most rapid rates of growth.

Labor Markets

Myth: Labor markets largely are segmented and inefficient in Ecuador with large numbers of workers trapped in low-paying jobs because of structural barriers to mobility. Reality: Labor markets linking agriculture and the other economic sectors are relatively efficient, moving large numbers of rural people out of agriculture and into higher paying employment in nonagricultural activities, largely in urban areas. While there is evidence of some segmentation in urban labor markets, the stagnant economy and lack of new higher-paying jobs appear to be the major barriers to upward mobility for most of the labor force, along with

generally low skill levels and limited investments in human capital.

III. Foundations for Agricultural Growth

This section summarizes several key factors contributing to agricultural development since the mid-1960s. These positive factors are a basis for optimism about the future and form the foundation for potentially more rapid agricultural growth and modernization. If this potential is to be realized, however, remedial actions must be taken which build on these strengths and simultaneously address the significant obstacles which constrain progress.

More Favorable Macroeconomic Policy Environment

The macroeconomic policy environment became somewhat more hospitable for agriculture in the 1980s, after three decades of discriminating against the sector and tradeable goods generally and heavily subsidizing industry and home goods in an inward-oriented approach to development. The modest improvements began in 1982 when the Hurtado government was forced to impose austerity measures and structural reforms in response to an international debt crisis. The Febres Cordero government implemented an outward-oriented development model intended to address the more fundamental stagnation of the industrial sector and the nonagricultural economy. The Febres Cordero and Borja governments also have had to respond to a series of major exogenous and internal events and factors, including the disastrous El Niño weather of 1983, the fall in petroleum prices during 1986, the rupture of the main petroleum pipeline in 1987 and several large budget deficits.

Although the nature of reforms has varied among and within governments and there have been some reversals, the net result through time has been movement toward more outward-oriented macroeconomic and trade policies and a more equal set of incentives across the economic sectors. Devaluation of the exchange rate, elimination of most taxes on agricultural exports, more responsible monetary and fiscal policy, some movement toward market prices and interest rates and some liberalization of trade policies all have combined to improve incentives for agriculture and tradeable goods generally.

The sector responded to improvements in the policy matrix with much more rapid rates of growth in the 1980s than in the 1970s when the internal terms of trade were much less favorable to agriculture. While there has been some improvement, macroeconomic policies still discriminate against agriculture and tradeable goods while subsidizing industry and home goods; an inward-oriented development model still dominates the economy in 1990.

The economic plan for 1990-1993 announced by the Borja government in February 1990 to the International Monetary Fund (IMF) commits to a more outward-oriented economic policy including further reduction of trade barriers, movement toward market prices and interest rates, reduction of government expenditures, improved tax collections and reduction of inflation. The proposed plan is clearly a substantial improvement over current policy; if it were to be fully implemented it would result in a more dynamic, competitive economy. There is some question as to whether the government has sufficient political support to fully implement the plan. Moreover, the plan does not go far enough and additional reforms will be needed before agriculture can compete with the rest of the economy on a level playing field and exploit opportunities for economic growth in international markets.

Strong Performance of Agriculture

Agriculture has performed very well over the last three decades even with the constrained and reduced incentive structure, which suggests it will do even better when incentives are improved. The sector grew slightly more rapidly than population on average even during 1965-1981, the height of the import-substitution period. Then growth rates accelerated with improvements in macroeconomic policies after 1982 and agriculture led economic development for most of the 1980s while the rest of the economy was relatively stagnant. Agriculture also has generated large trade surpluses and clearly has made Ecuador even more self-reliant in providing for its food and fiber needs. This is reflected in the availability of substantially more food per capita than is needed to meet minimum nutritional requirements.

The relatively strong performance of agriculture in the face of limited incentives bodes well for the future, given the relative importance of the sector in Ecuador's economy. Agriculture clearly has made major contributions to economic growth and development under a ponderous set of constraints. The sector has latent productive capacity that can be mobilized through improved incentives and appropriate investments and enjoys comparative advantages in international markets. The responsiveness of farmers to improved incentives after 1982 is an especially important index when considering alternatives for more rapid economic growth. Full implementation of outward-oriented and sector neutral macroeconomic policies which remove subsidies to industry and home goods and restore incentives to agriculture and tradeable goods can be expected to generate large increases in agricultural production and productivity and relatively higher rates of economic growth. Such changes also will permit other economic sectors, such as industry, to exploit their natural comparative advantages and begin to compete internationally where opportunities for growth are much greater. Failure to make such changes will constrain Ecuador to lower rates of economic growth implicit in its inward-oriented growth strategy.

Commercialization of Agriculture

The rapid commercialization of agriculture during the 1970s and continuing into the 1980s is another positive basis for future growth of agriculture. Rapid growth of urban areas and huge windfall gains from petroleum exports, along with the agrarian reform induced substantial structural changes in agriculture. Large *haciendas* shifted rapidly to commercial production of underutilized lands as a basis for avoiding expropriation. The concomitant elimination of shareholder (*huasipungeros*) and other similar arrangements along with greatly expanded urban markets and associated economic incentives resulted in most smallholders shifting quickly from subsistence to commercial production.

The shift from extensive hacienda and subsistence cultivation and the commercialization of agriculture augur well for the future development of the sector for two closely related reasons. First, farmers across the spectrum have demonstrated that they are willing to mobilize and shift resources in response to changing economic conditions. Farmers are economic agents and respond quickly and positively to improved incentives. Second, there now is a fairly long and wide base of experience in dealing with changing economic incentives as most farmers have participated in a market economy for a decade or more. This increasingly sophisticated base of market experience is an important foundation for expecting rapid responses to further improvements in the incentive structure facing agriculture. It also is a basis for expecting complementary social investments in

human capital and a science base to generate relatively higher rates of return.

Substantial Improvements to the Land

There have been substantial improvements to the land over the last two decades, especially through investments in irrigation and drainage, which provide a foundation for much more rapid growth. The magnitude of irrigation improvements is substantial. There were an estimated 330,000 hectares of land under private irrigation in 1989 and another 115,000 irrigable hectares in public projects, or roughly one of every five hectares of cropland. Public projects currently under construction will add another 108,000 hectares for a total of one of four hectares under irrigation by the mid-1990s. Public projects under design or serious study would add nearly 300,000 more irrigated hectares if completed and almost 40 percent of cropland would be under irrigation. Other improvements to the land also have been made including flood control, drainage, leveling, fencing, removal of rocks, terracing, etcetera.

These improvements can make land much more productive but most of the potential has not been realized because of failure to make complementary investments in human capital and a science base for agriculture. Investments in irrigation infrastructure have largely been wasted and the small benefits that have been produced are captured by larger farmers through a highly subsidized water tariff. Nevertheless, past investments in irrigation infrastructure and other improvements to the land provide a solid foundation for expecting very high returns to future investments in the science base. Such complementary investments will, in turn, enhance returns on investments in improvements to the land.

Improvements in Yields and the Emergence of a Science Tradition

Increases in yields explain an important share of the changes in production for most of Ecuador's major crops, which indicates that some farmers already have a substantial base of experience in adopting improved technologies. Increases in yields accounted for much of the increases in production (principally Costa crops) or cushioned decreases in production caused by reductions in land area (mainly Sierra crops) since 1965. The National Institute of Agricultural Research (INIAP) has been a key agency in developing and helping to diffuse new technical knowledge although its capacity and hard-earned prestige are waning quickly because of greatly reduced funding. Farmers have been responsive to opportunities to reduce costs of production inherent in improved techniques of production. These realities demonstrate the beginnings of greater dependency on science as an input to agricultural production and the emergence of a science tradition. The importance of technical change in explaining changes in crop production suggests that past investments in research, education and extension, while modest, have been socially profitable.

Two aspects of improvements in yields are especially germane to future growth of the sector. First, even though they have increased, yields still are relatively low compared to the rest of South America so that substantial increases in productivity are possible with existing and largely proven scientific knowledge. The practical implication of this is that Ecuador can increase yields substantially at a relatively low cost. Second, the experience of INIAP in generating improved technologies and Ecuadorian farmers in adopting them is an important part of the

foundation, along with past improvements to the land, upon which greater investments in the science base can be built. This experience base is another reason for optimism that such investments will produce very high social returns.

Good Natural Resource Base

Ecuador has a good endowment of natural resources, which are a partial basis for future agricultural growth. The Sierra and Costa have 3.1 million hectares of prime cropland (22 percent of their total area), 1.3 million hectares of more marginal cropland and 2.5 million hectares of pasture land, with much more limited amounts of good land in the Orient. Ecuador also has abundant surface water resources that are relatively well distributed throughout the country. The minimum flow of rivers just to the Pacific ocean is sufficient to irrigate twice the total land in crops in 1989. There are also substantial amounts of subterranean water although less is known about their extent. The country has adequate rainfall and moderate temperatures although it is affected by recurring periods of drought and excessive rains. Most of the Oriente and much of the Northwest are covered with virgin tropical forests which contain large quantities of commercial hardwoods and other important species that remain to be inventoried. Such forests cover about one-third of Ecuador. The country also has 1,821 km^2 of mangrove swamps and abundant other coastal resources which support a major fishing industry and shrimp farming.

These natural resources have been the principal basis for past agricultural development and are a partial foundation upon which future growth of agriculture can proceed. Two notes of caution are in order. First, the natural resource base, per se, is much less important than human capital and modern, industrial inputs in explaining differences in agricultural productivity among countries, although it obviously explains some of the gap. Even more critically, natural resources are being depleted or destroyed at fairly rapid rates. While the natural resource base may serve as a partial foundation for growth of agriculture, Ecuadorians need to be realistic about its limitations. Substantial complementary investments and policy changes must be made if Ecuador is to achieve rapid rates of agricultural development and simultaneously conserve its natural resources. Continued reliance on natural resources as the primary basis for agricultural development will generate relatively low growth rates for a few years and then complete stagnation as natural resources are exhausted.

IV. Principal Constraints to Progress

This section sets forth the majo constraints to more rapid agricultural growth and general economic development. While the agricultural sector has progressed, especially during the 1980s, it has been restricted from reaching its potential principally by the interrelated obstacles discussed below. These constraints must be addressed in concert through an integrated policy matrix which builds on past successes if agriculture is to make its potential contribution to economic growth and development.

Discriminatory Macroeconomic Policy Matrix

Macroeconomic policies constitute one of the two most formidable restrictions on agricultural growth and modernization at the beginning of the 1990s (the second is a deficient science base and limited human capital, discussed below).

This pessimistic conclusion is based on the large number of studies in developing countries around the world, including Ecuador, which found that biased macroeconomic policies swamped attempts to enhance agricultural growth through sectoral policies. The lesson from the experience of these countries is clear; when macroeconomic policies maintain the internal terms of trade against agriculture in contravention of market forces, other direct investments and policies to enhance agricultural growth will be largely wasted and ineffective.

The macroeconomic policy matrix in place in 1990 continues to discriminate against tradeables which are principally agricultural goods. This is true even though the situation has improved since 1981 and the Borja administration has continued to move toward externally-oriented macroeconomic policies. Although progress is being made, substantially more needs to be done to improve the macroeconomic policy environment and incentives for agricultural growth and economic development. The 1990-1993 economic plan announced to the IMF would address many of the constraints discussed below. It has several major deficiencies, however, which are noted in the discussion of each of the constraints.

Trade Barriers

Industry is heavily protected through a system of very high tariffs and other non-tariff barriers to trade including import prohibitions for some products. Import-substitution industrialization and internal growth still constitute Ecuador's dominant development model, although an across-the-board reduction in tariffs has been announced as part of the new economic plan. High tariffs and trade barriers increase the price of industrial and related home goods and shift the internal terms of trade against agriculture. They also result in an increasingly high cost, inefficient industry unable to compete in international markets, in the face of an increasingly saturated internal market.

Ecuador also restricts the importation of some agricultural products as a basis for promoting domestic production. Procedures are cumbersome for obtaining an import permit which have caused severe disruptions in cereals markets in recent years. Support prices have often been set higher that the border price for these products. Domestic production is high cost and consumers pay more than they would with free trade.

The government also prohibits the export of almost all raw and processed agricultural products and authorizes the export of only a few for which domestic demand is deemed to have been satisfied. This policy reduces incentives to invest in production for export and increases public costs associated with policing illegal exports. It also reflects the reality that fixed, consumer prices for agricultural commodities usually are less than border prices and attempts to help guarantee domestic supply at the low, fixed price. Colombia and Peru constitute relatively large markets for Ecuadorian agricultural products on the basis of recent experience, because of higher prices. Most exports to these countries are staple foods in short supply domestically and, consequently, are exported illegally. The magnitude of clandestine exports can be very large. For example, in 1988 an estimated 45,000 to 75,000 metric tons of vegetable oils were exported to neighboring countries illegally and 30,000 metric tons had to be imported at world prices to cover domestic shortfalls.

One major weakness of the 1990-1993 economic plan is the maintenance of agricultural trade restrictions and barriers based on the anachronistic concept of self-sufficiency in food production.

The government continues to levy taxes on the exports of agricultural

products which constrains agricultural growth and limits foreign exchange earnings. There is a .5 percent ad valorem tax on all exports which is earmarked for infant nutrition programs. This tax was enacted by the Borja administration in 1988 just as the shrimp industry began to experience significant international competition and declining productivity. The shrimp sector experienced a significant decline in 1989 in part due to this tax burden. There also are progressive, ad valorem taxes on coffee and cacao exports ranging from zero to 35 percent, depending on the export price.

Fiscal Deficits and Inflation

Fiscal irresponsibility, wasteful government spending and ensuing fiscal deficits throughout the 1980s have contributed to inflationary pressures. The Borja administration inherited a very difficult situation in August 1988 after the previous administration had financed a very large deficit with expansionary monetary policy and internal credits. A combination of very tight monetary policy and improvements in revenue collection, including increased energy prices and a revised tax code helped to reduce the deficit and inflation since the beginning of the Borja administration.

The annual inflation rate (measured by comparing the consumer price indexes for the same months in 1988 and 1989) fell to 52 percent in January 1990 after reaching nearly 100 percent in November 1988. The average monthly rate for the six-month period August 1989 through January 1990 implies an annual rate of inflation of 39 percent. Thus, it appears the government has been able to rout the tendency to hyperinflation with substantial decreases in the rate. Further reductions in inflation will be very difficult, however, because of substantial pressure on the fiscal deficit from structural government spending for entitlements and subsidies. It is important to recognize that the central government budget is only part of the broader public sector budget which also includes adjunct public agencies and businesses. Preliminary data indicate the central government budget generated a surplus in 1989 that amounted to 2 percent of GDP but that the consolidated public sector budget was in deficit for the same period at 3.5 percent of GDP (Cifra). The deficits of several public agencies that are not included in the central government budget (including the National Development Bank (BNF), the National Petroleum Company (PETROECUADOR, formerly CEPE), the National Electric Company (INECEL) and the National Telecommunications Company (IETEL)) have burgeoned in the last few years and are a principal source of consolidated public sector deficits.

The deficit of the consolidated public sector would have been even greater in 1987, 1988 and 1989 except for complete suspension of payments during 1987 and 1988 on the public foreign debt owed to private banks and payment of only 30 percent of the interest in 1989. The public debt to private banks may be reduced through negotiations in 1990 which would tend to reduce the magnitude of the deficit. Increasing fiscal deficits from inefficient government agencies and bureaucracies threaten, however, to replace much of the gain from any reductions in the foreign debt burden and to saddle the economy with large and increasing deficits for years to come. Ecuador's capacity to finance these deficits by borrowing abroad, especially from private banks, is likely to be sharply reduced. Multilateral and bilateral agencies also are likely to restrict credits which are perceived to mainly subsidize inefficient government bureaucracies and privileged special interest groups. Thus, Ecuador's future fiscal deficits are likely to have to be financed increasingly through internal credits which will be highly

inflationary.

Another major weakness of the 1990-1993 economic plan is its failure to deal with the fiscal deficit and especially the oversized, inefficient public sector and the large, recurring subsidies in the economy.

Negative Real Interest Rates

Interest rates have been set by the government at well below market rates and the rate of inflation during most of the 1980s. The Borja administration has maintained this policy for credit from public banks while allowing private financial intermediaries to charge borrowers no more than 19 points more than they pay savers. The gap between the inflation rate and public interest rates narrowed to a few points during the last quarter of 1989 as monthly inflation fell but the real rate remained negative and the gap again widened during the first quarter of 1990.

Thus, government policy has been to require public and private financial intermediaries to supply loans at subsidized interest rates. Credit has been allocated politically for most of the decade with industry and the urban sector receiving the majority of credit lines. Some credit also was allocated to agriculture but has been co-opted mainly by larger farmers and by employees of the National Development Bank (BNF) in the form of very high operating costs.

Negative real interest rates have had three deleterious effects on the economy. First, the financial sector and especially public banks have been severely decapitalized while privileged borrowers have received large windfall gains. The value of loan repayments is substantially less in real terms than the amount lent. Banks are increasingly decapitalized while borrowers receive windfall gains as their assets appreciate with inflation. The end result is less investment in agriculture, lower levels of production and a different product mix than would have prevailed under market conditions and huge transfers from financial intermediaries to borrowers.

The second negative impact from subsidized credit is that the bulk of loans tend to be concentrated among more affluent borrowers and diverted from the most productive investments. Demand for public credit has greatly exceeded supply at the highly subsidized, negative real interest rates. Consequently, credit has been allocated largely through political influence and other non-market mechanisms. The more influential borrowers are able to pre-empt most of the loan funds. Such loans often are diverted to other uses even outside agriculture including saving abroad. Small producers who are supposed to be primary beneficiaries of subsidized credit are largely excluded from access to such credit. Public banks tend to impose transactions costs as a partial basis for allocation of loan funds; these are relatively higher for small borrowers which further restricts them from subsidized credit.

The third consequence of subsidized credit is the reduction of savings in Ecuador and capital flight. Policymakers seem to have ignored the existence of an increasingly cohesive, world-wide capital market which transcends all national boundaries and attempts to avoid its pervasiveness. Financial intermediaries which charge negative real interest rates to borrowers can not pay any higher rates to savers. Thus, people must save at negative real interest rates in Ecuador or seek alternatives. The world-wide capital market which includes Ecuador, provides a very viable alternative and hedge against inflation through opportunities to save in hard currencies. One characteristic of the Ecuadorian economy has been significant capital flight during the late 1980s. Demand, time and savings deposits continued to shrink in Ecuador while multilateral banks picked up the slack by

financing much of the decapitalization of public banks. Multilateral banks and some bilateral lenders are now beginning to demand reforms in credit policy, with establishment of market interest rates as a prerequisite for further loans or even to continue disbursements of already approved credit.

Controlled Exchange Rates

The country still maintains a system of fixed, multiple exchange rates which tends to generate an overvalued currency through time and the need for periodic devaluations. The system comprises an official rate, fixed intervention rates with crawling pegs for most exports and imports and foreign investment (the import rate was set 2 percent higher than the export rate in December 1989) and a free-market rate for a limited set of transactions. The base intervention rates have tended to become increasingly overvalued despite the automatic, weekly micro devaluations, with several macro devaluations since September 1988 when the policy was initiated by the Borja administration. For example, the intervention rate for exports was estimated to be overvalued by nearly 13 percent in November 1989 compared to September 1988 when it was near parity, despite several interim macro devaluations, one as late as October 20, 1989 (CEA). A macro devaluation on December 13, 1989 again closed the gap but another macro devaluation probably will be necessary sometime in 1990 on the basis of past experience.

Agriculture has borne the brunt of this policy since it is comprised mainly of tradeables. As the Sucre becomes more overvalued, exporters receive increasingly less for their dollars than they are worth, which tends to reduce exports in the short-term and to restrict investments in production for export in the medium term. Farmers producing for the domestic market face competition from subsidized imports. The policy, although it is an improvement over the fixed exchange rates the Borja administration inherited, has tended to favor industry. The industrial sector, with its large imports of raw materials and capital equipment and other home goods has had access to foreign exchange at an overvalued rate (albeit somewhat less overvalued than the export rate because of the 2 percent higher import rate).

Seriously Deficient Science Base

The research, extension and education system serving Ecuadorian agriculture is seriously deficient which is the second, major constraint limiting agricultural and economic development. It is of equal importance to the discriminatory macroeconomic policy matrix and closely interrelated with it. While there has been some technical progress, the sector still is struggling to make the transition to a science-based growth path. For most farmers agricultural production depends largely on exploitation of the natural resource base and internal capital accumulation. The absence of a viable science base limits progress in all components of the agricultural sector from production to processing to marketing to consumption and in both rural and urban areas. The resultant low-productivity and high costs of production essentially would constrain Ecuador from taking advantage of growth opportunities in external (and internal) markets even if macroeconomic policies were rationalized.

Deteriorating Research System

The weakened and declining research capability in INIAP, which carries out

almost all agricultural research, is one of the most serious deficiencies in the science base. Public investments in research are grossly inadequate. Ecuador expended only .19 percent of its agricultural GDP on agricultural research during 1987-1988, compared to a recommended 1 to 2 percent. Moreover, the country has continually reduced its budget support for research since 1975 when it expended .85 percent of agricultural GDP, while most other developing countries increased their investments in agricultural research. Consequently, INIAP suffers from too-few senior scientists, inadequate salaries, continual turnover of staff, tenuous linkages to the international science base and the rest of the research, extension and education system, lack of focus and priorities and discontinuity of effort and short term focus.

Ecuador is very close to being competitive in international markets for several important agricultural crops and livestock but must increase their productivity substantially in order to exploit potential trade opportunities. However, the gestation period for improving yields is relatively long--five years or more--and investments in research have declined dramatically to the lowest levels in Ecuador's history. Technical improvements realized during the 1980s reflect earlier investments in research and the pipeline of improved technical knowledge is now nearly empty. New results can not be on stream for nearly a decade even if investments were increased immediately given the lead-time needed to rebuild and strengthen INIAP and the gestation period for developing improved technologies. Unfortunately, the research system is moving into a period of substantial retrenchment.

Uncoordinated, Disparate Agricultural Extension

There is no system of agricultural extension in Ecuador which further constrains the science base. There is a disparate collection of uncoordinated public and private extension programs and activities which tend to duplicate efforts and waste resources, especially scarce human capital. There is no clear, unifying philosophy or approach to technology transfer which further limits the effectiveness of the various extension efforts. Linkages between extension programs and research are weak and the large number of different entities impose high transactions costs on INIAP. Finally, there are only very tenuous and limited linkages between most farmers and the extension and research programs that are supposed to serve them.

Poor-Quality Agricultural Education

High schools, technical institutes and universities produce limited numbers of poorly-trained graduates in agriculture. There are too many high schools and universities leading to duplication of effort and wasted resources. Faculties are inbred with little graduate training, involvement in research is quite limited at most universities and facilities and equipment are generally inadequate. Training tends to emphasize theory with little field work or practical experience. Education and extension programs suffer from most of the same problems of research, especially inadequate budgets and limited human capital. Few linkages exist between university faculty and INIAP or extension programs, or with international educational and research institutions.

Limited Science for Natural Resources

The agricultural science base also is seriously deficient in failing to address the management of natural resources, which are an important input to agricultural production. There is only limited scientific input into natural resource management, mainly from a few university faculties of biology and coastal resources, on an ad hoc basis, supported by private foundations and international conservation groups. While there is a tendency in Ecuador to view the science base for natural resources as separate from that for agriculture, the physical and biological sciences are basic to both agriculture and natural resources. This dichotomy, along with absence of a critical mass of scientists for agricultural research has constrained more scientific management of Ecuador's natural resources. This is especially true of forest management and management of coastal resources. Failure to emphasize the role of science in the proper management of natural resources has hastened resource degradation.

Reduced Returns to Land Improvements

The inadequate science base also has significantly reduced the social returns on investments in land improvements. Past and current investments in irrigation works and other improvements to the land are much less productive than they could be if there were continual streams of improved technical knowledge being generated by the science base. Such improved knowledge, based on chemical-biological innovations would permit controlled application of irrigation water in combination with improved seeds and fertilizers to produce large increases in yields.

Limited Human Capital

The scarcity of human capital is a third major constraint to modernizing agriculture. This constraint is pervasive throughout the agricultural science base and the agricultural sector more generally. Lack of human capital is the single greatest problem of the deficient science base (discussed above) and is treated separately to emphasize and highlight its importance.

Too-Few Senior Scientists

The principal components of the science base--education, research and extension--all suffer from not having enough well-trained, experienced scientists and technicians. Senior scientists, defined as experienced PhDs or those who have attained equivalent capability, are seriously deficient. Ecuador has relied mainly on its undergraduates with some trained to the MSc level to staff its science base, erroneously believing that such training would be adequate for the country's research needs. While some of these become senior scientists in the full sense of the term, most do not.

Inadequate Salaries

The principal obstacles to attracting and retaining a critical mass of senior scientists and well-trained junior scientists and technicians are grossly inadequate salaries, especially for senior scientists; limited opportunities for career development and advancement; and extremely low budget support. As a result, a

significant number of the most promising and capable scientists and technicians who have been carefully selected and trained at great expense leave the science base each year for better jobs. A minimum critical mass of senior scientists and associated junior scientists and technicians is needed for each of the three components of the science base in order to release the constraints to growth and productivity imposed by increasingly scarce and degraded natural resources, especially land. Without such a critical mass of well-trained personnel (imported or local) it will be nearly impossible for Ecuador to increase agricultural productivity.

Low Levels of Rural Primary and Secondary Education

Low levels of primary and secondary education among rural children also tend to limit increases in agricultural productivity. More than half of rural children do not finish primary school with 80 percent of these leaving by the third grade. One problem appears to be the irrelevance of the curriculum to the needs of rural families. Another is that the constraints in the science base combine to reduce the value of primary education to rural people. Improvements in the curriculum would provide them with the skills to more easily interpret and adapt improved technologies. A more productive science base would make education more valuable to rural people by providing them with access to more profitable technologies if they have the appropriate skills.

Negative Sector Policies

A set of several negative, interrelated sector policies collectively constitutes a fourth serious constraint to more rapid development of agriculture. Included are fixed prices for several basic agricultural products and erratic state interventions in marketing. Such policies have slowed the rate of agricultural growth, distorted the mix of production and caused extreme price instability during some years.

Controlled Prices

Ecuador maintains fixed (maximum) consumer prices for sugar, wheat flour, pasteurized milk, edible oils and fats, rice, soft drinks, beer and molasses, which result in distortions and disincentives to the sector. It also maintains so called "minimum" prices to farmers for the unprocessed products for producing these foodstuffs, plus cotton, meat animals, hard corn and sorghum. The basic approach is to fix prices at each stage in the marketing system based on costs of production (including a "fair" return on investment). Thus, minimum prices are set for farmers and maximum prices for consumers for the agricultural products falling under the price control law.

These prices reflect only the supply side of agriculture on the basis of average costs of production and do not take into account consumer preferences and purchasing power. They usually are less than market prices, as reflected in border prices and thus generally reduce incentives to producers. Excess demand leads to non-price rationing at the farm gate and the wholesale and retail levels of the marketing system. Products are allocated to those with the greatest influence and black market operations (especially clandestine exports) are common, with resultant shortages. Low, controlled prices generally subsidize the well-to-do and other special interest groups who have non-market access at the official price. The poor, whom the fixed prices are intended to help, bear the brunt of shortages at

official prices, face relatively high black market prices, or inferior quality products. Fixed prices distort the mix of production and use of resources from what is socially desireable because relative price relationships are substantially different than market prices. They also encourage inefficiency and low productivity by constraining incentives to adopt improved technologies.

Producer prices have been set above world market prices during some years for two crops, hard corn and rice. In these cases incentives to producers are enhanced but consumers are relatively worse off. These high support prices have resulted in excess supply and relatively large government subsidies to purchase the crops which have had to be sold at a loss.

Market Interventions

Government interventions in the marketing system also have reduced incentives to invest in agriculture. The state directly competes with the private sector in the sale of food and in the provision of inputs and services. The National Company for Basic Products (ENPROVIT) maintains a large number of retail stores which distribute food to the poor at fixed, official prices, although their share of the market is small. It originally was intended to sell basic foods in the poorest neighborhoods but expanded to a broader range of products with several larger stores, including supermarkets, in middle class neighborhoods during the 1980s. The Borja administration has begun to close stores outside the poorest neighborhoods in an attempt to focus ENPROVIT on its original purpose. The government also has entered into direct competition with the private sector in the sale of fertilizers through the Ecuadorian Fertilizer Company (FERTISA), seeds through the National Seed Company (EMSEMILLAS), semen through the National Semen Company (ENDES), machinery services through the National Program for Agricultural Mechanization (PRONAMEC) and the Ecuadorian Institute of Water Resources (INERHI) and compost through the National Fertilizer Factory (FAB). Finally, the government maintains a price support program through the National Agricultural Storage and Marketing Company (ENAC) for rice, corn and soybeans which includes a nation-wide system of warehouses and buying and selling operations to maintain and stabilize prices of these basic grains. Most of these public entities sell their products at less than market price and are quite inefficient. Consequently, all have incurred large, continuing deficits during the last decade, which require recurring government subsidies. State subsidization of their losses constitutes unfair competition with the private sector which reduces incentives for private investments in agriculture and contributes to inflationary pressure. Because the products of these government agencies are generally priced below the market, they are allocated to buyers by non-market forces with special interest groups and larger farmers reaping most of the benefits of inherent subsidies. Again, the poor generally are not the major beneficiaries of such market interventions.

Degradation of Natural Resources

Degradation of natural resources is an increasingly serious problem and a fifth major constraint to agricultural development. Soil erosion is widespread, especially in the Sierra, where losses are accelerating. Farmers are increasingly abandoning depleted and already highly-eroded lands with steep slopes in the foothills of the valleys and encroaching onto new lands in the *Páramos*. Destruction of watersheds is rampant resulting in increased soil erosion and unexpectedly high

silting of major reservoirs such as Paute, with very high costs. Soil is a nonrenewable resource in any time germane to modern man and it is being depleted at increasing rates. Drainage problems and salinity are also emerging problems in some irrigation projects. Petroleum reserves, which are one of the principal bases of Ecuador's economy, will be exhausted shortly after the turn of the century. Native tropical forests are being decimated by loggers and farmers and mangrove swamps are being destroyed by shrimp producers. The extent of the destruction of forests in Ecuador is not documented but is known to be proceeding apace. The destruction of tropical forests is a subject of world-wide concern because of increasing concentrations of carbon dioxide in the global ecosystem (the greenhouse effect) and the destruction of beneficial species. Pesticide and other environmental contamination are known to be serious problems but their incidence has not been measured. Indifference or ignorance of the social costs generally surrounds the exploitation of natural resources.

Land tenure arrangements are one of the principal reasons that degradation of natural resources is increasing. The government is unable to enforce tenure rights on much of the natural resources it nominally owns. These resources tend to be exploited in common with overuse and depletion of the resource base as results. The government has extended private tenure rights over some of its resources in an attempt to exploit them more rationally. The terms under which these private rights are granted, however, also has led to resource degradation. For example, colonists in forested areas are required by law to clear the land of trees in order to obtain a title.

Inadequate Data Base and Analytical Capacity

The last major constraint to more rapid agricultural growth is a completely inadequate data base in combination with an extremely limited capacity for policy analysis in agriculture.

Deficient Agricultural Data

Data for analyzing agriculture are very inadequate and far out-of-date. The last agricultural census was in 1974 and the last rural household survey was in 1975 and 1978. There are no more recent national data on such important indicators as sources of income of farm families, tenure and farm size, rural-urban linkages, consumption and factor use. Weather forecasts and situation and outlook reports are nonexistent while market price reports are just beginning to be issued regularly. The data that are available on land area, yields and production underwent a major change in methodology in 1986 and are not comparable with earlier years. There also is some question about the reliability of production data due to weaknesses in collection methodology and preparation of statistical reports. There are almost no data available on the natural resource base or its products. National account data for agriculture are notoriously poor especially for some subsectors such as forestry, where data are gross estimates based on surveys of the wood industry several years ago. Preliminary data from the Central Bank are always suspect and usually undergo substantial revision.

Limited Capacity for Policy Analysis

The capacity for agricultural policy analysis is nearly as deficient as the data base. There are only a handful of agricultural economists in Ecuador with the

training and experience needed to carry out policy studies in agriculture. Very few other economists and policy makers are even conversant with modern theories of agricultural development and the role of agriculture in economic development. The inclusion of Chapter 1 in this assessment was a purposeful attempt to help address this deficiency by digesting what most agricultural economists in the developed world and many developing countries have taken for granted for more than a decade. The notion of policy formulation based on policy studies and analyses is just beginning to be accepted with resistance from those steeped in the notion of "planning."

The Agricultural Policy Institute (IDEA) is engaged in policy analyses in agriculture that integrate private and public perspectives, has sponsored several in-depth studies and seminars and has some fledgling in-house capability. The Ministry of Agriculture's Policy Analysis Unit, established in 1987, has done a credible job of studying various policy issues and presenting the options and their consequences to the minister and other key government officials. Nevertheless, capacity for policy analysis in agriculture is extremely weak. Perhaps the greatest deficiencies are in the areas of the effect of macroeconomic policies on agriculture and agriculture's role in economic development. The limited capacity to maintain an adequate and current data base and to do policy analyses and related studies is another manifestation of the deficient human capital base discussed above.

V. The Political Economy of Subsidies

Ecuador's economy can be divided into two basic sets of people; the poor and all others described as the affluent for want of a better term. The poor are those with too little income to provide basic food, clothing and shelter. Subsidies are usually justified politically to help the poor but, in fact, the affluent receive most of the benefits. The poor generally wield little political influence while the affluent dominate the political process and government. Subsidies both distort and limit economic development and leave the poor relatively worse off.

The affluent comprise interlocking sets of special interest groups, each of which benefits from a public subsidy of some kind. Each of these groups tends to politically support the vested interests of all the others with respect to the subsidy, upon the basis of reciprocity. Principal interest groups include public sector employees, industrialists, transport owners, building contractors, larger farmers organized by commodity groups and by region, the military, labor unions in both the public and private sector and affluent urban dwellers who may also belong to one or more of the other groups.

Each of these groups receives one or more kinds of public subsidies via various mechanisms. Public sector employees and the military receive subsidies in the form of wages and salaries that are, on average, much higher than their productivity; in short they receive more than they produce. They also tend to have preferential access to products at low, controlled prices. Industrialists benefit from tariff and non-tariff trade barriers, an overvalued exchange rate which reduces their import costs, tax exonerations, subsidized credit and direct subsidies. Larger farmers reap most of the benefits from subsidized credit, subsidized irrigation water, price supports, directed technical assistance and subsidized machinery pools. Taxi and bus driver-owners receive periodic fare increases, waivers of tariffs and restrictions on importation of vehicles and highly subsidized prices for petroleum derivatives. Building contractors receive subsidized credit and benefit from the overvalued exchange rate for imports of construction materials and equipment. Union members, especially those associated

with public sector employment, are subsidized by collective wage increases and other benefits prescribed by an ambitious labor code that on average exceed improvements in their productivity. Various firms who borrowed abroad and were caught in the interest rate crisis in 1982 received substantial government subsidies. Their loans with foreign banks were assumed by the government and converted to Sucre balances at a highly overvalued exchange rate and long repayment periods. Finally, the affluent people who live in urban areas tend to receive most of the subsidies to utilities and petroleum derivatives. For example, one study estimated that the wealthiest 10 percent of the population, who were concentrated in Quito and Quayaquil, consumed 90 percent of all energy in Ecuador in 1987. This small segment of the population was the beneficiary of most of the relatively large subsidies to electricity and gasoline, even though such subsidies are justified and maintained on the grounds they benefit primarily the poor (Kublank and Mora).

The poor also benefit directly from many of the same subsidies as the affluent. These subsidies are very important to the poor but they receive relatively much less than the affluent of the total of each class of subsidy. The poor include mainly small farmers with limited resources and the self-employed in the urban informal sector, who together constitute roughly 40 percent of the labor force. The affluent groups which constitute the majority of society usually support the continuation of subsidies. While often nominally antagonistic to each other, they constitute an informal political coalition which maintains the status quo. This is ostensibly done to help the poor but through the coalition the affluent capture most of the subsidies. The poor are not yet a cohesive political force and tend to support the populist proposals of the affluent classes since they also derive direct, albeit relatively small, benefits from public subsidies. This tends to explain, at least in part, the anomaly of how Ecuador, with its very skewed distribution of income, has remained an island of relative calm while its neighbors have been rent by social unrest.

The development of a society dominated by special interest groups which are the principal beneficiaries of large government subsidies has been underway for decades, with a significant boost during the petroleum boom. Such recurring subsidies and the political processes that maintain them have become institutionalized elements of the fabric of Ecuadorian society. Indeed, subsidies for almost all Ecuadorians--affluent and poor--have become a traditional way of life and many have no other experience. The problem appears to be especially serious in the large public sector where there is little correlation between productivity and remuneration. The problem is also serious in agriculture where larger farmers are assured a profit via recurring increases in support prices, combined with subsidized credit and other subsidies sufficient to cover costs and guarantee a return on investment. It is unlikely farmers will want to leave this safe haven and confront the risky and uncertain world of market forces. This helps to understand why the private agricultural sector often gives only lip service to efforts to move toward a market-based economy for agriculture.

The existence of large and growing public subsidies to a large segment of the population has been and remains a major constraint to economic growth and development. Subsidies introduce distortions into product and factor markets that result in misallocation of resources and less production than is possible and an inappropriate mix of products relative to consumers' preferences. In short, subsidies reduce the rate of economic growth relative to a market-determined rate.

Subsidies also are inflationary since they generate deficits which must be funded from some source. The petroleum boom provided the source for financing

subsidies during the 1970s but the government was forced to turn to foreign borrowing and central bank credits (increases in the money supply) during the late 1970s and 1980s. Subsidies have contributed directly to the large fiscal deficits of the 1980s which have been and are financed through internal credits and external borrowing. Consequently, they have been a principal cause of the rapid rates of inflation observed in Ecuador during the last decade. Much of the foreign debt of Ecuador can be traced directly to various subsidies captured by affluent, special interest groups. Examples include foreign loans for irrigation infrastructure, generation and transmission of electricity, assumption of private debt by the government, recapitalization of public banks and to cover recurring fiscal deficits. Moreover, the government continues to contract additional external and internal debt, even in the midst of the foreign debt crisis, to benefit special interest groups (e.g. the large multipurpose irrigation projects in the Costa).

Inflation acts as a regressive tax on the poor and especially those with fixed incomes. Thus, resources are being wrested away from the poor via an inflation tax in order to provide subsidies which benefit mainly the affluent, special interest groups and this has continued for years. While Ecuador is relatively peaceful now, the status quo can not be maintained indefinitely. One critical problem is how to break out of the unproductive and potentially socially disruptive cycle of subsidies mainly for the affluent and get onto a path of more rapid economic growth that will provide broad-based opportunities for increased employment and income. A second closely related problem is to design welfare programs that benefit the poor rather than the affluent and help to close the gap between them. The subsidies inherent in such welfare programs are necessary for orderly, more rapid economic growth. Subsidies to the poor can be provided without reducing growth or engendering inflation if appropriate welfare instruments are utilized along with conservative fiscal policy, in a more rapidly growing economy.

VI. The Emerging Scenario

Prospects for agricultural and economic growth during the 1990s and into the Twenty-first Century are not encouraging, because of inertia associated with the current policy matrix and the political will necessary to change it. The depletion of petroleum reserves will place increasing reliance on agriculture as the engine economic growth. This, in turn, will intensify exploitation of other natural resources because agriculture now is largely a natural resource-based economic sector with little prospect of quickly shifting to science-based growth. The likely result is increasingly rapid depletion and destruction of other natural resources during the decade, with declining rates of agricultural and economic growth, followed by stagnation.

This dilemma underscores the priority and urgency of rapidly upgrading and strengthening the science base for agriculture and of concomitantly shifting to an outward-oriented set of macroeconomic policies.

It is critical that greatly increased investments in the research system and science base be made immediately. Only a strong science base can generate the new technical knowledge that permits the substitution of modern, industrial inputs and relatively abundant labor for the increasingly scarce land and soils and other natural resources. Improved technologies and modern inputs together will increase productivity and employment, improve Ecuador's competitiveness in world markets and lead to higher rates of agricultural and economic growth. They also will reduce pressure on natural resources and permit their conservation. The capacity

of the research system has declined substantially with very little new research in process. The nearly empty research pipeline is compounded by the relatively long lag between investments in research and generation of viable, improved technologies. The juxtaposition of rapid degradation of natural resources and no significant flow of new research results until the late-1990s at the earliest reveals a near crisis situation on the horizon.

An outward-oriented set of macroeconomic policies is needed to greatly increase incentives for the industrial and commercial sectors to produce and import modern, industrial inputs for agriculture. These modern factors of production are needed to incorporate and complement new technical knowledge produced by the science base and to directly substitute for limited land and other resources. Lack of modern industrial inputs compounds the negative effects on the environment of a deficient science base. The degradation of natural resources will increase even with improvements in the science base if modern industrial inputs are not available in sufficient quantity and quality. Continuation of discriminatory macroeconomic policies which artificially depress agricultural prices will severely limit the availability of modern, industrial inputs and assure more rapid resource degradation.

The negative scenario on the horizon can be modified but only through courageous political actions leading to a strong science base and outward-oriented macroeconomic policies within the next two or three years. If such changes are made within this period, Ecuador can likely conserve its natural resources and experience much more rapid and equitable economic growth during the latter 1990s and the early 2000s. Specific recommendations for modernizing agriculture are presented in the next and final chapter.

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CHAPTER

14

MODERNIZING AGRICULTURE

MORRIS D. WHITAKER

I. Introduction

It is fully within the realm of possibility for Ecuador to attain much more rapid rates of economic growth and development and improve the welfare of its people. The stagnation of the past decade and the continual reduction in per capita gross domestic product (GDP) can be reversed with agriculture being the pivotal sector for rejuvenating the economy. Greater rates of agricultural and economic growth will require changes in macroeconomic and sectoral policies and corresponding reallocations and reductions of public expenditures. The general set of policies and programs needed to induce such improvements is relatively well known and accepted by most development economists. It has been successfully adopted by a variety of developing countries around the world, including Chile, Paraguay and Bolivia in South America. These countries have experienced higher rates of growth after policy reform and some Pacific rim countries have progressed to the status of newly developed countries in two or three decades.

The focus on agriculture is not an argument for agricultural fundamentalism; the recommendations presented in this chapter are consistent with evenhanded development of all the productive sectors. The emphasis on agriculture derives from its major and growing role in the economy, in spite of the fact that agricultural prices have been artificially depressed for decades. It also is based on opportunities for growth inherent in a large, relatively untapped international market in which production agriculture and related economic activities have a comparative advantage. This external market can be exploited as an important basis for more rapid and equitable economic development.

Mobilizing political support for the policies and programs needed in Ecuador for more rapid growth will be difficult but possible with courageous, futuristic leadership. Most of the interest groups that compose the current political coalition will be exposed to greater economic risk and uncertainty in the short term from modifying policies. The necessary policies and programs will reduce and eliminate subsidies and will cause substantial shifts in relative prices. Changing prices will, in turn, induce reallocations of private investment which will result in

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decapitalization and losses for those whose investments are sunk.

Resistance to requisite policy changes will be tempered by the prospects of much more rapid rates of economic growth. The period of uncertainty and risk will simultaneously provide great opportunities for higher returns from investments in new, more profitable alternatives. More importantly, the proposed policy changes will permit more rapid expansion of the economy with increases in employment, productivity and income. The economic pie will be much larger in five to ten years than would be possible under the old policy regime and likely will be more equitably sliced.

This chapter presents recommendations for modernizing agriculture as the primary basis for more rapid economic growth and development during the 1990s. Section II suggests several changes needed to rationalize macroeconomic policies and adopt an outward-oriented growth strategy, which are of highest priority for more rapid, sustained agricultural growth. Section III presents an equally important set of recommendations for improving the agricultural science base and strengthening research, education and extension functions, with special emphasis on increasing the stock of human capital. Section IV considers requisite price and marketing policies for agriculture while Section V turns to recommendations for improving the management and conservation of natural resources. Recommendations for improving agricultural data and capacity for policy analysis are presented in Section VI. Section VII proposes increased government efforts to help reduce population growth and protect hard-won economic growth from erosion by a burgeoning population. Section VIII discusses the likely impact of the recommendations on the poor and the need to clearly separate efficiency and welfare instruments in designing welfare programs. Section IX presents a caveat about the sustainability of a high-input, science-base agriculture, while Section X considers the need to act expeditiously in implementing requisite reforms. Section XI concludes the sector assessment by considering Ecuador without petroleum in the early 2000s, under alternative policy scenarios.

II. An Outward-Oriented Macroeconomic Policy Matrix

One of the two most important recommendations of this study concerns the need to move quickly to a sector-neutral, outward-oriented set of macroeconomic policies. The importance attached to this recommendation is based on the fact that biased macroeconomic policies have swamped the effects of positive policies and programs intended to directly help agriculture. If macroeconomic prices continue to reflect government intervention rather than the actual value of products and factors, resources expended to strengthen agriculture will largely be wasted. Four principal changes are needed: (a) eliminate non-tariff barriers to trade and establish a low uniform tariff that can gradually be phased out; (b) reduce and eliminate the public sector deficit by reducing government waste and inefficiency, increasing public prices and improving the tax system; (c) unfetter capital markets and let interest rates be determined in the market place for financial transactions; and (d) establish a single, unified exchange rate for all foreign trade transactions. Such changes will permit agriculture to compete with the rest of the economy on an equal footing for the first time in decades. They will also improve incentives for domestic production or importation of modern industrial inputs that, along with new technical knowledge generated by the science base, can substitute for limited land and other increasingly scarce natural resources.

Reduce Trade Barriers

Recommendation: Remove all non-tariff barriers to trade and establish a relatively low, uniform tariff that is eventually eliminated.

Rationale: Removal of trade restrictions and reduction of tariffs will: reduce subsidies to industry and other protected sectors, help restore agriculture's competitive position, expose protected firms to international competition and help them to become more efficient, induce reallocation of resources to more profitable enterprises with higher returns to investors, and benefit consumers through lower prices and better quality products. These changes will enhance economic growth, new jobs and higher incomes.

Discussion: The climate for reducing or eliminating trade barriers is relatively good. The country has made some progress towards this goal during the 1980s with a reduction in the average tariff and removal of some trade restrictions. The Borja administration is considering a general reduction of tariffs to be implemented in mid-1990. The Presidents of the Andean Pact Countries met in Galápagos Islands of Ecuador during December 1989 and agreed to work toward free trade.

Removal of trade restrictions and reduction and eventual elimination of tariffs will have several salubrious effects on the economy. Subsidies to industry and other protected segments of the economy will be reduced. This will help restore agriculture's competitive position and directly complement the effects of a unified exchange rate (see below) in enhancing agricultural growth and productivity. Currently protected firms will be exposed to international competition which they will have to face eventually if they are to survive. Such firms must become more efficient in order to compete in the world marketplace and those that do will have greatly expanded opportunities for growth. The resulting reallocation of resources will lead to more efficient organization of production with higher returns to investors throughout the economy. All of these changes will contribute to higher rates of growth, increased employment and greater income. Consumers are likely to be the greatest beneficiaries of reduced trade barriers. Imported consumer goods generally are higher quality and lower priced than those produced in currently protected industry. At the same time, goods produced domestically will tend to improve in quality and prices will fall as firms become more efficient through international competition.

The proposal at the 1989 Galápagos summit to work toward free trade among the Andean countries is clearly a positive development. However, Ecuador should be objective about the difficulties of attaining such an agreement and the limitations on growth inherent in the regional market. Ecuador has perhaps the most to gain from a free trade agreement of any of the Andean countries, given its relatively low level of productivity and internally focused policies. Consequently, its neighbors might be less willing to accept it as a full partner without concessions. More importantly, the five Andean countries represent a relatively small market, with each country producing roughly the same set of products. Opportunities for substantial gains from trade within the bloc are likely to be smaller than with other major markets like the Pacific-rim countries, North America and Europe. Ecuador should develop a trade policy which permits it to exploit its comparative advantages in the broader international economy while simultaneously strengthening trade within the Andean region.

The recommendation to remove non-tariff barriers to trade applies equally to agricultural products as well as those of industry and other sectors. The outright prohibition on exports of almost all agricultural products should be

eliminated. The policy, which is intended to assure domestic supply of food and fiber in conjunction with low fixed prices (see below) results in less production and lower growth rates than are possible. It is based on the false premise that self-sufficiency in food production is the most efficient basis for economic growth. In fact, trading or self-reliance is more efficient, leading to cheaper supplies of food and faster economic development.

Reduce Public Sector Deficits

Recommendations: (a) Reduce government expenditures and streamline services by privatizing public enterprises, reorganizing the public sector and reducing public sector employment; and (b) Enhance revenues by continuing to improve the tax system and increasing the prices of energy and other public produced goods.

Rationale: Reduction and elimination of public sector deficits are necessary to control inflation and reduce it to an acceptable rate. Such deficits have continued at relatively high levels throughout most of the 1980s and are one of the principal sources of inflationary pressure in the economy. The principal problem is profligate spending on a too-large, inefficient public sector and subsidies to a variety of public and private sector interest groups, including inefficient public businesses. Revenues have been enhanced through domestic increases in energy prices and an overhaul of the tax system, which still remains to be fully implemented. Failure to adopt a more conservative fiscal policy and eliminate public sector deficits will doom the economy to relatively high inflation rates for the foreseeable future.

Discussion: The Borja administration has succeeded in reducing inflation to an annual rate of about 50 percent in January 1990 through a combination of monetary and fiscal policy. The government has maintained a very tight monetary policy and has attempted to control prices and limit exports of domestically produced food. On the fiscal side, the fight against inflation benefitted from higher international petroleum prices than projected in the 1989 budget. Revenues also improved from increases in domestic prices of fossil fuels, electricity and water although these commodities still are far below market prices. Finally, the government introduced new tax legislation which promises to increase revenues in 1990 by increasing coverage and compliance.

Further reductions in the inflation rate are likely to be much more difficult to attain because of government spending and ensuing fiscal deficits. Moreover, Ecuador's future fiscal defic · are likely to have to be financed increasingly through internal credits (beca of its poor international credit rating) which will be highly inflationary. This sce..ario underscores the urgency of reducing the size of the public sector, streamlining the provision of vital public services and making hard choices about the necessity and productivity of alternative public investments.

This dilemma also highlights the inconsistency of increasing public investments (and subsidies) through foreign borrowing in the face of large public deficits and foreign debt. The foreign financing for new multi-purpose irrigation projects is a case in point. Such loans will add over US$2.2 billion or 20 percent to the foreign debt and most benefits will be captured by a relatively small number of larger farmers and land speculators. Another example is foreign borrowing to continually recapitalize the National Development Bank (BNF) with most of the benefits of subsidized credit accruing to more well-to-do farmers.

Approximately three-fourths of the public sector budget is for current

expenses, most of which are wages and salaries (Cifra). The relatively large number of public employees is a major drain on the public treasury. Wage increases, mandated by law, have eroded the capacity of most agencies to purchase other complementary operating inputs, let alone increase capital investments. The results are large numbers of public employees who are restricted from fully carrying out their prescribed functions, ensuing reduction of services and limited capital investments.

These grim realities suggest the need for two kinds of reforms in order to reduce public expenditures. First, the government should divest itself of businesses and activities that can be carried out by the private sector. These should be privatized and if no investors can be found should be eliminated as expeditiously as possible. Specific recommendations for public agencies serving agriculture are set forth in Section IV below. Second, there should be a major reduction in the number of public employees (perhaps as much as 20-25 percent on average) and a realignment of agencies and functions to assure efficiency. The proposed reduction in force should be carried out over several years to provide opportunities for obtaining alternative employment. Also it should be accompanied by a safety net to provide for basic necessities of the unemployed during the transition period.

The government also should maintain its efforts to improve the tax system and enhance revenues. The prices of fossil fuels, water and electricity should continue to be increased in order to eliminate subsidies to the rich and reduce fiscal deficits and ensuing inflationary pressure. Fiscal policy should, however, place much greater emphasis on reducing public expenditures and making the public sector more efficient.

Continuation of the status quo will almost certainly assure hyperinflation and economic crisis within the next few years. Ecuador can not afford to continue large and increasing subsidies to much of its public sector and various private groups. If reforms in the provision of government services are not initiated voluntarily they will eventually be forced on the economy with no time for orderly transition. This would almost certainly result in substantial social upheaval and political stress.

Unfetter Capital Markets

Recommendations. (a) Allow market forces to establish interest rates for borrowers and savers; and (b) Eliminate government intervention in the allocation of loan funds and the extent of services provided by financial intermediaries.

Rationale: Allowing market forces to set interest rates and reducing government intervention in capital markets will preclude decapitalization of banks and other financial companies through subsidized loans which confer windfall gains on borrowers. Subsidies to larger farmers and other influential groups and the tendency for concentration of loans among them will be eliminated. In turn, the public deficit and inflationary pressures will be reduced. Such policy changes will reduce capital flight, increase savings and investments, make credit more universally available and channel investments into more productive uses.

Discussion: Succeeding governments have implemented a policy of subsidized, controlled interest rates during most of the last two decades. Moreover, real interest rates have been negative because of high inflation for almost all sectors of the economy during most of the 1980s. The situation has improved somewhat under the Borja administration with the falling inflation rate nearing the increasing interest rates for public credit lines. The private sector

rate appears to be slightly positive in early 1990 although this depends on what rate of inflation the interest rate is compared to.

Negative real interest rates have severely decapitalized public banks while privileged borrowers have received large windfall gains. Demand for public credit has greatly exceeded supply at the subsidized interest rates and credit has been allocated largely through political influence and other non-market mechanisms. The bulk of loans tend to be concentrated among more affluent borrowers and are often diverted to other uses outside agriculture, while small farmers seek financing in the informal credit market. Negative interest rates have led to a reduction of savings in Ecuador and loss of capital as savers have sought more viable alternatives in the world capital market. International lenders are beginning to ask for establishment of market interest rates as a prerequisite for further credit.

Thus, the financial sector of Ecuador is on the horns of a dilemma; public financial institutions are being decapitalized, very little savings are being generated and foreign financing is increasingly difficult to obtain. Only a shift to market-determined interest rates for all public and private savings and loans and elimination of government intervention in credit and savings allocation will resolve the problem.

Ecuador already has tested the water of less-restricted capital markets when it permitted the payment of market interest rates on certificates of deposit during the mid-1980s. The response of savers was immediate and relatively large. This experience suggests that Ecuadorians will respond positively to establishing a market rate of interest and removing government constraints from the capital market.

Unify the Exchange Rate

Recommendation: Shift to a unified, floating exchange rate for all foreign trade transactions.

Rationale: A unified exchange rate, unencumbered by government intervention, is the principal mechanism by which Ecuador can fully exploit opportunities for economic growth inherent in expanding world markets. The current system forces the government to constantly monitor and intervene in the market to assure that the sucre is not overvalued or undervalued. To the extent the fixed rate is overvalued, incentives to invest in agriculture and tradeables are constrained. A unified rate will make domestic production generally more profitable for all exportable and importable goods and will especially help agriculture since the sector comprises largely tradeables. A unified exchange rate also will eliminate the subsidies inherent in non-market allocations of foreign exchange to special interest groups when the intervention rate becomes overvalued.

Discussion: The policy of regular mini-devaluations and periodic macro-devaluations implemented by the Borja administration has resulted in an exchange rate that is only modestly overvalued and that does not vary substantially from the ideal. This is a much more constructive policy than that of the 1970s and is a stepping-stone to a sector-neutral, optimal policy. The maintenance of the fixed rate introduces the need for continual monitoring and devaluation by the government, since the market rate is constantly changing (generally increasing). The government has had to make occasional macro-devaluations and to adjust the magnitude of the regular micro-devaluations, with subsequent mini-shocks to the economy, in order to maintain Ecuador's competitive position is world markets.

Shifting to a unified, market-determined exchange rate would eliminate the need for government monitoring and assure smooth adjustments to changing

economic conditions. It would eliminate subsidies to production of industrial and other home goods and simultaneously increase the profitability of agriculture and tradeables. It would improve opportunities nontraditional exports from the industrial and services sectors as well as from agriculture. Ecuador's competitive position would be enhanced in world markets for all exportable goods with increased opportunities for economic growth. More rapid growth would contribute to employment generation and greater opportunities for the poor to share the fruits of economic progress.

Ecuador also has had a positive experience with a market exchange rate. It implemented a unified, floating exchange rate in August 1986; the rate was actually maintained for several months at less than the free market rate that had prevailed just prior to floating the exchange rate. Irresponsible monetary and fiscal policy contributed to subsequent rapid devaluation, which resulted in reestablishment of an overvalued official exchange rate in March 1988. Critics have incorrectly blamed the rapid devaluation of the Sucre on the floating exchange rate, rather than on expansionary fiscal and monetary policies in conjunction with the exogenous shocks from falling oil prices and the rupture of the petroleum pipeline. Agriculture, in the meantime, responded quickly and positively to improved incentives from the unified exchange rate with some of the fastest growth rates in history among all its subsectors. This experience suggests the shift to a free market exchange rate can be made with little negative impact or political stress, especially because the differential already is very small and the government continues to pursue responsible monetary and fiscal policies.

III. A Science Base for Agriculture

Establishment of a viable science base for agriculture is of equal importance to shifting to an outward-oriented macroeconomic policy set as the two principal foundations for future growth of the economy. These two major recommendations are synergistic and more rapid, sustained agricultural and economic development is dependent on both being implemented. Establishment of the science base results in the production of new technical knowledge. The outward-oriented macroeconomic policy matrix provides broad-based incentives for investing in agriculture, including the production or importation of modern, industrial inputs which complement and incorporate new technical knowledge. The new technical knowledge and modern, industrial inputs substitute directly for limited land and natural resources and thus release the constraints to growth imposed by the resource endowment.

There are four principal recommendations for strengthening the science base for agriculture: (a) make the National Institute of Agricultural Research (INIAP) autonomous and greatly increase funding for INIAP through a debt-equity swap so it can pay competitive salaries and assemble a critical mass of senior agricultural scientists; (b) consolidate and streamline the disparate extension services of the Ministry of Agriculture (MAG) and related public sector entities; (c) strengthen selected technical schools and universities with special emphasis on their research capacity; and (d) integrate research, extension and education programs into a cohesive, national system with viable linkages back to farmers and forward to the international science network. All of these recommendations focus on resolving the shortage of human capital, especially senior agricultural scientists and technicians, which is the single most important limitation to a viable science base for agriculture.

Make Research Autonomous and Increase Funding

Recommendations: (a) Make INIAP an independent, fully autonomous organization so it can pay competitive salaries, employ a critical mass of agricultural scientists and technicians and manage research more efficiently; and (b) Increase INIAP funding to 1.5 percent of agricultural GDP, the standard recommended by the World Bank, or about US$17.5 million, up from current levels of US$2.0 million, using a debt-equity swap to finance an endowment.

Rationale: New technical knowledge and modern, industrial inputs are the foundation for more rapid and sustained increases in agricultural production, productivity and income. These modern, science-based inputs lead to increased growth by augmenting the productivity of limited land and other natural resources that restrict development. In essence, improved technologies are substitutes for increasingly scarce natural resources: they reduce dependence on them and contribute to resource conservation. Generation of new technical knowledge is seriously constrained by limited investments in research and by institutional barriers which limit employment of a critical mass of agricultural scientists and technicians. Transition from a low-productivity, natural resource-based agriculture to a high-productivity, science-based agriculture thus will require greatly increased research capacity along with an appropriate macroeconomic policy matrix. INIAP is the principal agricultural research agency in Ecuador accounting for 85-90 percent of all such research, with universities accounting for the balance. Thus, the recommendations for strengthening research focus on INIAP, given its dominate role in agricultural research; recommendations for university research are made below.

Discussion: Ecuadorian agriculture relies mainly on exploitation of natural resources and internal capital accumulations as production inputs. Consequently, agricultural productivity is relatively low, even in comparison to the average for South America and Ecuador's products are less competitive in world markets. All agricultural land is in production and there is increasingly serious degradation of the environment, especially soil erosion and destruction of tropical forests and coastal resources.

The extremely debilitated state of INIAP is the principal constraint to a stronger science base and wider utilization of modern technologies and production inputs in Ecuadorian agriculture. Low average levels of productivity are highly correlated with limited and declining investments in agricultural research. Ecuador invested only .19 percent of agricultural GDP in agricultural research via INIAP during 1987-1988 compared to .94 percent for 52 other developing countries and a recommended level of 1-2 percent. Ecuador's investments have decreased continually since 1975 when they were at an all-time-high of .85 percent of GDP.

INIAP lost over one-third of its senior agricultural scientists between 1986 and 1989. This was partly due to precipitate decreases in its real budget. Also, the institute can not pay competitive salaries for its scientists because of restrictions in the civil service code which governs it. As a result, the quality and quantity of research has declined. Research efforts, which were spread across far too many crops and programs even before the loss of senior scientists and budget cuts, are now seriously diluted. There is lack of focus and priority, linkages to the international science network are increasingly tenuous, researchers are more and more isolated from extension workers and farmers and the loss of scientists has accelerated. Agricultural research and INIAP are increasingly politicized with little semblance of the relatively healthy INIAP of the late 1960s.

Two major reforms are needed. First, INIAP must be able to pay competitive

salaries for its staff, especially senior scientists. The salary constraint can be resolved by removing INIAP from the purview of the civil service code and its status as a public agency dependent on the Ministry of Agriculture. INIAP should be reestablished as a fully autonomous entity, perhaps as a not-for-profit foundation, capable of paying competitive salaries and establishing its own personnel and administrative policies. Recommending autonomous administrative status for INIAP should not be viewed as a recommendation to privatize it. Indeed, its functions are public in nature and it should be accountable to the government. This is because it is producing a public good which will not and can not be produced by private investors since they can not capture the benefits. INIAP's role is social in nature but it can not fulfill its mandate under current strictures on adjunct public agencies.

A second major reform, closely related to competitive salaries, is the need for greatly increased funding for research on a sustained basis. It is recommended that Ecuador attempt to meet the mid-range of the recommended level or 1.5 percent of agricultural GDP. This would require that the budget of INIAP be increased to about US$17.5 million per year, up from the 1989 level of US$2.0 million or by 9 times. Again, because INIAP produces a public good it is dependent on government funding. Research will have to accorded a much greater priority and funding shifted from other activities to meet this target.

One approach could focus on earmarked sources such as a modest tax on imports and exports, or from petroleum revenues. A second approach would be to divest of other public agencies and shift funds to INIAP. A preferred approach is a debt for equity exchange, to be financed from funds that would be provided by the government, World Bank, the International Monetary Fund (IMF) and other donors. These funds would be used to purchase Ecuadorian debt instruments as part of the proposal to reduce Ecuador's foreign debt that is currently under consideration. Part of the proceeds then could be dedicated to financing agricultural research. The latter approach may well be the best as it would assure long-term viability of INIAP. The general approach should be to develop an endowment for INIAP that could assure its long-term survival. An endowment of approximately US$175 million would be needed to produce an annual budget of US$17.5 million at current yields on dollar accounts. While this may seem very large, it is less than one-tenth of the amount that will be sunk into much less productive investments in multi-purpose irritation projects during 1988-1993.

It is urgent that the government act quickly to increase INIAP's funding and create conditions which permit it to employ and retain a critical mass of senior agricultural scientists. The gestation period for producing viable new technical knowledge is quite long--five to seven years at minimum. INIAP's research pipeline is nearly empty because reduced funding and loss of scientists. This suggests that no sustained flow of technical knowledge will be available before 1996-98 at the earliest. If none is available then, the consequences for degradation of natural resources will be staggering.

Careful attention must be given to modifying the mix of scientists in INIAP. The institute needs to broaden it focus from production agriculture to include transportation, marketing and processing. It also needs to expand its concern to farm families and consumers. There is an urgent need to incorporate more agricultural economists and livestock scientists. Also, INIAP needs to carefully consider its role in natural resources, especially forestry and coastal resources. The sciences that relate to management of natural resources are basically the same as those that support agriculture. Consequently, INIAP should probably play a much more important role in strengthening the science base for natural resources.

Consolidate Extension Services

Recommendation: Consolidate the extension services of the various sections of MAG and its adjunct agencies into a streamlined, focused agency with a clearly delineated philosophy.

Rationale: Improved diffusion of new technical knowledge, generated by INIAP, can greatly increase agricultural productivity and farm income. Extension efforts suffer from fragmented, duplicative, uncoordinated programs with different objectives and limited, tentative linkages to farmers and INIAP. Extension efforts also are constrained by the seriously deficient research capacity and most programs have little to offer farmers. A major reorganization of disparate, public extension programs into a unified, more compact agency with single objective and philosophy will result in important savings. A smaller, more focused extension service will be a much more efficient mechanism for interfacing with INIAP and transferring improved technologies to farmers. It also will link farmers much more closely to researchers and establish a two-way communication process between them. This, in turn, will allow research programs to focus much more tightly on the actual constraints facing production agriculture so that new technologies will have a much higher probability of being adopted.

Discussion: Deficiencies in the technology transfer system also constrain agricultural productivity and progress toward a science-based sector. While inadequate research is the major constraint, the large number of independent, uncoordinated, extension efforts also are an important restriction to higher yields. One major problem is the demands placed on INIAP to interface with a large number of extension entities. Closely related to this is the reality that several extension agents, perhaps from different entities, often serve one farmer, given their specialization in one product or problem area. Finally, there are practically no agricultural scientists serving as extension specialists who can work closely with researchers on a peer basis and link researchers with extension agents and vice-versa.

Consolidation of public and private extension programs into a single, unified entity should incorporate all public extension programs, including those of adjunct agencies. The regional and cantonal organizations of MAG provide the basis for structuring a streamlined extension service. All other extension-like programs in MAG, such as the Livestock Directorate, the Crops Directorate, Rural Development, Farmer Training, Animal Health and the five crop programs in the Costa should be incorporated into the extension service. Also, similar programs in adjunct agencies such as the Ecuadorian Institute of Water Resources (INERHI) and the Ecuadorian Institute of Agrarian Reform and Colonization (IERAC) should be transferred to the new consolidated extension service.

Private sector extension efforts should be required to be closely coordinated with the reorganized service in order to assure complete coverage and avoid duplication of effort. Consideration should be given to consolidating all those programs into the public system that are largely philanthropic in nature, sponsored by private voluntary organizations (PVOs) with a particular region or product focus. This would facilitate management and coordination and reduce demands on INIAP. Such consolidation might include grant funding by the PVOs to the consolidated extension service within the general objectives and scope of the extension program. Proliferation of efforts to serve very parochial interests should be avoided as they tend to divert management attention and personnel from main objectives and priorities. Other private extension programs sponsored by processing firms who make forward contracts for processing, e.g. barley, should

be encouraged to function independently, with only general coordination to eliminate duplication of effort.

The reorganization of extension programs should be closely coordinated with the establishment of INIAP as an independent entity. The new extension service also should be endowed with authority to pay competitive salaries and more efficiently manage technology transfer. This suggests that it may also need to be established as an independent entity, perhaps jointly with INIAP.

The role of PROTECA will need to be modified to support the revitalized INIAP and extension services. It should be redesigned consistent with the above recommendations and its budget reallocated. Perhaps part of the loan funds should be combined with those of other donors to purchase foreign debt for INIAP's endowment.

The role of FUNDAGRO needs to be more clearly defined vis-à-vis INIAP and the extension services especially if INIAP is granted autonomy. FUNDAGRO is serving as a fund-raising and financing mechanism for crop-specific research of special interest to international donors in close coordination with INIAP. It also is helping to link research, extension and education efforts; it has successfully done so for a few crops on a regional basis. Its Research-Extension Linkage Units (RELU's) which provide a cadre of extension specialists to link farmers and researchers are especially noteworthy. An optimal solution might be to ultimately join INIAP and FUNDAGRO into a single, autonomous research entity. This would address INIAP's need for administrative autonomy, competitive salaries and would provide a basis for improved funding. It would permit FUNDAGRO to extend its experience in fund-raising and in linking research, education and extension programs through its RELU's to the national level and in a much broader range of products than in its present limited program.

Consolidate and Strengthen Universities and Technical High Schools

Recommendations: (a) Consolidate the 39 faculties and resources of the 15 universities with professional agricultural programs into four or five key regional universities and greatly strengthen and improve their teaching and research programs and linkages between university research and INIAP; (b) Reduce the number of technical high school programs in agriculture from the 272 that existed in 1989 to about 20 and upgrade faculty and programs.

Rationale: Consolidation and concentration of resources of the agricultural universities and technical high schools will greatly improve efficiency and quality. The 39 professional degree programs in the 15 agricultural universities average about 13 graduates (*egresados*) per year, while the 272 agriculture high schools only graduate about 7 students each year. These programs have an extremely high cost per student and a relatively low quality of training, on average. Integrating resources into fewer university and high school faculties can result in substantial savings and a fund for upgrading the quality of the degrees and their usefulness to agriculture and economic development. Two important uses of funds freed up by consolidation will be to strengthen research at the universities and linkages to INIAP and to provide practical experience for both high school and university students.

Discussion: The human capital base for agriculture is seriously deficient. Less than 4 percent of university students and only about 3 percent of high school students study agriculture, a much smaller proportion than the importance of agriculture in the economy. The quality of training is relatively poor, with heavy

emphasis on theory and little field and laboratory experience. Faculties are highly inbred, most professors do not have graduate degrees and most are employed part-time. Salaries for new graduates are relatively low and career opportunities are limited. Society has depreciated training in agriculture and manual arts generally while exalting law, medicine and economics. The quality and quantity of human capital available for agriculture must be substantially improved and increased in order to shift to a science-based sector.

Ecuador has substantially overinvested in too many agricultural schools and poorly-trained professors. Consolidation of higher and high school education for agriculture can obviously free up substantial resources that are now wasted on inefficient, duplicative programs. Fewer, better quality schools and programs will simultaneously improve the quality of graduates and their value in the marketplace but will also help to trim public sector expenditures.

The diagnosis and prescription for improving human capital formation for agriculture are much easier to make than implementing the proposed changes. The political consensus necessary to close schools and programs in cities throughout Ecuador will be difficult to attain given provincial vested interests and the autonomy of the universities. This very real dilemma will pervade attempts to rationalize societal investments not only in education for agriculture but in all efforts to reduce government expenditures and waste.

An alternative but higher cost set of recommendations, is proffered as an intermediate step: select four or five universities and 20 technical high schools and provide greatly increased funding to upgrade faculties and equipment and field experience. The university programs should emphasize research and linkages to INIAP and the international science network. The high school programs should concentrate on practical field experience and vocational programs as well as basic concepts. Funding for other schools should be frozen or even reduced under this option in order to induce their closing.

Ecuador must eventually address the problems affecting its entire educational system. The university system has failed to contribute much to economic growth and development. It is too large and generally characterized by archaic regulations and structures that offer little to a modern society. Primary and secondary education hold little value for many people and especially for rural primary students as evidenced by extremely high drop out rates. In this regard, a much more careful evaluation and analysis of primary and secondary education needs to be done. While no formal recommendations are made here, it is highly likely that the curriculum for rural primary school children needs to be substantially modified. At the same time, greatly increased investments in research and a more efficient, streamlined extension service will make basic literacy and primary education more valuable to rural children.

No recommendations have been made regarding higher technical education, due to limited information. There are an estimated 21 technical programs in 9 universities and four other two-year technical institutes. These programs appear to suffer from the same problems as high school and university agricultural education. It is likely that they also should be consolidated with emphasis on building a few strong technical programs rather than attempt to maintain a much larger number of inefficient, low-quality programs.

Link Components of the Science Base

Recommendations: (a) Integrate research, extension and education programs into a cohesive, national system; (b) Enhance two-way communication between

farmers and the science base; and (c) Strengthen ties to the international science network.

Rationale: Research, extension and education programs must function as a systematic whole if the adoption of new agricultural technologies by farmers is to be optimized. Each element of the system carries out a unique role and generally is administratively independent in producing its particular social good. But the final products of the system--adoption of improved technical practices and higher agricultural productivity--depend on close coordination and clearly articulated linkages between the elements as well as the efficient functioning of each element. The final product of the system also depends on viable two-way communication between farmers, extension workers and researchers. Finally, it depends on the ability of the national system to access improved technologies in the international science network through continuing ties with sister institutions in other countries.

Discussion: Ecuador's research, education and extension institutions have tended to work in relative isolation from each other, the farmers they are supposed to serve and similar institutions outside Ecuador. It is extremely important that the three main elements of the science base work in much closer coordination with each other and with farmers. Researchers need to collaborate closely with extension specialists and selected farmers to identify and resolve the most serious problems limiting increased productivity. Farmers need to learn what promising new technologies are being tested and make inputs to research design so it takes into account their actual production constraints. They also need to participate in field trials and demonstrations of newly released varieties and recommended cultural practices. Universities need to be much more directly incorporated into the research system and work more closely and collaboratively with INIAP and extension specialists. The extension programs need to assure that they are effectively communicating new technologies from INIAP and universities to farmers and farmers' problems back to researchers.

One serious need is substantially more extension specialists. Such specialists who are highly-trained scientists link researchers with rank and file extension agents. They should participate in setting research priorities, designing research and interpreting technical problems at the farm level. In short, they are experienced scientists who tie research, extension and farmers together. Significantly more resources need to be devoted to establishing a cadre of extension specialists à la the RELU's of FUNDAGRO. This could be done by developing a special unit in INIAP to assure this linkage is established and maintained.

Another serious need is to work more closely with other institutions in the international arena, especially research organizations. There is substantial body of technical knowledge that Ecuador can import from the international network of agricultural science. This reality is reflected in the higher average yields already obtained in most neighboring countries. Accessing the knowledge base behind these higher yields will require a conscious strategy to do so and scientists who can collaborate with colleagues in other countries on a continuing basis. It is not economic for Ecuador to carry out basic or even much applied research in most of its principal agricultural products. Germplasm which incorporates improved genetic material and many new cultural practices are available in the international science network, usually as public goods. This new knowledge is not free, however. It can be obtained only by regular interchanges with the institutions and scientists that produced it. This requires financial resources and highly trained scientists who can work and communicate as peers with scientists in other countries. The ultimate utility of new technologies from the international science system also depends on

a strong research capability in Ecuador since most imported technologies will have to be adapted to local conditions. Agricultural technologies are highly location specific and it often requires three to five years of applied and adaptive research to attain the yields realized in the place of origin. The cost of accessing the new technologies and adapting them are generally much lower, however, than the costs of basic research that produced the new technology.

IV. A Market-Based, Private Agricultural Economy

The third set of recommendations focuses on the establishment of market pricing for agricultural products and a reduced and modified role for the state. These recommendations are complementary to those in Sections II and III. Market prices for all agricultural products and factors will induce public sector investments in the science base to be focused on highest priority needs of private producers and consumers. Prices that reflect actual supply and demand conditions will provide incentives to farmers to adopt new technologies that release the most serious constraints to growth and to produce the mix and level of products consistent with consumers' wants. An outward-oriented macroeconomic policy matrix will provide much greater incentives to invest in agriculture, directly complement market pricing and allocation of agricultural products and factors, and make public investments in the science base more profitable.

This section offers three recommendations for improving the market economy in agriculture: (a) divestiture of most public businesses and some agencies serving agriculture; (b) elimination of the few remaining price controls on agricultural products at the consumer level and elimination or modification of those at the producer level; and (c) increased government services in grades, standards and market information. These recommendations, if implemented, will allow the economy to function more efficiently and will assure the highest rates of return possible to public investments in improvements to the land and the science base. They also will result in reduced public expenditures and a modified role for government which will contribute to greater agricultural production and productivity.

Divest from Public Businesses and Agencies

Recommendation: (a) The government should divest itself of public businesses that compete with the private agricultural sector or substantially modify their role. The government should sell, liquidate or significantly reorganize: the National Company for Basic Products (ENPROVIT), the National Agricultural Storage and Marketing Company (ENAC), BNF, the National Finance Company (CFN); the National Semen Company (ENDES), the Ecuadorian Fertilizer Company (FERTISA), the National Program for Agricultural Mechanization (PRONAMEC) and the National Fertilizer Factory (FAB).

Rationale: The private sector can provide all the services that are currently being proffered by the above named agencies (except for ENAC) and can do so more efficiently. These public businesses and agencies compete directly with the private sector. They enjoy an unfair advantage as all have suffered losses in the last few years which have been covered by large, recurring government subsidies to keep them solvent and operating. Sale of these firms to the private sector or their reorganization or liquidation will reduce government expenditures and deficits and lessen inflationary pressure in the economy. Such changes also will eliminate subsidies which accrue to favored clients because of below-market prices with all

the attendant problems of non-market rationing.

Discussion: The public agricultural sector, along with the rest of the public sector, needs to eliminate wasteful programs in order to free up resources for higher priority activities that can only be carried out publicly. The private sector already is providing the same services as the entities recommended for sale, excepting for ENAC. Private firms can be expected to cover the demand previously serviced by them but more efficiently. ENAC, a public agency attempts to stabilize and maintain producer prices for three commodities through buying, storage and selling operations, also has sustained large losses and competes with the private sector in storage services. The storage services of ENAC could easily be sold and the agency left to help stabilize prices through the price support programs (see below).

The government should offer the recommended public businesses for sale, or otherwise transfer them to the private sector so they no longer require government funding and subsidies. If no acceptable offers are received or mechanisms devised for divestiture, the particular entity should be eliminated and its assets sold or reassigned to other high priority public sector programs.

Some public businesses such as EMSEMILLAS may carry out some functions which can only be done publicly, although they also are involved in some private sector activities. EMSEMILLAS should be reorganized to assure that it focuses solely on providing only public goods. Its main function is to sell certified seed produced by private growers based mainly on INIAP's foundation seed. If private investors are unwilling to compete in the same crop lines then that certified seed will have to be produced publicly. In public entities such as EMSEMILLAS, emphasis should be on increasing operating efficiency and privatizing components of the business when feasible.

Privatization of the BNF and CFN is easily justified in the context of market determined interest rates. Under such a policy the principal role of government would be to assure compliance with safe financial practices and the solvency of financial intermediaries. Fiat allocations of credit would disappear as would the allocations of credit to favored sectors and groups through non-market mechanisms. Internal savings would increase substantially at market interest rates.

ENPROVIT could possibly serve as a mechanism for distributing basic foods and related products to the poor as part of a targeted welfare program. Since such a program is needed to help the poor, careful consideration should be given to whether ENPROVIT could contribute to this. If so, it should be transferred to the Ministry of Social Welfare and divest of its supermarkets and stores that serve mainly middle income people. A welfare-oriented ENPROVIT would operate at a loss by the very nature of its function.

Liberate Prices for the Few Remaining Controlled Products

Recommendations: (a) The government should establish market prices at the consumer level for all agricultural products that still are subject to control; and (b) producer prices should be freed for all products, except rice, hard corn, the oilseeds and sugar which should be permitted to trade freely within a price band relative to world price trends.

Rationale: Removing consumer price ceilings on the few remaining products still subject to control would tend to encourage use of more modern technologies, improve product quality, increase production and eventually exercise downward pressure on prices. It also would eliminate subsidies to more influential consumers

who tend to capture most of the benefits of controlled prices through non-market allocations. Removing producer floor prices will eliminate subsidies and also encourage improvements in technology and production. Tying prices of the cereals, oilseeds and sugar to the world price, in a price band or a reference price, addresses problems of market failure in some commodities and the need for greater price stability in others. Most agricultural products are produced and traded in a free market setting and supply is regular with no evidence of secular price increases beyond the level of inflation, excepting in years of extreme weather. Criticism that prices are too high tends to focus on those products whose prices are controlled.

Discussion: Maintenance of controlled consumer prices usually results in excess demand since such prices are almost always set below market prices. The available supply is rationed to consumers through various non-market mechanisms. Those with the most influence are able to purchase at the official price where personal or political connections or bribes are the basis for allocation. Poorer consumers with little influence end up facing shortages or inferior quality at the official price, or are forced to purchase at higher market prices in the black markets, which are controlled and exploited by those with influence to buy at official prices. Thus, the benefits of the low, fixed prices are captured mainly by the more affluent and the poor benefit very little from policies that are intended to help them. Retail markets for food products are highly competitive with large numbers of buyers and sellers; consequently public-sector interventions are not only unnecessary but disruptive at the retail level.

Price support programs result in excess supply or demand at the producer level depending on where the price support is fixed in relation to the market price (border prices). The case of excess demand is the same as that described above with influential middlemen gaining access at the below-market price and with large clandestine exports by producers and processors to neighboring countries. When the floor price is set above the market price, large government expenditures are needed for ENAC to purchase the crop, which usually must be sold at a loss. Subsidies tend to be concentrated among the larger producers since they are able to influence ENAC to purchase their production at the official price. The official floor price is almost always set on the basis of the cost of production, plus a normal return on investments and is raised each year after successful lobbying by larger farmers. It has become a system for guaranteeing returns especially in rice, soybeans and corn and needs to be eliminated for most crops and modified for the cereals and oilseeds.

A price band set with reference to medium term world price trends is recommended for rice and hard corn to moderate seasonal and annual price fluctuations in these key commodities. The price-band approach allows market participants to freely buy and sell at whatever market clearing price results. However, "rules of the game" are set so that this equilibrium price will generally lie within the price band. Two mechanisms are available to achieve this result. Government purchases at the price floor (when market prices fall below it) and sales at the price ceiling (when market prices rise above it) will be necessary if the band is to be closely enforced. Nevertheless, cost and efficiency considerations of government buying and selling operations require that free market exports and imports in combination with variable levies be used at least as a complementary measure. Imports would be subsidized if the import price were above the ceiling price and taxed if the import price were below the ceiling. Likewise, exports would be subsidized if the world price were below the floor price and taxed if the world price were above the floor. Under this mechanism, importers would always pay the

ceiling price and exporters would always receive the floor price. It is important that the price band be fixed relative to the world price, so that over the medium to long run, net costs would be small. Even so, large government expenditures in certain years must be expected. As the import/export process becomes more efficient over time, greater and greater reliance could be placed on trade relative to government purchases and sales.

Significant market concentration at the processing level in the sugar and oilseed markets requires that these processors be exposed to world market competition. All quantitative restrictions on foreign trade should be eliminated for raw products (sugarcane and soybeans), intermediate products (unrefined sugar, unrefined oil and soybean meal) and final products (refined sugar and oil). Over time, the access to alternative markets that this policy gives to retailers and farmers would negate the market power that processors currently enjoy.

If the government desires to stabilize the prices of soybeans and soybean by-products, then reference prices tied to medium term, world market price trends must be set at the factory door for both raw and final products. The system would closely resemble that described for rice and hard corn, with the exception that the reference price for the final processed oil products should be enforced solely through a free-trade, variable-levy system. Any reference price for soybeans would have to be supported government price support program via purchases and sales.

Improve Government Market Services

Recommendations: (a) Update and improve, in consultation with wholesalers and retailers, the regulations concerning quality standards, grades, weights and measures; (b) Increase funding support for and improve the policing of market regulations; and (c) strengthen and expand provision of market information including market news service for prices, outlook and situation reports for crops and livestock, and agroclimatic data.

Rationale: The government has an extremely important role in assuring that producers and consumers have sufficient information in order for markets to function efficiently. The government also must establish and enforce regulations to assure that quality products and of full measures or weights, are available at each level in the marketing system. Inadequate information about market conditions can and does lead to market failure. Limited distribution of information about supply and demand conditions permits those with access to the information to exploit other producers and consumers to their advantage. Failure to establish and enforce grades and standards leads to short weights, poor quality, adulteration, contamination and mixing of grades. The government can assure that markets function efficiently by distributing market information widely and by establishing and policing grades and standards. The emphasis should be on improving the efficiency of markets and assuring delivery of wholesome products at full measure and weight.

Discussion: The government in Ecuador has attempted to control rather than regulate the activities of private traders in the agricultural economy. This has derived mainly from political pressure from urban areas to maintain low food prices and the general stigma that is associated with the socially denigrated middleman. Government control of markets has resulted in increased risks and costs to the private sector and has slowed agricultural growth and development.

There has been substantial progress in establishing standard weights and measures. Also descriptive criteria for quality standards are beginning to emerge,

although grading and pricing by quality is not very widespread. However, compliance with existing regulations is sporadic and limited. There are several areas of major concern, including lack of sanitation in food processing, fraudulent labeling, short weights and measures, pesticide and other carcinogenic contamination and product adulteration. Principal problems are lack of funds to adequately police the regulations, more rigorous policing of price laws which reinforces fears of private traders about the role of government, and the possibility that the set of market regulations is out-of-date or overly ambitious.

The poor quality of statistics about production agriculture is well known. Several different agencies each collect data which are incomplete and often inconsistent. The result is insufficient data and information for sound policy-making by the government or informed production and marketing decisions in the private sector. The absence of widespread information on expected supply and demand conditions and prices has permitted those with access to such data to corner and distort markets and make abnormally large profits. It is critical that the government improve the collection, analysis and diffusion of market-related data. Major emphasis should be given to a market news service with regular publication and diffusion of price information, situation and outlook reports and agroclimatic data. Such efforts have been initiated in MAG with support from the U.S. Agency for International Development (USAID) under its Agricultural Sector Reorientation Project but need to be expanded and improved.

V. Better Management and Conservation of Natural Resources

The two most important recommendations for conserving natural resources already have been made. The establishment and strengthening of a science base for agriculture and shifting to an outward-oriented macroeconomic policy matrix together will permit modern, industrial inputs to be substituted directly for limited land and scarce natural resources and reduce pressure on them. These two recommendations mitigate increased demand (from growing population and higher incomes) for using natural resources in agricultural production by providing a substitute set of more productive inputs. Ergo, the recommendations to: (a) shift to an outward-oriented macroeconomic policy set, and (b) concomitantly greatly increase investments in the science base for agriculture, also are the two main elements of a broader policy set to help conserve natural resources.

The recommendations made in this Section directly complement these two key recommendations. The complementary recommendations focus on creating and improving incentives for private resource conservation. Three recommendations are made: (a) modification of tenurial arrangements with incentives for private conservation of natural resources; (b) improvement in the science base for natural resources as a way to increase productivity and better management; and (c) and consolidation and strengthening of management of natural resources. Natural resource conservation, especially of tropical forests, is a topic of global interest in 1990. Ecuador, because of its extensive tropical forests with their unique areas of biological diversity is at the center of international concern about deforestation. The policy prescriptions that are usually proffered in Ecuador focus on improved management through the establishment of reserves, buffer zones and better policing as the basis for protecting and conserving renewable natural resources and enforcing public property rights. Improved management, by itself, will fail since it does not address the principal causes of resource degradation--increased demand for natural resources as inputs for agricultural production. It clearly is,

however, a necessary complement to the other key elements of a policy set to conserve natural resources.

Rationalize Property Rights

Recommendations: (a) Modify private tenurial arrangements for exploiting publicly-owned natural resources so that conservation is encouraged, e.g. by not requiring clearing of tropical forests as a basis for obtaining a title; and (b) Establish private property rights to public resources that are being exploited in common in order to encourage conservation.

Rationale: Private tenure rights to public resources can be designed so that private exploitation of natural resources coincides with public interests. The government is unable to enforce the public property rights which it holds in much of Ecuador's natural resources; indeed the economic, social and political costs of such an effort are prohibitive. This is evidenced by the fact that it has given some restricted property rights to private users of these public resources and that other important resources are widely and generally exploited in common. Unfortunately, private property rights in publicly-owned natural resources are usually structured so as to encourage resource degradation rather than conservation. Requirements to clear half of a parcel of forest land or to construct shrimp ponds in a mangrove swamp as a basis for obtaining legal title are cases in point. Modifying these requirements could induce management of private parcels of forest land and mangroves for their natural products. Granting property rights under similar conditions for use of public resources that are being exploited in common also can result in improved conservation.

Discussion: There are several examples of private property rights being granted to publicly-owned natural resources. The National Institute of Colonization (IERAC) grants title to colonists of new land, only if they clear the timber from half the land and plant crops or pasture. Ecuadorian law requires the destruction of Mangrove swamps in order to issue a use permit for shrimp farming. Once a permit is issued, shrimp ponds must be constructed in order to obtain title; as a result an estimated one-fourth of Ecuador's mangroves have been destroyed which has reduced the wild shrimp population.

Forest resources and mangrove swamps also tend to be exploited in common, with rapid degradation of the resources as each private user attempts to claim a maximum share of the "free" products obtainable from the resources. This behavior has resulted in increasing destruction of tropical forests with high-grading of the most valuable species. It also has damaged the ecosystems of the remaining mangrove swamps.

A ban on timber concessions, intended to conserve forests, has led to greater rates of settlement and logging by colonists. An export prohibition on logs, intended to enhance domestic wood production, has caused low prices through oligopsony purchasing by a few dominant firms, which reduces incentives for private agro-forestry and resource conservation.

Modification of private property rights is recommended as a partial basis for improving natural resource conservation and management. The case for forest lands is clear. Requirements for clearing the land as a basis for obtaining a title should be eliminated and incentives provided to operate the parcel in forestry production or natural forest products rather than in agriculture. The size of the parcel may also need to be increased. Settlement of the Oriente and the Northwest is going to proceed rapidly throughout the 1990s; modifying private tenure arrangements in areas where colonization is now allowed can lead to conservation

of natural resources.

Granting private or community-level tenure rights to natural resources that are under heavy common property use should be carefully considered as a basis for enhancing resource conservation. The government should consider extending the colonization zones more broadly but shift emphasis to agro-forestry and harvest of natural forest products. Leasing exploitation rights via auctions to private firms for logging and other purposes is another recommended mechanism. All of these approaches would eliminate destructive, common use of the resource, since holders of private rights would tend to protect and enforce them against intruders.

Changes in macroeconomic and pricing policies suggested above will be necessary along with improved tenure arrangements in order to assure profitability of forestry production. Trade policies that limit prices of natural resources such as the log export ban should be eliminated. Higher prices in export markets will provide incentives and income for conserving the resource base if there are appropriate tenurial arrangements.

Recommending increased private property rights is not a call for a laissez-faire assault on Ecuador's natural resources. There will clearly need to be public constraints and limits on the nature of private property rights. The design of optimal policies will require a careful weighing of the cost and benefits vis-à-vis the existing situation. The government, however, should begin to explore how private interests can be harnessed to contribute to conservation of natural resources and should endow individuals and firms with such rights when it is in the public interest. This will require a change of mentality from the perspective that natural resources belong to the state and that private exploitation should be limited. As noted above Ecuador can not afford the costs of enforcing its public property rights; an alternative strategy is urgently needed.

Strengthen the Science Base for Natural Resources

Recommendation: Increase investments in science capacity to undergird improved management of Ecuador's renewable natural resources, with special emphasis on tropical forests and coastal resources, in close coordination with selected universities, foreign research agencies, the National Forestry Directorate (DINAF) and INIAP.

Rationale: Just as in agriculture, natural resources suffer from a grossly inadequate science base. Knowledge and understanding about natural resources from the physical, biological and social sciences is extremely limited. The limited knowledge base constrains more efficient management and use of natural resources. For example, very little is known about the potential uses of a large number of species which are unique to Ecuador and in danger of extinction. A careful, sustained program of research on native species might well identify a superstar that could easily replace petroleum in economic importance. Unfortunately, many species have already become extinct and more will follow even if optimal policies and programs were immediately implemented. Research also is needed to understand how tropical forests and coastal resources can be managed for multiple purposes including tourism, agro-forestry, mariculture and harvesting of native species. The potential returns to social investments in such research are large and highly complementary to agricultural research.

Discussion: There are only limited and sporadic efforts to research the constraints to improved management and utilization of natural resources. Research efforts in forestry are quite limited being carried out by DINAF in collaboration

with several national institutions and international research agencies. A limited research program also is being carried out on coastal resources under auspices of the Polytechnic University of the Coast (ESPOL) with foreign assistance. While the status of the science base for natural resources has not been analyzed in detail as part of this study it appears to suffer from many of the same deficiencies as does the agricultural science base. The most serious constraints appear to be limited human capital; ineffective, uncoordinated institutions and programs; inadequate salaries; and insufficient funding.

The sciences supporting natural resources and agriculture are basically the same which suggests that a strengthened agricultural science base could address most natural resource issues. It is recommended that INIAP's mandate be broadened to include forestry research with special emphasis on management and conservation of Ecuador's tropical forests. The DINAF-led program of forestry research could be incorporated as a separate division into the autonomous INIAP recommended above. It is also recommended that research on coastal resources be greatly expanded and include domestic production of aquatic species. A university, such as ESPOL, should be selected to lead research on coastal resources with increased public funding and reforms along the lines suggested for INIAP. Finally, a special research program on native species and their niche in fragile ecologies and ecosystems of the tropical forests should be mounted, perhaps in a well-known faculty of biology at a key university, such the Catholic University at Quito. Such research also would need increased funding and institutional reforms to assure a minimum critical mass of scientists and technicians.

Improve Management Systems

Recommendation: Consolidate and improve the management of natural resources, with a more coordinated, integrated program, consistent with the recommendations made above.

Rationale: Ecuador needs to sharply focus and improve its efforts to manage its environment and natural resources, since there is a tendency to disparate, sporadic efforts. The philosophy of natural resource management needs to be expanded beyond establishment of reserves and policing of public property rights to incorporate private property rights as a mechanism for resource management and conservation. It also needs to incorporate a science base and flows of improved knowledge for natural resources. The tendency to expand public sector agencies with overlapping jurisdictions should be avoided. Such duplication of effort contributes to deficits and inflation and results in largely ineffective and often contradictory programs.

Discussion: The MAG and the Ministry of Energy and Mines (MEM) both announced the creation of natural resource divisions in early 1990. There are a variety of other public and private agencies and foundations that are concerned with or involved in the management of natural resources. While this study has not examined the institutional structure for natural resource management in detail, there are a number of involved entities with little coordination, no clear mandate or philosophy and overlapping jurisdictions.

The natural resources sector clearly is suffering from lack of focused leadership, weak institutions and inappropriate policies. It appears to be concerned primarily with ineffective reforestation programs, enforcement of public property rights and management issues. It would be a grave mistake for Ecuador and the donor community to emphasize such a myopic focus, while the science base for agriculture continues its precipitate decline and while the macroeconomic policy

matrix is focused on internal growth and subsidy of industry and urban people. Improved management of natural resources is a necessary but not a sufficient condition for assuring resource conservation. Even a broader definition of resource management to include private property rights and an integrated science base for natural resources is not enough. The causes of pressure on natural resources from agriculture--a seriously deficient science base and discriminatory macroeconomic policies--are the principal problems to be addressed if destruction of tropical forests and coastal resources is to be avoided.

VI. Reliable Agricultural Data and Analytical Capacity

The data base serving agriculture must be substantially improved and updated and analytical capacity enhanced as another fundamental basis for more rapid agricultural development. Government policies and programs will be no better than the data and analyses which undergird them. Private decisions based on erroneous conceptions will tend to reduce production, productivity and profitability relative to those made with more accurate information. Three principal recommendations are suggested: (a) carry out an agricultural census as quickly as feasible; (b) improve data collection and management; and (c) continue to enhance analytical capacity for policy analyses and data development and management.

Take An Agricultural Census

Recommendation: Ecuador should take an agricultural census as soon as possible.

Rationale: The set of global data about agriculture and rural people is completely out of date. The last agricultural census was done in 1974 and the last rural household surveys in the late 1970s. Almost nothing can be inferred from current data about rural poverty, land tenure, private irrigation, factor use, employment and a continuing long list of various social and economic characteristics of agriculture and rural people. Most policy prescriptions have had to rely on small samples, with their well-known statistical dangers, or on data 16 years old. A comprehensive, well designed agricultural census is an indispensable part of the foundation for more rapid agricultural growth during the 1990s. Ideally, it needs to be available for public distribution by the change of government in 1992 although none is now planned.

Discussion: Careful and immediate attention should be given to planning an agricultural census. The MAG and the National Institute of Statistics and Census (INEC) should form a task force to design the basic parameters of the proposed census including its scope and budget. While there is some urgency to making the census, sufficient time and effort should be devoted to planning to assure the quality of the project. Technical assistance may be needed, especially during the planning and design stage, and external financial support for taking the census and publishing it.

Improve Data Collection and Management

Recommendation: Continue and expand efforts to rationalize the collection and publication of data on area, yields, production and market prices and sales.

Rationale: Reliable, accurate data on production agriculture are the principal bases for situation and outlook and market news reports. These reports and the

underlying data, produced publicly, are of critical importance for private sector decision-makers. There are several sources which report data on global agricultural production which are inconsistent and contradictory. Crop and livestock production statistics after 1986 are based on area sample frames and are not strictly comparable to 1985 and earlier data. Preliminary estimates of production made by MAG usually vary substantially from those reported later by the National System of Agricultural Statistics (SEAN). Data traditionally were recorded, analyzed and reported in a system that utilized clerks and hand calculators. A modern data system based on computers still is being implemented in 1990, with significant components still not in place. Continued and increased efforts are needed to make the transition to a computer-based storage and retrieval system founded on reliable statistical samples. The entire historical data series also needs to be rationalized so it is internally consistent.

Discussion: A modern computer center has been installed in the MAG for supporting collection, analysis and dissemination of data on agricultural production and marketing, with support from USAID. While the center is largely in place and functioning most of the data systems still are being developed. The task is relatively complex and involves a number of inter-institutional arrangements especially between SEAN and MAG.

The improved data system has begun to produce regular market news reports, which are almost exclusively constituted of price, sales and meteorological data. It also is producing some production data but is far from being functional. Operational problems and continually changing leadership threaten the continuation of market news reports, which were suspended in January 1990. Also, technical assistance for data development has not been available since May 1989.

Continued development of the capacity to collect, store, retrieve and publish data on agricultural production and marketing are of highest priority. Also, capacity to analyze the data must be improved as recommended below. The government needs to give high priority to these endeavors.

Develop Analytical Capacity

Recommendations: (a) Enhance and develop the capacity of the Agricultural Policy Institute (IDEA) to do macroeconomic policy analyses and link the public and private sectors in policy dialogue. and (b) Continue to strengthen and institutionalize the capacity of MAG's Policy Analysis Unit (PAU) with emphasis on situation and outlook reports and microeconomic policy studies.

Rationale: Careful policy analyses, based on reliable data, which clearly set forth the costs and benefits of alternative policies and programs, are of vital importance for optimal public and private decisions and agricultural growth. The capacity for agricultural policy analysis in Ecuador is very limited. There are only a few agricultural economists in the country, with no critical mass in any institution. The limited capacity in the PAU and IDEA, developed with financial and technical assistance from USAID, needs to be nurtured and strengthened. These entities both are contributing to policy analysis and formulation but still are in very formative stages. More resources should be devoted to improving these each of these agencies with several senior agricultural economists and sustained funding for operations being the critical constraints.

Discussion: The PAU and IDEA should work in close collaboration but with a clear division of labor between them. The PAU should provide the bulk of policy analysis for the formulation of sectoral policies. IDEA should concentrate on the role of agriculture and natural resources in economic development and help analyze

and formulate macroeconomic policies vis-à-vis agriculture. IDEA should develop a critical mass of senior agricultural economists who would constitute the first such disciplinary group in the country. The PAU will need more limited agricultural economics capacity at the senior level but the two groups should work closely to establish a common professional relationship.

The government should support the development and strengthening of both the PAU and IDEA. The PAU has already proven its utility to MAG through a series of excellent policy studies which have helped to guide policy formulation. IDEA has also sponsored a series of policy studies and public seminars on a variety of topics ranging from the environment to price policy to the role of agriculture in Ecuador's economic growth. It also has worked very closely with the PAU and other parts of MAG on the development of policy recommendations for consideration by the Economic Front (*Frente Económico*). This proven track record suggests that enhanced capacity in these two agencies can contribute substantially to more rapid, sustained agricultural growth.

VII. Slower Population Growth

Ecuador's population is projected to grow rapidly during the 1990s with a burgeoning labor force and increasing pressure on natural resources and social services. Reducing the rate of population growth will amplify the effects of more rapid economic growth, reduce ecologic stress and lead to greater improvements, on average, in individual well-being. Thus, the general recommendation made in this section is interrelated with and directly complements those made above for fomenting agricultural growth and overall economic development. Reducing the rate of population growth is an important objective of the set of policies needed for more rapid and equitable economic development.

Recommendations: (a) Develop a more specific government policy for reducing the rate of population growth; and (b) Provide more focused instrumentation of the policy with greater public financial support for private entities engaged in educational programs and family planning services.

Rationale: Rapid growth of the population during the next decade will erode the results of faster economic growth from implementing the set of recommendations made above. The effects of a rapidly growing population are illustrated by the experience of the 1980s. Per capita GDP fell because of relatively low rates of growth in economic activity, along with relatively high rates of population growth. The economy grew at 2.0 percent between 1980-1988 while population grew at 2.9 percent, for an average decrease in per capita GDP of .9 percent. If population had grown at less than 2.0 percent, there would have been a modest increase in per capita GDP, notwithstanding the relatively low rate of economic growth. This simple comparison shows how a burgeoning population stresses the economy and dilutes economic growth. It also suggests the need for a more focused and explicit public policy and program for limiting population growth.

Discussion: The effects of a rapidly growing population are apparent in almost every aspect of Ecuadorian life. Urban centers are increasingly unable to meet the demands for potable water, electricity, fuel, roads, health care and schools. Housing is poor and supply will not catch up with demand for decades. The poverty index is relatively high with an estimated 20 percent of the population unable to afford a minimum diet, let alone other basic necessities. There is a serious nutrition problem, especially among poor children and their mothers, in part due to health care and feeding practices. Degradation of tropical forests and coastal resources is proceeding apace, especially in the Oriente which has the

highest population growth rates in the country from colonization of virgin lands. The labor force is increasing by 118,000 per year in 1990 compared to only 83,000 in 1982 and will explode to 153,000 by the year 2000. Most new entrants in 1990 are forced into self-employment in the low-skill services sector as few new jobs are being created in the near-stagnant economy.

Ecuador had no formal population policy until late 1987. The policy was developed under the leadership of the National Development Council (CONADE) and was focused broadly to include such concerns as family planning, mortality and health care, protection of the family, incorporation of women into the economy, nutrition and employment. CONADE subsequently developed a national population plan in 1988 which included a specific focus on family planning. The National Development Plan for 1989-1992 weakened the family planning and birth control objectives of the population plan (and the previous development plan) by making them more nebulous and general.

There are several family planning programs in Ecuador with most being supported by private agencies, one by the Ministry of Public Health (MSP) and a second, much smaller program, by the Ecuadorian Social Security Institute (IESS). Various donors have provided technical and financial assistance in this area with the USAID being the principal foreign donor. These programs have been relatively successful, with a significant increase in the rate of contraceptive use. An internal USAID projection indicates that if use of contraceptives increases at the same rate during this decade as during the 1980s, the population growth rate could fall to near 2.0 percent by the year 2000, instead of being at the official projections of 2.5 percent.

A reduction of the population growth rate from 2.5 to 2.0 percent would substantially increase per capita GDP and reduce pressure on natural resources and the economy, ceteris paribus. It is important that the government provide greater leadership and resources for addressing the problem of too-high population growth rates. The thoughtful population policy and plan developed during 1987-1988 are valuable bases for structuring an action program. Failure to act expeditiously in this area can undo much of the progress realized from the other important policy and program changes already in place or that can be expected from implementing the recommendations made above. The positive experiences of the 1980s and the population control programs currently in place suggest that a low-key but concerted government effort could result in a substantial reduction in population growth.

VIII. Policy Changes and Poverty

One major, often-expressed political concern about implementing the changes in macroeconomic and sectoral policies recommended in this chapter is their potential impact on the poor, comprising mainly small farmers and those in the urban informal sector. It is argued that the poor will immediately bear the brunt of the proposed policy changes in the form of higher prices and unemployment. Thus, such policy changes are deemed to be politically not viable. The rationale for this commonly held viewpoint is subject to question.

The Timing and Incidence of Adjustment Costs

Much of the costs of adjustment and subsidies have already been paid by the poor. They have suffered since 1981 from inflation and rising prices; reduced incomes and purchasing power; low growth; unproductive, low-paying employment;

and few new jobs. As a result of structural adjustments implemented by the Borja administration the exchange rate has been substantially devalued and is maintained near the market rate; most food and other prices are free with only a few products still subject to control and their prices have been increased regularly; interest rates have been increased to near market levels although the real rate still is negative; and prices of fossil fuels, electricity and water have been increased substantially. Most of the effects of these important structural adjustments have already impacted on the poor.

Little has been done during the 1980s to improve economic performance or reduce government expenditures and fiscal deficits. Consequently inflation has characterized the economy during most of the decade, with especially high rates since 1988. Subsidies that began in the era of the petroleum boom still are largely intact and the inflation tax, which falls disproportionately on the poor, is used to finance them. Thus, the poor have borne an especially onerous burden from subsidies, fiscal deficits and inflation since 1980 and especially since 1988.

The marginal impact of additional structural reforms on the poor is likely to be relatively small. The most important remaining adjustments include trade and fiscal reform, reduction and elimination of subsidies and further adjustments in energy prices. While these policy changes will affect the poor they will impact most heavily on the more favored economic classes.

Moreover, eliminating subsidies and ensuing fiscal deficits should improve the lot of the poor by reducing the size of the inflation tax. The poor also will benefit generally from expanded, more productive employment as the economy grows in response to new economic opportunities engendered by reform in trade policy and an improved science base for agriculture.

Thus, the political concern about exacerbating the plight of the poor from shifting to an outward-oriented policy matrix, while undoubtedly genuine, also appears to reflect more fundamental, underlying forces. Opposition to the proposed policy changes more likely is based mainly on the concern of special interest groups about reduction or removal of their privileges and subsidies inherent in the existing policy regime. The largest share of the short-run adjustment costs from implementing recommendations made in this assessment will fall on the affluent (non-poor) classes who benefit relatively more than the poor from public subsidies. Some in the lower-income strata of these privileged groups could well experience enough loss of real income to become part of the poor class.

Helping the Poor Adjust

The above argument does not suggest that there are not serious poverty problems in Ecuador or that poor people will not suffer in the short run from policy changes. Any successful economic development model must confront this reality and help address fundamental causes of poverty and cushion people from temporary losses of income associated with the transition to new economic opportunities.

Attempts to eradicate poverty and improve the distribution of income while the economy is stagnant or growing very slowly are likely to be unsuccessful. It will be very difficult to pay the so-called social debt without a substantial expansion of economic activity and employment. In short, Ecuador has to increase the size of its economy as quickly and as greatly as possible in order to create the wealth and political support needed to simultaneously improve the welfare of its poor. The recommendations made in this chapter provide the basis for more rapid growth and development and for expanded employment opportunities, especially

among the poor. Thus, economic growth, itself, will help lift some out of poverty by increasing productivity and employment. In turn, a healthy, vigorous economy is the basis for taxation and provision of social and welfare services to assist those who do not benefit immediately and directly from economic growth.

A welfare program to provide minimum food and other basic necessities will be necessary to protect people from the short-run effects of implementing the outward-oriented policies recommended herein. The welfare program should focus on shielding poor people from increasing prices, inflation and unemployment during the period of transition to a higher growth path and expanded employment opportunities. This program could be based on public employment, transfer payments (a negative income tax), or targeted subsidies. It should provide a safety net for the poor to assure political stability as the economy is restructured.

Welfare Versus Efficiency

There is a need to clearly distinguish between welfare and efficiency instruments as policies and programs for economic growth and to help the poor are designed and implemented. If efficiency instruments are utilized to improve welfare the result will likely be reductions in production and efficiency and, ultimately, in the welfare of those that were to be helped. Ecuador's policy regimen has used efficiency instruments to attempt to achieve improvements in welfare. The result has been reduced economic growth, misplaced subsidies which benefit mainly the well-to-do, fiscal deficits and inflation. Much better results would have been obtained if efficiency instruments were used to enhance economic growth, while welfare instruments had been used to address poverty problems.

Price policy illustrates this point. Price controls have been used to attempt to help the poor by holding down food costs. The use of price controls to effect improvements in welfare has two major flaws. First, it confers subsidies on more influential and affluent consumers who benefit directly either from low, fixed prices or through illegal sales but do not need subsidies. Second, fixed consumer prices reduce incentives to producers, which is reflected in low productivity, reduced production, decapitalization of the agricultural sector and ultimately higher prices. They also result in food shortages and low quality at the official price, black market operations including clandestine exports, non-market allocations and influence peddling. Low official prices are of little use if no food is available at that price.

A more useful approach is to directly subsidize the poor through a targeted welfare program using food stamps, food for work or some similar mechanism and allow market prices to prevail for other consumers and producers. Producers would have greater incentives to produce, thus eventually lowering prices through increased supplies. A similar approach should be used to deal with the problem of pricing gasoline and other petroleum derivatives, medicines, or any other commodity which has low, fixed price as a basis for attempting to help the poor.

IX. A Caveat about High-Input Agriculture

One caveat needs to be raised about whether a science-based, high-input agriculture can be sustained. The principal recommendations of this study have focused on the need to shift from a traditional, natural resource-based to a modern, science-based agriculture as the principal foundation for more rapid economic growth and conservation of natural resources. The degree to which a high-input

agriculture is sustainable needs to be carefully considered in developing and disseminating improved technologies. While a science-based agriculture can reduce pressure on natural resources and increase economic growth, important hidden costs emerge in the form of externalities associated with the use of modern, industrial inputs, which must be taken into account socially. The high social costs resulting from intensive use of chemicals, fertilizers and irrigation are cases in point. These hidden costs of high-technology agriculture take the form of pollution and environmental degradation so that the net improvement in natural resource conservation from shifting to a science-based agriculture may be less than expected.

The principal question concerns the economic and environmental sustainability of high-input systems relative to the gamut of less-intensive systems which are less productive but might be more socially and even privately profitable and sustainable because of lower costs. For the immediate future in Ecuador, it appears that a substantial increase in the use of new technical knowledge and modern, industrial inputs will result in higher social returns than more extensive systems given the relatively low levels of agricultural productivity. Moreover, it will generate substantially higher growth rates necessary to fuel more rapid economic development consistent with Ecuador's high rate of population growth. Research programs, however, should be carefully designed to address the question of sustainable agriculture. Public and private entities should clearly consider the range of technological alternatives and the negative externalities associated with modern, high-input agriculture, as they formulate investment plans and public policies for the transition to a science-based agriculture.

X. Act Expeditiously

The time for Ecuador to act is now, before a depressed economy and exogenous events force the country to impose the recommendations suggested above in the midst of economic and political crisis. All these recommendations--strengthening the science base for agriculture, establishing outward-oriented macroeconomic policies, moderating population growth, eliminating price controls and government interventions in agricultural markets, improving management of natural resources and upgrading agricultural data and analytical capacity--can be strongly justified as part of the government's evolving program to stimulate economic growth, which is the single most important challenge facing Ecuador in 1990.

Several Latin American countries have adopted such policies, some with more foresight and planning and, consequently, less disruption than others. It is instructive to compare the convulsive reactions to such changes in Argentina, Bolivia, Brazil and Venezuela with those in Chile and Costa Rica. The former countries waited until crisis situations made the establishment of outward-oriented macroeconomic and related policy changes inevitable and then paid a high social and political price in terms of major adjustments and shocks to their economies. Chile and Costa Rica acted with more foresight and experienced much less difficulty in the shift; they now have among the highest growth rates and lowest inflation rates in Latin America (Chile's economy grew at 10 percent in 1989 with a 21 percent inflation rate; Costa Rica grew at 2.3 percent with 10 percent inflation)(El Comercio).

Ecuador is not yet in a crisis situation and should carefully consider the sad lessons of it neighbors in waiting too long to make urgently needed macroeconomic adjustments, improve their science base and implement other needed reforms. The

stagnant economy, inflation still near 50 percent, increasing degradation of natural resources and the tendency to expansionary fiscal policy are not bases for complacency.

XI. Ecuador Without Petroleum

The Ecuadorian economy is at a major crossroads with very little time to decide which way to turn.

It will become a net petroleum importer in about 13 years unless significant new reserves are found. Recent exploration has not yielded any major new discoveries and prospects are poor doing so in the future. Almost 80 percent of current production is already from secondary recovery, at increasingly higher costs and the profitability of tertiary recovery is being actively analyzed. Internal demand and clandestine exports are burgeoning at the highly subsidized prices, which could shorten the life of reserves by two or three years. Thus, Ecuador will very likely have to make the transition to an economy without petroleum exports around the year 2000.

Agriculture will play an increasingly important, pivotal role in the economy as petroleum reserves are depleted. Primary agricultural production and processing will constitute about one-third of the post-2000 economy. Agriculturally-related activities will permeate the rest of the economy and account for much of the production of the other economic sectors. As much as 50-60 percent of the country's GDP will be derived directly or indirectly from agriculture.

Agriculture today is based largely on exploitation of natural resources and internal capital accumulations. All good and marginal agricultural land is in production, yet demand for food and fiber is increasing rapidly, mainly from relatively high rates of population growth. Soil erosion is rampant and degradation of other natural resources is accelerating to alarming rates, especially tropical forests and coastal resources. Crop and livestock yields are among the lowest in South America. The pressure on natural resources from agriculture will grow more intense as petroleum is used up. Agricultural and economic development based on exploitation of natural resources will result in modest growth until natural resources are degraded and destroyed, followed by economic stagnation.

Three principal problems are forcing Ecuador onto this dead-end road to economic stagnation and environmental crisis. First, the science base for agriculture is nearly extinct with only extremely limited capacity to generate improved technical knowledge. Second, the macroeconomic policy matrix continues to artificially depress the prices of agricultural products and tradeables relative to industrial and other home goods. Third, rapid population growth erodes the benefits of the modest economic growth that is realized.

The combined result of the first two constraints is the absence of new technologies for agriculture or of complementary, modern, industrial inputs which incorporate the improved technologies. These two sets of inputs--new technical knowledge and modern, industrial inputs--are absolutely critical for more rapid, sustained agricultural and economic development. They are the direct substitutes for limited land and other natural resources which can save these increasingly scarce and irreplaceable natural endowments. They also are the basis for raising the productivity of land and allowing abundant labor to be more productively employed. Thus, they also permit plentiful labor to be substituted for scarce natural resources.

Time is of the essence. Prompt, courageous actions must be taken now if Ecuador is to get onto the high road and make the transition from a natural

resource-based to a science-based agriculture and to slower population growth before petroleum reserves are depleted.

Funding levels for research must be increased nearly nine-fold and a critical mass of senior scientists mobilized as quickly as possible if ecologic and economic disaster are to be avoided. This strong conclusion rests on the three realities: (a) the research pipeline is nearly empty after continual funding cuts and loss of most of Ecuador's senior agricultural scientists; (b) it will take at least 2-3 years at a minimum to start up the research process again after the decision to do so; and (c) the long gestation period associated with agricultural research will require another 6-8 years for a meaningful, sustained flow of improved technologies to be produced.

Improved incentives also are vital to the transition to a modern, science-based agriculture. An outward-oriented, sector-neutral set of macroeconomic policies must be implemented in order to increase investments in agriculture generally and for production and importation of modern industrial inputs specifically. An improved macroeconomic policy matrix will thus contribute to higher rates of sustained economic growth.

Finally, reduced rates of population growth will assure greater improvements in individual welfare, on average and reduce pressure on natural resources and the economy generally. It is important for the government to dedicate more resources and quiet leadership to reducing population growth.

If petroleum reserves are depleted before the transition to a science-based agriculture and reduced population growth are achieved, Ecuador's natural resources will quickly become more intensively exploited for agricultural production. Agricultural growth will be constrained to relatively low rates for a time by the inelastic supplies of natural resources and will eventually stagnate as natural resources are exhausted. The end result of failing to invest in the science base, improved macroeconomic policies and slower population growth will be economic stagnation and environmental crisis.

Implementing the recommendations presented in this chapter will require strong leadership, a clear vision of the future and political acumen. Achievement of more rapid, equitable economic growth can only be realized through statesmanlike actions which subjugate short-term, self-serving political agendas to the more fundamental, longer-term needs of the people of Ecuador. Fortunately, a viable democratic system and enlightened government leadership have already moved the economy in the direction of the recommended changes, albeit slowly.

Three principles are suggested to guide the process of implementing the recommendations. First, the needed reforms should be implemented as a set in a single major initiative. Attempting to reform the economy one step at a time gives special interest groups time to mount counteroffensives to block the loss of their subsidies. A big package of reforms will help assure that losses to any particular group are offset by gains, while a piecemeal approach will result in losses without gains. Second, the reforms should be implemented quickly and carried out at full speed. The recommendations will take several years to implement and the benefits will lag behind the costs which will endanger the viability of the reforms. Third and finally, the reforms should all be focused on giving economic power back to individuals. Governments of every persuasion have found that sick economies do not respond to regulation or ideological commands as the events in Eastern Europe and Russia during 1989 and 1990 so clearly demonstrate.

As Douglas points out, "The abolition of privilege is the essence of structural reform." The substance of the recommendations in this study is the abolition of privilege and the exaltation of individual economic choice as the basis for a more prosperous, egalitarian society.

NOTES

1. These principles are summarized from those suggested by Roger Douglas, former Minister of Finance in New Zealand during 1984-88 as reported in the Wall Street Journal.

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APPENDIX TABLES

Appendix Table 3.1 Gross Domestic Product (GDP) by Economic Sector: 1965-1988 (millions of sucres in constant 1975 prices)

Year	Agriculture	Petroleum And Mining	Industria	Utilities	Construcion	Wholesale/ Retail Trade	Transport/Communication	Financial Services	Household Services[a]	Government Services	Total Services	Net Customs Taxes	Imputed Bank Services	Total GDP (at market prices)
1965	13,072	(604)	7,721	297	3,291	8,637	2,298	5,843	3,648	4,119	13,610	3,037	(653)	50,706
1966	13,260	(805)	8,173	310	3,060	8,840	2,441	6,070	3,639	4,299	14,008	3,356	(698)	51,945
1967	14,154	(1,083)	8,865	337	3,662	9,528	2,702	6,357	3,697	4,503	14,557	3,578	(758)	55,512
1968	14,751	(1,656)	9,103	357	3,590	10,169	2,908	6,707	3,770	5,236	15,713	3,727	(913)	57,749
1969	14,662	(1,795)	9,583	418	3,912	10,222	3,189	7,070	3,890	5,593	16,553	3,375	(1,023)	59,096
1970	15,710	(2,314)	10,803	477	3,940	10,731	3,765	7,536	4,087	6,005	17,628	3,430	(1,258)	62,912
1971	16,497	(2,271)	11,340	512	5,076	11,682	3,992	7,882	4,202	5,867	17,951	3,424	(1,351)	66,852
1972	17,160	5,071	12,386	595	4,402	12,620	4,352	8,275	4,195	6,178	18,648	2,735	(1,476)	76,493
1973	17,340	18,575	13,527	644	4,856	13,665	4,773	9,521	4,584	6,446	20,551	3,542	(1,606)	95,867
1974	18,894	15,597	14,936	693	5,585	14,959	5,326	10,610	4,908	8,319	23,837	4,247	(2,028)	102,046
1975	19,333	12,482	17,209	809	5,988	16,949	6,169	11,237	5,067	9,640	15,944	4,920	(2,063)	107,740
1976	19,892	15,127	19,476	915	6,415	17,929	6,944	12,108	5,708	10,914	26,730	4,555	(2,304)	117,679
1977	20,360	13,509	21,797	927	6,573	20,056	8,003	13,703	6,411	11,056	31,170	5,745	(2,781)	125,369
1978	19,575	15,605	23,577	915	6,903	21,504	8,616	14,622	7,072	11,926	33,620	6,478	(3,161)	133,632
1979	20,133	16,448	25,864	1,014	6,853	22,862	9,314	15,478	7,581	12,557	35,616	6,227	(3,613)	140,718
1980	21,198	15,070	26,807	1,115	6,906	24,789	10,038	17,694	8,287	13,709	39,690	7,015	(5,006)	147,622
1981	22,647	15,992	29,159	1,117	7,239	25,032	10,517	18,274	8,928	14,000	41,202	5,597	(5,059)	153,443
1982	23,101	15,527	29,584	1,241	7,285	25,562	10,687	18,590	9,406	14,224	42,220	5,373	(5,315)	155,265
1983	19,891	13,893	29,183	1,426	6,728	22,537	10,511	18,972	9,803	14,493	43,268	3,606	(6,158)	150,885
1984	22,007	21,879	28,643	1,836	6,583	23,467	10,914	17,679	10,080	14,775	42,534	3,848	(4,485)	157,226
1985	24,178	23,875	28,710	1,833	6,742	24,268	11,506	18,162	10,252	14,842	43,256	4,205	(4,519)	164,054
1986	26,656	24,513	28,241	2,232	6,841	24,793	12,571	18,579	10,508	14,898	43,985	4,238	(4,934)	169,136
1987[b]	27,766	11,210	29,179	2,627	6,955	25,286	12,895	18,246	10,852	14,978	44,076	4,249	(4,405)	159,838
1988[c]	30,289	26,700	30,331	2,985	6,365	26,073	13,158	18,431	11,163	15,121	44,715	4,101	(4,401)	180,316
1989[d]														
Growth Rates[e] (%)														
1965-88	3.20	4.59[f]	7.02	10.02	3.64	5.56	8.49	6.11	6.01	6.63	6.25	1.71	--	6.21
1965-72	4.01	--	6.89	10.74	5.98	5.39	10.01	5.26	2.45	6.54	4.97	-1.02	--	5.55
1973-81	2.49	-0.20	10.21	7.04	4.39	8.18	10.70	8.64	9.15	9.09	8.88	7.18	--	5.27
1965-81	3.40	6.05	9.28	9.51	5.84	7.60	10.71	7.86	5.03	8.69	7.71	5.10	--	8.18
1982-88[g]	6.15	2.14	0.22	15.56	-1.07	1.24	4.28	-0.19	2.75	0.92	0.87	-1.37	--	2.30
1984-88[h]	8.02	-3.51	1.32	14.25	-0.35	2.55	5.00	0.88	2.64	0.56	1.19	1.39	--	2.51

Source: BCE 1989, 1988a, 1982a, 1982b.

a Household services includes social and personal services provided to homes by firms, and the services of domestics in homes.
b Refined data but still not final (semidefinitiva).
c Provisional data.
d Space is left for 1989-90 so the reader may add data as it becomes available.
e The annual average, continuous growth rate as calculated by fitting a curvelinear (exponential) trend line to the data. The formula utilized is $y = ae^{bt}$ where $a>0$, and $y>0$.
f Petroleum growth rates based on data for 1972 and later, due to a national accounting procedure that resulted in negative GDP for 1965-1971.
g When 1983 (the bad El Nino year) data are excluded for agriculture the rate of growth for 1982-1988 increases to 6.33 percent. When 1987 (year of petroleum pipeline rupture due to earthquake) data are excluded for petroleum for 1982-1988, the growth rate is 10.28 percent.
h When 1987 (year of petroleum pipeline rupture due to earthquake) data are excluded for petroleum for 1984-1988, the growth rate is 6.44 percent.

Appendix Table 3.2 Gross Domestic Product in Agriculture and its Subsectors, 1965-1988 (millions of sucres in 1975 prices)

Year	Bananas Coffee & Cacao	Other Crops	Livestock Production	Forestry	Hunting & Fishing	Total
1965	3,435	5,088	3,841	401	307	13,072
1966	3,475	5,090	3,944	452	299	13,260
1967	3,786	5,518	4,056	472	322	14,154
1968	4,332	5,408	4,121	519	371	14,751
1969	3,099	6,230	4,380	555	398	14,662
1970	3,398	6,609	4,693	570	440	15,710
1971	3,740	6,611	4,913	631	602	16,497
1972	3,915	6,533	5,316	745	651	17,160
1973	3,730	6,630	5,396	861	723	17,340
1974	4,214	7,324	5,661	941	754	18,894
1975	3,766	7,833	5,880	1,019	835	19,333
1976	3,598	8,145	6,151	1,090	908	19,892
1977	4,421	7,161	6,533	1,252	993	20,360
1978	4,349	6,104	6,733	1,336	1,053	19,575
1979	4,393	6,211	6,948	1,440	1,141	20,133
1980	4,027	6,804	7,216	1,540	1,611	21,198
1981	4,023	7,680	7,578	1,593	1,773	22,647
1982	4,208	7,112	8,043	1,739	1,999	23,101
1983	2,718	5,457	8,043	1,724	1,949	19,891
1984	3,071	6,734	8,326	1,662	2,214	22,007
1985	3,955	7,011	8,737	1,712	2,763	24,178
1986	4,000	8,595	8,990	1,879	3,192	26,656
1987 [a]	3,586	8,805	9,339	1,966	4,070	27,766
1988 [b]	4,005	9,866	10,020	1,806	4,592	30,289
1989 [c]						
Growth Rates[d] (%)						
1965-88	0.16	1.71	4.30	7.58	12.48	3.20
1965-72	0.75	4.55	4.72	8.22	12.33	4.01
1973-81	1.11	-0.64	4.27	8.39	11.70	2.49
1965-81	1.21	2.05	4.56	9.61	11.73	3.40
1982-88	2.42	8.11	3.77	1.80	16.74	6.15
1984-88	4.43	10.43	4.47	3.09	20.28	8.08

Source: BCE 1989, 1988a, 1982a, 1982b.

[a] Refined but still not final (semidefinitiva).
[b] Provisional.
[c] Space is left for 1989-1990 so the reader may add data as it becomes available.
[d] The annual average (continuous) growth rate as calculated by fitting a curvelinear (exponential) trend line to the data. The formula utilized is $y = ae^{bx}$ where $a>0$, and $y>0$.

Appendix Table 3.3 Amount and Share of Agricultural, Petroleum and Other Exports 1965-1989 (US$ 1,000,000 FOB)

Years	Agriculture		Petroleum		Other		Total	
	Amount	Share (%)	Amount	Share (%)	Amount	Share (%)	Amount	Share (%)
1965	124.1	94.0	2.1	1.6	5.8	4.4	132.0	100.0
1966	135.5	97.0	0.0	0.0	4.2	3.0	139.7	100.0
1967	154.6	97.8	0.0	0.0	3.5	2.2	158.0	100.0
1968	190.6	97.7	1.1	0.6	3.5	1.8	195.2	100.0
1969	147.6	96.8	0.6	0.4	4.3	2.8	152.5	100.0
1970	184.4	97.1	0.9	0.5	4.6	2.4	189.9	100.0
1971	191.7	96.3	2.0	1.0	5.4	2.7	199.1	100.0
1972	257.4	78.9	59.9	18.4	9.0	2.8	326.3	100.0
1973	234.1	44.0	282.7	53.1	15.2	2.9	532.0	100.0
1974	403.9	35.9	696.7	62.0	22.9	2.0	1,123.5	100.0
1975	360.5	37.0	588.0	60.4	25.3	2.6	973.9	100.0
1976	483.0	38.4	740.4	58.9	34.1	2.7	1,257.5	100.0
1977	695.3	48.4	713.3	49.7	27.7	1.9	1,436.3	100.0
1978	803.3	51.6	718.4	46.1	35.8	2.3	1,557.5	100.0
1979	875.6	41.6	1,178.2	56.0	50.4	2.4	2,104.2	100.0
1980	855.4	34.5	1,564.5	63.1	60.9	2.5	2,480.8	100.0
1981	769.3	35.5	1,341.7	61.9	57.0	2.6	2,168.0	100.0
1982	664.5	29.7	1,526.6	68.2	46.4	2.1	2,237.4	100.0
1983	549.2	24.7	1,644.5	73.9	32.0	1.4	2,225.6	100.0
1984	763.3	29.6	1,797.7	69.7	20.0	0.8	2,581.0	100.0
1985	955.7	32.9	1,929.6	66.4	19.5	0.7	2,904.7	100.0
1986	1,174.5	53.7	982.6	45.0	28.8	1.3	2,185.8	100.0
1987	1,157.9	57.3	817.6	40.4	45.8	2.3	2,021.3	100.0
1988	1,170.4	53.4	975.7	44.5	46.4	2.1	2,192.5	100.0
1989	1,148.1	48.8	1,147.5	48.7	58.4	2.5	2,354.0	100.0
Average								
1965-69	150.5	96.8	0.8	0.5	4.2	2.7	155.5	100.0
1975-79	643.5	43.9	787.7	53.7	34.7	2.4	1,465.9	100.0
1984-87	1,012.9	41.8	1,381.9	57.0	28.5	1.2	2,423.2	100.0
1986-87	1,166.2	55.4	900.1	42.8	37.3	1.8	2,103.6	100.0

Source: BCF 1988b, 1978; Unpublished data for 1988 and 1989 from BCE, Economics Studies Departament.

Appendix Table 3.4 Exports of Primary and of Processed Agricultural Products 1965-1989 (US$ 1,000 FOB)

Years	Primary							Processed [c]	Total
	Fresh Bananas	Cacao Beans	Coffee Beans	Fresh Shrimp	Fresh Fish & Lobster	Other Traditional Exports [a]	Non Traditional Exports [b]		
1965	49,997	19,489	34,902	1,953	1,031	4,768	1,448	10,489	124,077
1966	59,393	16,980	32,539	1,590	1,161	9,705	2,025	12,167	135,540
1967	67,158	23,497	39,871	1,617	1,800	5,996	1,364	13.456	154.559
1968	92,219	38,883	34,687	2,139	1,481	5,592	1,739	13,861	190,581
1969	68,175	24,240	26,045	2,688	2,146	6,606	1,008	16,726	147,634
1970	83,299	22,182	50,002	1,706	2,340	7,682	1,857	15,363	184,431
1971	88,157	24,332	36,100	4,363	5,221	7,314	2,196	23,993	191,676
1972	130,991	23,628	46,990	13,024	3,288	9,523	3,262	26,667	257.373
1973	74,126	26,016	65,427	9,172	5,827	15,021	3,767	34,778	234,134
1974	126.723	102,613	67.756	11,330	7,171	18,031	4,252	65.969	403,905
1975	138,652	42,165	65.532	14,581	10,260	12,392	4,664	72,302	360,548
1976	103,223	31,461	192,793	20,791	9,477	20,319	3,282	101,639	482.985
1977	148,259	59,954	175.006	25,567	11,201	20,056	4,768	250,444	695,255
1978	150,935	50.093	265,719	24,034	12,291	16,194	4,816	279,170	803,252
1979	156,540	40,264	263,848	30,956	20,174	25,539	8,636	329,651	875,608
1980	195,591	31,294	132,151	71,771	20.052	22,663	4,816	377,050	855,388
1981	212,766	39,549	102,386	92,792	11,449	27,550	4,602	278,159	769,253
1982	116.316	55,864	142,793	121.253	9,381	18,455	11,445	188,972	664,479
1983	145,562	11,899	151,132	146,478	7,765	17.723	3,502	65,120	549,181
1984	132,786	95,991	174,739	159,840	6,786	20,408	5,327	167,407	763,283
1985	219,984	138,411	190,800	156,485	11,984	17,704	6,088	214,246	955,702
1986	263,402	71,063	298,914	287,880	27,148	8,431	8,437	209,249	1,174,524
1987	266,934	82,766	192,284	383,135	37.963	14,234	11,038	169,550	1,157,904
1988	297,803	77,363	152,356	387,045	35,573	20,035	11,657	187,892	1,169,723
1989	369,534	55,545	142,014	328.220	49,773	25,925	17,721	158,618	1,147,349
Average									
1965-69	67,388	24,614	33,605	1,997	1,484	6,533	1,517	13,340	150,478
1975-79	139,522	44,787	192,580	23,186	12,681	18,900	5,233	206,641	643,530
1984-87	220,777	97,058	214,184	246,835	20,970	15,194	7,723	190,113	1,012,853

Source: BCE 1988b, 1978; Unpublished data for 1988 and 1989 from BCE, Economics Studies Department.

[a] Includes primarily:rice, manila hemp, castor oil, lumber and livestock.

[b] While composition varies by year, this class includes primarily: flowers, tea and tobacco up to 1985, with natural flowers and fresh fruits becoming more important in recent years.

[c] Includes: sugar; molasses; processed cacao, coffee and bananas: canned seafood; animal feeds; pyrethrum; plywood; and other processed comodities.

Appendix Table 3.5 Exports of Principal Primary and Processed Agricultural Products, 1965-1987 (US$ 1,000 FOB)

Years	Bananas		Cacao		Coffee		Fish and Shrimp		Subtotal		Others		Total	
	Processed	Primary	Processed	Primary	Processed	Primary	Processed	Primary	Processed	Primary	Processed	Primary	Processed	Primary
1965	0	49,997	355	19,489	0	34,902	1,224	2,984	1,579	107,372	8,910	6,216	10,489	113,588
1966	3	59,393	1,494	16,960	2	32,539	1,060	2,751	2,559	111,643	9,608	11,730	12,167	123,373
1967	8	67,158	1,547	23,497	1	39,871	1,428	3,217	2,984	133,743	10,472	7,360	13,456	141,103
1968	2	92,219	2,528	38,883	2	34,667	1,208	3,620	3,740	169,389	10,121	7,331	13,861	176,720
1969	1	68,175	2,018	24,240	3	26,045	1,411	4,834	3,433	123,294	13,293	7,614	16,726	130,908
1970	1	83,299	2,642	22,182	15	50,002	1,468	4,046	4,126	159,529	11,237	9,539	15,363	169,068
1971	6	88,157	4,471	24,332	0	36,100	3,584	9,584	8,061	158,173	15,932	9,510	23,993	167,683
1972	4	130,991	6,486	23,628	592	46,990	2,097	16,312	9,179	217,921	17,488	12,785	26,667	230,706
1973	2	74,126	8,801	26,016	739	65,427	6,138	14,999	15,680	180,568	19,098	19,788	34,778	199,356
1974	0	126,723	23,617	102,613	1,074	67,756	8,067	18,561	32,758	315,653	33,211	22,283	65,969	337,936
1975	1	138,652	29,782	42,165	1,009	65,532	6,863	24,841	37,655	271,190	34,647	17,056	72,302	288,246
1976	1	103,223	64,261	31,461	1,473	192,793	12,212	30,268	77,947	357,745	23,692	23,601	101,639	381,346
1977	0	148,259	186,077	59,954	3,628	175,006	19,743	36,768	209,448	419,987	40,996	24,824	250,444	444,811
1978	0	159,935	209,663	50,093	4,750	265,719	25,420	36,325	239,833	503,072	39,337	21,010	279,170	524,082
1979	1	156,540	233,629	40,264	12,614	263,848	28,139	51,130	274,383	511,782	55,268	34,175	329,651	545,957
1980	1	195,591	180,106	31,294	13,391	132,151	73,658	91,823	267,156	450,859	109,894	27,479	377,050	478,338
1981	1	212,766	101,588	39,549	20,330	102,386	53,300	104,241	175,219	458,942	102,940	32,152	278,159	491,094
1982	0	116,316	52,060	55,864	17,709	142,793	76,089	130,634	145,858	445,607	43,114	29,900	188,972	475,507
1983	0	145,562	16,151	11,899	17,845	151,132	10,812	154,243	44,808	462,836	20,312	21,225	65,120	484,061
1984	4,281	132,786	50,354	95,991	22,034	174,738	64,011	166,626	140,680	570,141	26,727	25,735	167,407	595,876
1985	4,009	219,984	78,763	138,411	18,111	190,800	97,246	168,469	198,129	717,664	16,117	23,792	214,246	741,456
1986	3,594	263,402	77,219	71,063	28,786	298,914	72,561	315,028	182,160	948,407	27,089	16,868	209,249	965,275
1987	4,210	266,934	57,137	82,766	18,759	192,284	58,626	421,098	138,732	963,082	30,818	25,272	169,550	988,354
Average														
1965-69	3	67,388	1,588	24,614	2	33,605	1,266	3,481	2,859	129,088	10,481	8,050	13,340	137,138
1975-79	1	139,522	144,682	44,787	4,695	192,580	18,475	35,866	167,853	412,755	38,788	24,133	206,641	436,888
1984-87	4,024	220,777	65,868	97,058	21,923	214,184	73,111	267,805	164,925	799,824	25,188	22,917	190,113	822,740

Source: BCE 1988b, 1978.

Appendix Table 3.6 Principal Imports, 1965-1987 (US$ 1,000,000 CIF)

Years	Agriculture[a]	Industrial Consumer Goods[b]	Raw Materials & Capital for Industry[c]	Construction[d]	Transport, Fuel & Misc.[e]	Total Imports
1965	44.0	27.2	53.7	9.0	31.5	165.5
1966	49.4	25.0	63.0	12.2	24.5	174.1
1967	51.5	27.0	79.9	11.8	44.0	214.2
1968	72.1	29.7	90.0	24.4	39.2	255.5
1969	64.3	29.5	86.1	13.1	48.8	241.8
1970	69.8	31.7	105.9	15.4	51.1	273.8
1971	64.3	31.8	133.8	36.7	73.5	340.1
1972	56.9	38.6	141.6	24.9	56.6	318.6
1973	76.6	55.3	176.9	18.7	69.7	397.3
1974	140.4	89.0	289.3	30.4	129.1	678.2
1975	204.9	105.8	429.4	73.6	173.2	987.0
1976	187.8	90.4	459.6	65.3	155.2	958.3
1977	196.4	117.3	578.3	72.2	226.2	1,190.5
1978	251.4	159.5	723.5	80.8	289.8	1,505.1
1979	249.2	153.7	816.7	69.4	310.7	1,599.7
1980	357.1	194.7	1,029.9	99.1	572.5	2,253.3
1981	258.8	161.7	885.0	77.8	537.2	1,920.6
1982	351.7	242.6	1,143.6	113.4	573.4	2,424.6
1983	417.1	144.8	708.9	55.6	148.4	1,474.6
1984	343.6	145.7	764.2	45.8	330.9	1,630.0
1985	375.2	130.8	859.9	49.8	351.3	1,767.0
1986	308.2	148.9	944.4	62.0	346.8	1,810.2
1987	310.1	174.6	1,097.8	73.5	396.2	2,052.1
Average						
1965-69	56.3	27.7	74.5	14.1	37.6	210.2
1975-79	218.0	125.4	601.5	72.3	231.0	1,248.1
1984-87	334.3	150.0	916.6	57.7	356.3	1,814.8

Source: BCE 1988b, 1978.

[a] Foods, beverages, tobacco, agricultural inputs (raw materials) and capital goods and raw food products and fibers for industrial processing.

[b] Pharmaceuticals, clothing, other non-durables and consumer durables.

[c] Minerals, chemicals and capital goods for industry.

[d] Construction materials.

[e] Transportation equipment, fuels and lubricants and miscellaneous.

Appendix Table 3.7 Principal Agricultural Imports, 1965-1987 (US$ 1,000 CIF)

Year	Agricultural Consumer Goods[a]	Fertilizer & Other Inputs[b]	Capital Goods[c]	Agricultural Raw Materials for Industry[d]	Total
1965	4,245	4,875	4,648	30,211	43,979
1966	8,372	4,254	4,193	32,575	49,394
1967	6,143	4,161	4,715	36,489	51,508
1968	7,[illegible]0	4,875	6,759	52,861	72,105
1969	5,565	5,078	6,172	47,489	64,304
1970	4,514	5,552	7,557	52,129	69,752
1971	6,467	3,695	6,670	47,499	64,331
1972	7,621	4,557	4,370	40,314	56,862
1973	8,731	5,746	5,695	56,435	76,607
1974	12,684	26,024	13,940	87,705	140,353
1975	23,883	46,689	35,467	98,882	204,921
1976	21,758	29,080	30,151	106,763	187,752
1977	25,319	20,600	36,595	113,934	196,448
1978	46,988	33,754	45,866	124,831	251,439
1979	54,374	31,766	30,385	132,669	249,194
1980	48,401	57,729	39,347	211,630	357,107
1981	38,545	41,898	34,553	143,850	258,846
1982	32,342	59,957	33,662	225,706	351,667
1983	38,537	49,565	21,960	306,988	417,050
1984	34,623	65,057	14,425	229,515	343,620
1985	21,658	71,673	34,101	247,769	375,201
1986	20,725	62,851	35,047	189,582	308,205
1987	33,812	52,713	28,820	194,712	310,057
Average					
1965-69	6,387	4,649	5,297	39,925	56,258
1975-79	34,464	32,378	35,693	115,416	217,951
1984-87	27,705	63,074	28,098	215,395	334,271

Source: BCE 1988b, 1978.

[a] Foods, beverages and tobacco.
[b] Fertilizer, animal feeds, pesticides and other inputs.
[c] Machines and implements, tractors and transportation equipement, and other agricultural equipment.
[d] Cereal grains, unrefined vegetable oils, powered milk and other unprocessed foods, natural fibers, and hides.

Appendix Table 3.3 Agricultural Trade Balance, 1965-1987 (US$ 1,000,000)

Years	Agricultural Exports (FOB)	Agricultural Imports (CIF)	Trade Balance	Raw Materials & Capital for Industry	Trade Balance as Share of Industrial (%)
1965	124.1	44.0	80.1	53.7	149.1
1966	135.5	49.4	86.1	63.0	136.7
1967	154.6	51.5	103.1	79.9	129.0
1968	190.6	72.1	118.5	90.0	131.6
1969	147.6	64.3	83.3	86.1	96.8
1970	184.4	69.8	114.7	105.9	108.3
1971	191.7	64.3	127.3	133.8	95.2
1972	257.4	56.9	200.5	141.6	141.6
1973	234.1	76.6	157.5	176.9	89.0
1974	403.9	140.4	263.6	289.3	91.1
1975	360.5	204.9	153.6	429.4	35.8
1976	483.0	187.8	295.2	459.6	64.2
1977	695.3	196.4	498.8	578.3	86.3
1978	803.3	251.4	551.8	723.5	76.3
1979	875.6	249.2	626.4	816.7	76.7
1980	855.4	357.1	498.3	1,029.9	48.4
1981	769.3	258.8	510.4	885.0	57.7
1982	664.5	351.7	312.8	1,143.6	27.4
1983	549.2	417.1	132.1	708.9	18.6
1984	763.3	343.6	419.7	764.2	54.9
1985	955.7	375.2	580.5	859.9	67.5
1986	1,174.5	308.2	866.3	944.4	91.7
1987	1,157.9	310.1	847.8	1,097.8	77.2
Average					
1965-69	150.5	56.3	94.2	74.5	126.4
1975-79	643.5	218.0	425.2	601.5	70.7
1984-87	1,012.9	334.3	678.6	916.6	74.0

Source: BCE 1988b, 1978.

Appendix Table 3.9 Food Balance Sheet for Ecuador, 1985

Food Source	Production	Imports	Exports	Seeds	Ani.feed	Losses & Wastage	Apparent consump	Availability per/cap	Daily per capita calories	protein
	mt	mt	mt	mt	mt	mt	mt	k/year	No	grams
Total	9,594,128	573,820	2,045,658	116,603	257,841	3,444,304	4,303,544	458.90	2,354.27	46.55
I. Grains	660,104	265,531	16,984	55,096	204,708	35,276	612,571	65.32	576.54	14.73
II. Legumes & Nuts	122,253	1,456	0	10,347	0	40,740	72,622	7.74	60.49	3.52
III. Tubers	669,759	0	10	48,999	0	30,840	589,910	62.90	188.91	3.05
IV. Oils and Fats	546,962	267,649	5,458	2,161	53,133	584,974	168,885	18.01	436.26	0.00
V. Vegetables	215,659	0	0	0	0	23,528	192,131	20.49	20.07	0.67
VI. Fruits	3,563,071	1,627	1,649,173	0	0	412,461	1,503,064	160.28	451.37	4.46
VII. Animal	871,117	37,557	62,944	0	0	27,700	818,030	87.23	225.35	17.81
VIII. Other	2,945,203	0	311,089	0	0	2,287,784	346,330	36.93	395.27	2.31
I. Grains	660,104	265,531	16,984	55,096	204,708	36,276	612,571	65.32	576.54	14.73
Rice(paddy)	397,354	21,352	16,959	11,392	130,769		259,586	27.68	275.29	5.38
Soft corn(dry)	35,421	16,1[illegible]	15	5,292			46,227	4.93	48.21	1.04
Wheat	18,464	183,035		4,932	53,073		143,494	15.30	148.40	5.45
Barley	26,723	26,160	10	9,636	12,625		30,612	3.26	31.30	0.89
Oats	730	18,871		27	8,241		11,333	1.21	12.71	0.40
Soft corn(ear)	181,381			23,814		36,276	121,291	12.93	60.59	1.56
Quinoa	31			3			28	0.00	0.03	0.00
II. Legumes & Nuts	122,253	1,456	0	10,347	0	40,740	72,622	7.74	60.49	3.52
Beans (dry)	26,006	203		3,377			22,832	2.43	23.15	1.40
Peas (dry)	3,195	315		782			2,728	0.29	2.66	0.19
Lentils (dry)	250	938		44			1,144	0.12	1.12	0.07
Broad beans(dry)	3,101			425		268	2,408	0.26	2.37	0.18
Chocho(lupinus)	879			50			829	0.09	1.01	0.10
Peas (green)	6,000			1,553		889	3,558	0.38	1.21	0.08
Beans (green)	29,243			2,830		5,283	21,130	2.25	9.82	0.64
Broad beans(green)	7,496			831		1,333	5,332	0.57	2.24	0.18
Peanuts (dry)	7,679			443			7,236	0.77	11.67	0.63
Sesame (dry)	70			12			58	0.01	0.10	0.00
Coconut	38,334					32,967	5,367	0.57	5.14	0.06

Appendix Table 3.9 Food Balance Sheet for Ecuador, 1985 (Continued, p.2)

Food Source	Production	Imports	Exports	Seeds	Ani.feed	Losses & Wastage	Apparent consump	Availability per/cap	Daily per capita calories	Daily per capita protein
	mt	mt	mt	mt	mt	mt	mt	k/year	No	grams
III. Tubers	669,759	0	10	48,999	0	30,840	589,910	62.90	188.91	3.05
Potatoes	423,186			48,258		18,746	356,182	37.98	92.61	2.50
Cassava	228,808		10			11,440	217,358	23.18	91.44	0.51
Sweet Potatoes	4,825			426		220	4,179	0.45	1.39	0.01
Mellocos	2,794			219			2,575	0.27	0.38	0.01
Ocas	1,466			96			1,370	0.15	0.39	0.00
White carrot	8,680					434	8,246	0.88	2.70	0.02
IV. Oils and Fats	546,962	267,649	5,458	2,161	53,133	584,974	168,885	18.01	436.26	0.00
Oilpalm	457,895					366,316	91,579	9.77	236.24	0.00
Soybeans	62,885	267,649		2,161	51,566	217,700	59,107	6.30	152.47	0.00
Royal palm	2,849				1,567	64	1,218	0.13	3.14	0.00
Pork lard	12,033					602	11,431	1.22	30.09	0.00
Fish oil	11,300		5,458			292	5,550	0.59	14.32	0.00
V. Vegetables	215,659	0	0	0	0	23,528	192,131	20.49	20.07	0.67
Hot chili	503					50	453	0.05	0.05	0.00
Garlic	2,709					271	2,438	0.26	0.86	0.02
Onions	55,475					5,548	49,928	5.32	7.29	0.22
Cabbage	25,918					3,888	22,030	2.35	1.61	0.10
Tomatoes	64,677					6,468	58,209	6.21	4.59	0.17
Carrot	8,274					827	7,447	0.79	0.91	0.02
Lettuce	10,913					1.637	9,276	0.99	0.30	0.02
Cauliflower	2,402					360	2,042	0.22	0.16	0.01
Beet root	5,724					572	5,152	0.55	0.62	0.02
Squash	23,707					2.371	21,336	2.28	2.87	0.05
Pickles	9,047					905	8,142	0.87	0.33	0.02
Pepper	6,310					631	5,679	0.61	0.48	0.02

Appendix Table 3.9 Food Balance Sheet for Ecuador, 1985 (Continued, p.3)

Food Source	Production	Imports	Exports	Seeds	Ani.feed	Losses & Wastage	Apparent consump	Availability per/cap	Daily per capita calories	Daily per capita protein
	mt	mt	mt	mt	mt	mt	mt	k/year	No	grams
VI. Fruits	3,563,071	1,627	1,649,173	0	0	412,461	1,503,064	160.28	451.37	4.46
Bananas	1,969,559		1,616,397			88,291	264,872	28.24	74.29	0.93
Plantains	945,500		31,606			228,474	685,421	73.08	302.37	2.20
Avocados	28,382					4,257	24,125	2.57	9.51	0.10
Peaches	3,321	16				334	3,003	0.32	0.64	0.01
Tangerines	34,297					5,145	29,152	3.11	2.73	0.04
Apples	29,879	1,154				1,552	29,481	3.14	4.91	0.03
Oranges	230,726					34,609	196,117	20.91	20.63	0.52
Naranjilla	18,509					1,851	16,658	1.78	2.09	0.03
Pineapples	70,067		339			13,946	55,782	5.95	8.31	0.07
Watermelon	35,266		7			5,289	29,970	3.20	2.10	0.06
Papaya	30,811					3,081	27,730	2.96	2.92	0.04
Grapefruit	29,629					4,444	25,185	2.69	1.91	0.04
Babaco	7,212					721	6,491	0.69	0.44	0.02
Prunes	1,290					194	1,097	0.12	0.16	0.00
Chirimoya	1,224					245	979	0.10	0.27	0.00
Strawberies	9,140		579			428	8,133	0.87	0.93	0.02
Guanabana	676					101	575	0.06	0.10	0.00
Limes	1,455					218	1,237	0.13	0.08	0.00
Lemons	22,018		53			3,295	18,670	1.99	1.53	0.07
Mango	26,869					5,374	21,495	2.29	3.83	0.02
Passion fruit	22,682					4,536	18,146	1.93	5.09	0.14
Blackberry	2,826						2,826	0.30	0.48	0.01
Pears	6,450	18				647	5,821	0.52	0.85	0.01
Tomate de arbol	12,577					1,258	11,319	1.21	1.59	0.07
Tamarindo	3,810					572	3,239	0.35	2.36	0.02
Taxo	1,927					289	1,638	0.17	0.17	0.00
Melon	16,756		192			3,313	13,251	1.41	0.97	0.02
Grapes	213	439					652	0.07	0.14	0.00

Appendix Table 3.9 Food Balance Sheet for Ecuador, 1985 (Continued, p.4)

Food Source	Production	Imports	Exports	Seeds	Ani.feed	Losses & Wastage	Apparent consump	Availability per/cap	Daily per capita calories	Daily per capita protein
	mt	mt	mt	mt	mt	mt	mt	k/year	No	grams
VII. Animal	871,117	37,557	62,944	0	0	27,700	818,030	87.23	225.35	17.81
Beef	83,760					22,615	61,145	6.52	19.11	3.79
Poultry	43,865						43,865	4.68	33.06	2.26
Pork	21,759					1,741	20,018	2.13	12.[illegible]1	1.10
Sheep	5,417					596	4,821	0.51	1.50	0.29
Fish(canned)	39,581		15,778				23,803	2.54	17.04	1.70
Fish (fresh)	35,009	39	28,297			338	6,413	0.68	1.42	0.33
Shrimp	20,588		18,869			258	1,461	0.16	0.31	0.07
Eggs	43,065					2,153	40,912	4.36	18.88	1.43
Milk	552,775	37,518					590,293	62.94	105.20	5.35
Cheese	25,298						25,298	2.70	16.63	1.50
VIII. Other	2,945,203	0	311,089	0	0	2,287,784	346,330	36.93	395.27	2.31
Sugar	2,693,570		142,929			2,270,071	280,571	29.92	316.39	0.00
Cacao	130,772		91,155			10,697	28,920	3.08	37.77	1.12
Coffee	120,861		77,005			7,017	36,839	3.93	41.11	1.19
Sugarcane a	2,301,231					2,048,096	253,135	26.99	207.07	0.00

Source: MAG; Fish and shrimp production are from unpublished data provided by the Subsecretaria de Recursos Pesqueros. Ministry of Industry and Commerce; Ministry of Finance.

Notes on Food Balance Sheet

Rice.-	Imports and stocks were converted to paddy with a coefficient of 1.504; stocks increased for the year end were accounted for as exports. After substracting seeds, milled rice was obtained with a milling rate of .665. The polishing residue is accounted for as animal feed.
Soft corn (ear).-	Wastage was estimated at .20 by ratio of the yield of shelled corn to ear corn. Wheat, Barley and Oats.- A milling rate of 0.73, 0.708, and 0.573 respectively, was used; the residual is used for animal feed.
Beans.-	Includes "frejol de palo".
Broad beans (dry).-	A wastage of .10 was estimated for the shell.
Beans,Peas and Broad beans (green).-	A wastage estimate of .2 was used for losses in food preparation.
Coconut.-	The wastage estimate for water and shells is 0.86.
Tubers.-	The usable portion of tubers with the exception of mellocos and ocas is 0.95. White carrots includes "papa china".
Oilpalm.-	The extraction rate for oil is 0.2; the rest is taken as wastage.
Soybeans.-	Imports were reported as oil, the conversion factor to beans is 5.556. Oil extraccion rate is 0.18, the rest of local production is used for animal feed and the rest of imports in bean-equivalents is accouted for as wastage.
Vegetables.-	The usable portion is 0.85 or 0.9 depending on the nature of each vegetable.
Fruits.-	The usable portion is 0.8 or 0.95 depending on each fruit. The waste in food preparationof bananas and plantains is estimated as 25%.
Meats.-	The edible portion of beef, pork, sheep, fish and shrimp is estimated as 0.73, 0.92, 0.89, 0.95 and 0.85 respectively.
Eggs.-	A wastage factor of 0.05 for the shell was used.
Milk.-	Imports of powder milk were transformed to fluid using 1 MT = 8,333 lts.
Cheese.-	Estimated as 30% of total milk available.Milk produced: 789,679 lts; imported:53,598 (fluid converted).The convertion factor for whole milk into cheese is 10:1.
Sugarcane.-	Production of refined sugar is estimated as 11% of sugarcane used for sugar. The rest is used as fuel for steam

Appendix Table 3.10 Caloric Requirements for Ecuadorian Population by Age Group and Sex, 1985

Ages	A. Males				B. Females (Not Lactating or Pregnant)				Total k Calories
	Population	k Calories required	Share of population (%)	Component Weighted Average	Population	k Calories required	Share of population (%)	Component Weighted Average	
0 - 4 years	752,353	1,242	8.02	100	727,663	1,242	7.76	96	196
5 - 9 years	650,691	1,923	6.94	133	631,881	1,923	6.74	130	263
10 - 14 years	586,507	2,788	6.25	174	570,918	2,439	6.09	148	323
15 - 19 years	524,604	3,101	5.59	173	439,567	2,370	4.69	111	285
20 - 24 years	442,683	2,990	4.72	141	265,867	2,200	2.84	62	204
25 - 29 years	368,965	2,990	3.93	118	216,005	2,200	2.30	51	168
30 - 34 years	309,951	2,990	3.31	99	201,135	2,200	2.14	47	146
35 - 39 years	243,624	2,990	2.60	78	178,930	2,200	1.91	42	120
40 - 44 years	194,062	2,860	2.07	59	166,750	2,090	1.78	37	96
45 - 49 years	162,741	2,860	1.74	50	157,771	2,090	1.68	35	85
50 - 54 years	130,180	2,665	1.39	37	132,803	1,980	1.42	28	65
55 - 59 years	106,097	2,665	1.13	30	109,664	1,980	1.17	23	53
60 - 64 years	83,504	2,535	0.89	23	87,597	1,870	0.93	17	40
65 - 69 years	64,941	2,535	0.69	18	70,160	1,870	0.75	14	32
70 - 74 years	46,019	2,145	0.49	11	51,519	1,870	0.55	10	21
over 75 years	49,818	2,145	0.53	11	62,774	1,870	0.67	13	24
Subtotal	4,716,750			1,254	4,071,004			865	2,120

Ages	C. Lactating Females				D. Pregnant				Total k Calories
	Population	k Calories required	Share of population (%)	Component Weighted Average	Population	k Calories required	Share of population (%)	Component Weighted Average	
0 - 4 years									
5 - 9 years									
10 - 14 years									
15 - 19 years	36,299	2,850	0.39	11	36,299	2,583	0.39	10	21
20 - 24 years	83,757	2,750	0.89	25	83,757	2,483	0.89	22	47
25 - 29 years	73,483	2,750	0.78	22	73,483	2,483	0.78	19	41
30 - 34 years	52,874	2,750	0.56	16	52,874	2,483	0.56	14	30
35 - 39 years	31,783	2,750	0.34	9	31,783	2,483	0.34	8	18
40 - 44 years	13,783	2,750	0.15	4	13,783	2,483	0.15	4	8
45 - 49 years	3,135	2,750	0.03	1	3,135	2,483	0.03	1	2
50 - 54 years									
55 - 59 years									
60 - 64 years									
65 - 69 years									
70 - 74 years									
over 75 years									
Subtotal	295,114			87	295,114			79	165
Total									2,285

Source: Oleas; INEC 1984, 1982.

Appendix Table 3.11 Protein Requirements for Ecuadorian Population by Age Group and Sex, 1985

Ages	A. Males				B. Females (Not Lactating or Pregnant)				Total Protein
	Population	Protein required	Share of population (%)	Component Weighted Average	Population	Protein required	Share of population (%)	Component Weighted Average	
0 - 4 years	752,363	25	8.02	1.97	727,663	25	7.76	1.90	3.87
5 - 9 years	650,691	37	6.94	2.55	631,881	37	6.74	2.48	5.03
10 - 14 years	586,507	57	6.25	3.56	570,918	51	6.09	3.12	6.68
15 - 19 years	524,604	65	5.59	3.64	439,567	54	4.69	2.53	6.17
20 - 24 years	442,683	62	4.72	2.93	265,857	50	2.84	1.40	4.33
25 - 29 years	368,965	62	3.93	2.44	216,005	50	2.30	1.14	3.58
30 - 34 years	309,951	62	3.31	2.05	201,135	50	2.14	1.06	3.11
35 - 39 years	243,624	62	2.60	1.61	178,930	50	1.91	0.94	2.56
40 - 44 years	194,062	62	2.07	1.28	166,750	50	1.78	0.88	2.16
45 - 49 years	152,741	62	1.74	1.08	157,771	50	1.68	0.83	1.91
50 - 54 years	130,180	62	1.39	0.86	132,803	50	1.42	0.70	1.56
55 - 59 years	106,097	62	1.13	0.70	109,664	50	1.17	0.58	1.28
60 - 64 years	83,504	62	0.89	0.55	87,597	50	0.93	0.46	1.01
65 - 69 years	64,941	62	0.69	0.43	70,160	50	0.75	0.37	0.80
70 - 74 years	46,019	62	0.49	0.30	51,519	50	0.55	0.27	0.58
over 75 years	49,818	62	0.53	0.33	62,774	50	0.67	0.33	0.66
Subtotal	4,716,750			26.28	4,071,004			19.01	45.29

Ages	C. Lactating Females				D. Pregnant				Total Protein
	Population	Protein required	Share of population (%)	Component Weighted Average	Population	Protein required	Share of population (%)	Component Weighted Average	
0 - 4 years									
5 - 9 years									
10 - 14 years									
15 - 19 years	36,299	75	0.39	0.29	36,299	62	0.39	0.24	0.53
20 - 24 years	83,757	68	0.89	0.61	83,757	55	0.89	0.49	1.10
25 - 29 years	73,483	68	0.78	0.53	73,483	55	0.78	0.43	0.96
30 - 34 years	52,874	68	0.56	0.38	52,874	55	0.56	0.31	0.69
35 - 39 years	31,783	68	0.34	0.23	31,783	55	0.34	0.19	0.42
40 - 44 years	13,783	68	0.15	0.10	13,783	55	0.15	0.08	0.18
45 - 49 years	3,135	68	0.03	0.02	3,135	55	0.03	0.02	0.04
50 - 54 years									
55 - 59 years									
60 - 64 years									
65 - 69 years									
70 - 74 years									
over 75 years									
Subtotal	295,114			2.17	295,114			1.76	3.92
Total									49.21

Source: Oleas; INEC 1984, 1982.

Appendix Table 3.12 Consumer Price Indices, Low & Medium Income Families: Quito, Guayaquil and Cuenca (May 1978-April 1979=100)

Year	CPI	Food/Bev.	Annual Variation in Food/Bev.(%)	Housing	Clothing	Misc.	Composite [a]	Annual Variation in Composite(%)	Food/Bev. Relative to Composite(%)
65	29.9	25.0	---	37.4	30.5	38.6	36.7	---	68.1
66	31.0	26.2	4.8	38.5	31.8	40.3	38.1	3.8	68.7
67	32.5	27.9	6.5	39.2	31.7	42.8	39.4	3.4	70.8
68	33.5	28.9	3.6	40.0	32.1	43.6	40.1	1.9	72.0
69	35.2	31.1	7.6	40.9	34.0	44.4	41.2	2.6	75.5
70	37.1	32.1	3.2	43.9	37.4	47.2	44.2	7.3	72.7
71	40.7	34.6	7.8	48.7	42.3	51.9	48.9	10.8	70.7
72	43.7	38.2	10.4	51.6	45.1	53.6	51.3	4.9	74.4
73	49.0	44.7	17.0	54.5	49.9	57.4	54.9	7.0	81.4
74	60.1	58.6	31.1	61.0	60.4	64.3	62.2	13.4	94.1
75	68.7	68.3	16.6	69.3	69.9	68.6	69.1	11.0	98.8
76	75.7	74.7	9.4	76.9	77.9	75.4	76.5	10.6	97.7
77	85.5	85.7	14.7	86.1	88.0	82.0	84.7	10.8	101.1
78	96.7	96.7	12.8	97.1	97.4	95.5	96.5	13.9	100.2
79	106.5	106.2	9.8	106.0	105.6	108.6	107.0	10.9	99.3
80	120.1	116.6	9.8	123.9	124.9	123.9	124.1	16.0	94.0
81	137.8	132.2	13.4	143.5	144.6	146.1	144.7	16.7	91.3
82	158.0	164.4	24.4	150.7	156.3	157.6	154.5	6.7	106.4
83	234.0	297.3	80.8	178.9	196.9	212.2	195.5	26.6	152.1
84	305.1	405.1	36.3	218.9	251.5	267.2	244.1	24.8	166.0
85	390.6	532.8	31.5	249.8	311.8	357.2	304.0	24.6	175.3
86	480.6	659.1	23.7	290.9	394.5	446.7	371.8	22.3	177.3
87	626.6	854.1	29.6	363.9	502.5	610.0	487.5	31.1	175.2
88	856.8	1,403.2	64.3	502.0	771.1	962.3	734.8	50.7	191.0
Weights	100.00%	38.09%	---	26.28%	10.39%	25.24%	61.91%	---	---

Source: BCE 1988b, 1987.

[a] Housing, Clothing and Miscelaneous with 61.91% = 100%.

Appendix Table 5.1 Rural and Urban Population by Geographic Area for Census Years: 1950, 1962, 1974 and 1982, and Projected for 1982, 1990 and 1995

	Unadjusted Censuses				Projections		
	1950	1962	1974	1982	1982	1990	1995
A. Ecuador	3,202,757	4,476,007	6,521,710	8,060,712	8,606,116	10,781,613	12,314,210
Urban	913,932	1,612,343	2,698,722	3,968,352	4,225,653	5,976,833	7,237,242
Capitals [a]	683,458	1,239,663	2,051,973	2,975,159	3,154,968	4,386,820	5,292,959
Quito	209,932	354,746	599,828	866,472	918,674	1,281,849	1,549,417
Guayaquil	258,966	510,804	823,219	1,199,344	1,272,014	1,764,170	2,125,421
Others	214,560	374,113	628,926	909,343	964,280	1,340,801	1,618,121
County seats [b]	230,474	372,680	646,749	993,203	1,070,685	1,590,013	1,944,283
Rural	2,288,825	2,863,664	3,822,988	4,092,350	4,380,463	4,804,780	5,076,968
B. Sierra	1,856,445	2,271,345	3,146,565	3,801,839	4,047,182	4,926,776	5,527,360
Urban	485,475	744,387	1,202,796	1,707,022	1,817,272	2,512,670	3,007,550
Capitals	375,386	612,044	998,008	1,407,849	1,494,097	2,047,522	2,448,293
Quito	209,932	354,746	599,828	866,472	918,674	1,281,849	1,549,417
Others	165,454	257,298	398,180	541,377	575,423	765,673	898,876
County seats	110,089	132,343	204,788	299,173	323,175	465,148	559,257
Rural	1,370,970	1,526,958	1,943,769	2,094,817	2,229,910	2,414,106	2,519,810
C. Costa	1,298,495	2,127,358	3,179,446	3,946,801	4,214,289	5,359,743	6,171,622
Urban	422,893	857,530	1,470,591	2,199,296	2,343,101	3,354,241	4,084,477
Capitals	305,195	621,915	1,041,217	1,540,119	1,632,275	2,293,682	2,784,803
Guayaquil	258,966	510,804	823,219	1,199,344	1,272,014	1,764,170	2,125,421
Others	46,229	111,111	217,998	340,775	360,261	529,512	659,382
County seats	117,698	235,615	429,374	659,177	710,826	1,060,559	1,299,674
Rural	875,602	1,269,828	1,708,855	1,747,505	1,871,188	2,005,502	2,087,145
D. Oriente	46,471	74,913	173,469	263,797	275,690	407,330	513,873
Urban	5,564	10,426	22,979	57,551	60,493	101,789	134,258
Capitals	2,877	5,704	11,437	25,526	26,800	43,223	57,100
County seats	2,687	4,722	11,542	32,025	33,693	58,566	77,158
Rural	40,907	64,487	150,490	206,246	215,197	305,541	379,615
E. Galápagos and Other	1,346	2,391	22,230	48,275	68,955	87,764	101,355
Urban	0	0	2,356	4,493	4,787	8,133	10,957
Capitals	0	0	1,311	1,665	1,796	2,393	2,763
County seats	0	0	1,045	2,828	2,991	5,740	8,194
Rural	1,346	2,391	19,874	43,782	64,168	79,631	90,398

Source: INEC 1985a, 1985b, 1977, 1964; Ministry of Economy.

[a] Capitals of Provinces.
[b] In spanish: Cabaceras de Cantones.

Appendix Table 5.2 Global, Rural and Urban Population Growth Rates by Geographic Area for Census Years: 1950, 1962, 1974 and 1982, and Projected for 1982, 1990 and 1995

	Intercensuses			Interprojections	
	1950-62 12 years	1962-74 11.53 years	1974-82 8.47 years	1982-90 8 years	1990-95 5 years
A. Ecuador	2.83	3.32	2.53	2.86	2.69
Urban	4.84	4.57	4.66	4.43	3.90
Capitals [a]	5.09	4.47	4.48	4.21	3.83
Quito	4.47	4.66	4.44	4.25	3.86
Guayaquil	5.82	4.23	4.54	4.17	3.80
Others	4.74	4.61	4.45	4.21	3.83
County seats [b]	4.09	4.90	5.20	5.07	4.11
Rural	1.88	2.54	0.81	1.16	1.11
B. Sierra	1.70	2.87	2.26	2.49	2.33
Urban	3.63	4.25	4.22	4.13	3.66
Capitals	4.16	4.33	4.15	4.02	3.64
Quito	4.47	4.66	4.44	4.25	3.86
Others	3.75	3.86	3.69	3.64	3.26
County seats	1.55	3.86	4.58	4.66	3.75
Rural	0.90	2.12	0.89	1.00	0.86
C. Costa	4.20	3.55	2.59	3.05	2.86
Urban	6.07	4.79	4.87	4.59	4.02
Capitals	6.11	4.57	4.73	4.34	3.96
Guayaquil	5.82	4.23	4.54	4.17	3.80
Others	7.58	6.02	5.42	4.93	4.48
County seats	5.95	5.34	5.19	5.13	4.15
Rural	3.15	2.61	0.26	0.87	0.80
D. Oriente	4.06	7.55	5.07	5.00	4.76
Urban	5.37	7.09	11.45	6.72	5.69
Capitals	5.87	6.22	9.94	6.16	5.73
County seats	4.81	8.06	12.80	7.16	5.67
Rural	3.87	7.63	3.79	4.48	4.44
E. Galápagos and Other	4.90	21.34	9.59	3.06	2.92
Urban	N/A	N/A	7.92	6.85	6.14
Capitals	N/A	N/A	2.86	3.65	2.92
County seats	N/A	N/A	12.47	8.49	7.38
Rural	4.90	20.16	9.77	2.74	2.57

Source: Appendix Table 5.1.

[a] Capitals of Provinces.
[b] In spanish: Cabeceras de Cantones.

Appendix Table 6.1 Current Farmgate Prices of Principal Crops and Livestock Products. 1971, and 1978-1988 (sucres per kilogram except where noted)

Product / Year	1971	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1. Grains												
a. Paddy Rice	1.98	5.20	5.31	5.63	6.79	7.00	13.81	19.26	27.22	34.02	23.74	53.29
b. Hard Corn	2.31	4.52	5.15	6.12	6.03	6.46	17.04	18.43	20.92	20.70	30.76	59.00
c. Soft Corn	4.06	6.60	6.09	7.36	10.16	10.78	23.38	45.03	40.67	44.26	47.58	95.40
d. Wheat	2.52	4.53	4.76	6.02	6.85	7.33	14.20	19.84	25.57	25.05	28.96	59.61
e. Barley	2.28	5.16	5.73	6.18	6.36	6.52	14.95	22.81	24.83	26.75	28.70	58.40
2. Legumes (dry)												
a. Beans	5.13	14.64	16.45	18.57	18.76	26.86	45.76	87.63	83.13	90.53	96.51	235.98
b. Peas	6.17	13.32	15.47	16.64	21.22	24.90	55.74	98.10	93.93	92.03	88.82	167.65
c. Lentils	12.28	20.09	21.97	25.96	41.32	44.96	68.71	90.24	97.32	99.28	184.11	272.93
d. Broad beans	2.33	7.91	10.45	11.06	14.15	15.77	28.22	43.11	56.65	70.15	75.78	132.62
3. Tubers												
a. Potatoes	1.06	4.16	4.71	4.94	6.34	6.65	17.22	11.23	17.95	20.77	23.25	57.35
b. Cassava	0.76	2.30	2.39	2.56	3.00	3.84	6.39	7.98	8.08	13.18	12.16	27.66
c. Sweet potatoes	1.23	1.59			3.68	4.58		10.21	10.57	16.45	16.70	17.95
4. Oils												
a. Crude palm oil [a]	3.90	14.30	14.30	14.30	18.00	19.50	29.25	46.25	57.50	62.00	85.00	162.00
b. Cotton	3.96	11.36	12.08	12.37	13.27	13.22	13.22	42.70	67.47	70.34	90.76	179.01
c. Soybeans	3.91	9.80	9.99	10.31	10.17	10.33	20.15	17.73	29.15	46.09	55.14	75.91
d. Castor beans	2.22	6.16	6.36	7.11	6.23	8.82	17.11	17.17	22.81	22.88	30.44	60.21
e. Peanuts	8.17	19.10	19.67	20.04	22.75	27.19	73.55	81.52	79.43	94.45	92.05	245.63
5. Export Crops												
a. Bananas(Export)	0.82	1.69	2.02	2.02	2.10	2.87	4.02	6.91	8.46	14.37	13.94	32.96
b. Cacao	8.14	55.59	56.61	51.32	32.56	40.96	107.11	145.83	161.75	198.48	302.55	393.57
c. Coffee	2.13	7.27	7.53	11.05	6.77	7.14	13.81	28.16	28.62	62.12	66.08	82.11
d. Sugarcane	0.08	0.19	0.32	0.36	0.21	0.39	0.39	0.47	0.99	1.40	1.17	2.58
e. Manila Hemp	5.05	14.28	15.62	16.52	22.33	24.24	30.23	40.00	76.54	77.50	97.31	262.76
f. Plantains	0.58	1.03	1.26	1.32	1.55	1.78	2.99	3.79	5.57	7.49	9.23	12.27
6. Vegetables												
a. Garlic	7.53	30.24	28.77	28.87	36.18	37.34	72.69	141.64	182.88	202.54	139.72	359.24
b. Onions [b]	2.07	6.01	5.65	6.49	11.53	14.69	29.81	26.22	23.73	41.03	51.08	53.49
c. Cabagge	0.93	6.07	2.43	2.87	3.57	3.84	6.30	8.84	11.80	12.04	15.85	21.89
d. Tomatoes	2.94	4.76	4.95	6.22	5.77	10.81	14.34	20.02	16.19	23.65	37.82	56.10
7. Fruits												
a. Avocados	3.09	5.22	5.91	6.90	11.35	11.51	13.63	14.23	16.92	23.26	27.72	49.24
b. Peaches	3.75	11.85		10.48	16.50	18.39	29.79	48.36	51.50	76.95	66.52	198.41
c. Lemons	1.72	4.39	5.01	5.58	9.42	10.30	34.30	20.06	21.06	24.86	45.12	57.68
d. Tangerines	4.56	5.43	5.02	5.19	6.80	7.92	12.68	21.52	15.80	23.47	31.12	54.39
e. Apples	7.22	10.00	10.02	11.06	9.17	12.45	14.07	23.21	24.75	49.17	68.14	93.97
f. Oranges	0.71	1.87	1.92	2.27	2.74	2.93	7.68	10.03	10.26	11.96	13.40	20.82
g. Naranjillas	2.80	11.34	11.36	11.41	15.22	18.05	23.25	33.36	37.58	47.97	51.58	69.56
h. Pineapples	1.56	3.47	3.68	4.05	5.89	6.15	7.82	8.46	15.48	18.62	27.12	44.99
i. Watermelon	2.96	3.91	5.39	5.88	9.04	9.88	9.25	20.42	28.13	25.44	36.64	52.83
j. Bananas(Domestic)	0.38	0.97	1.02	1.08	1.08	1.18	1.66	2.88	2.62	4.19	6.51	5.86
8. Livestock												
a. Eggs [c]	18.79	37.50	37.50	41.83	52.67	57.33	82.00	143.33	163.33	190.83	225.83	403.50
b. Milk (liters)	1.60	4.67	5.11	5.76	7.23	8.38	12.20	15.21	19.80	25.72	32.69	50.94
c. Beef	17.66	20.20	23.72	24.24	42.88	56.31	80.81	113.20	157.00	190.05	216.42	307.66
d. Pork	19.27	26.54	28.35	29.68	43.69	58.29	81.97	127.53	170.00	186.00	218.60	331.86
e. Sheep	14.58	16.40	18.01	18.36	33.01	39.30	64.85	94.91	151.00	172.46	195.50	290.21
f. Chicken	27.89	57.36	57.40	58.10	103.76	119.00	143.37	220.55	254.00	255.67	320.73	501.54
9. Shrimps [d]	44.81	32.13	37.33	86.26	84.22	124.51	139.00	236.00	324.40	492.94	484.07	966.41

Source: MAG (1988) for 1978-1988 prices; BCE (1977) for 1971 prices; Unpublished data from Palm Growers Association for prices of crude oil; Unpublished data from the Unit for Statistics and Studies for Fisheries, Undersubsecretary of Fisheries, MICEI, for shrimp prices.

[a] African palm is sold both as fruit and as crude oil by farmers. Consequently, palm fruit production in Appendix Table 6.2 was converted to crude oil equivalent at the extraction rate of .2, and multiplied by the price of crude oil to obtain farmgate value.

[b] Average price of red and white onions.

[c] Eggs converted to Kilograms, assuming the average weight of 1 egg is 60 gms, based in unpublished data from IIEP, University of Guayaquil.

[d] Prices for 1971, 1978 and 1979 are for whole shrimp; prices for 1980-1988 are for shrimp tails.

Appendix Table 6.2 Production of Principal Crops, Ecuador, 1965-1988 (1,000 metric tons)

Crop / Year	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1. Grains												
a. Paddy Rice	236.36	249.89	239.51	138.66	274.09	247.00	200.98	248.12	277.28	354.83	448.76	395.20
b. Hard Corn	128.27	110.66	154.53	87.73	81.30	101.85	120.66	100.78	153.53	185.63	203.39	209.11
c. Soft Corn	60.36	55.84	72.72	41.28	141.70	167.99	139.95	170.64	100.34	76.25	90.25	105.65
d. Wheat	64.77	62.44	78.78	82.51	94.02	81.00	68.76	50.45	45.11	54.91	64.65	46.42
e. Barley	92.65	77.34	82.10	75.62	77.66	109.99	68.38	73.76	79.20	56.14	62.80	61.77
2. Legumes (dry)												
a. Beans	31.16	36.75	38.11	35.14	38.19	41.64	30.21	26.10	31.84	28.81	26.10	33.05
b. Peas	18.10	18.17	[illegible].95	22.12	11.06	20.98	14.06	9.83	8.99	9.38	9.75	8.73
c. Lentils	1.69	0.81	0.98	0.86	1.14	0.94	0.74	0.90	1.54	2.27	1.90	1.80
d. Broad beans	23.30	20.53	19.82	19.82	10.99	18.01	14.76	9.41	12.39	11.65	15.63	13.06
3. Tubers												
a. Potatoes	390.53	347.18	398.70	510.77	456.86	541.61	680.95	473.51	539.08	503.34	499.37	549.80
b. Cassava	250.50	223.61	261.65	190.88	390.17	371.17	382.99	376.89	741.26	837.67	597.18	377.81
c. Sweet potatoes	8.15	7.89	7.85	6.89	11.31	11.54	6.82	8.90	8.37	10.61	13.59	13.52
4. Oils												
a. Oilpalm	2.04	4.22	6.38	9.11	13.24	21.11	31.47	44.51	58.33	75.89	94.49	111.51
b. Cotton [a]	9.40	19.95	15.76	13.95	23.66	7.55	10.71	11.55	19.55	41.89	30.21	21.71
c. Soybeans	0.36	0.11	0.21	0.11	0.30	0.60	1.09	0.84	1.54	4.37	12.33	15.03
d. Castor beans	24.52	24.89	26.87	9.18	23.67	16.49	34.53	23.02	51.40	39.95	3.39	13.20
e. Peanuts	10.92	11.70	8.77	6.14	5.83	5.24	9.79	10.74	12.47	17.18	11.42	7.92
5. Exports												
a. Bananas	2,220.60	2,521.35	2,557.71	2,765.36	3,031.00	3,154.63	3,312.76	3,083.18	3,203.36	3,397.25	2,569.45	2,767.94
b. Cacao	46.88	50.16	61.23	49.56	47.99	53.56	70.11	58.42	62.43	90.71	73.71	56.38
c. Coffee	254.63	270.02	289.59	284.93	208.03	339.43	292.17	334.77	353.25	326.96	359.85	409.89
d. Sugarcane [b]	8,086.73	9,004.21	7,528.30	9,528.32	5,457.91	5,611.63	5,546.83	5,576.30	5,476.99	6,647.14	7,723.42	6,340.31
e. Manila Hemp	0.16	0.19	0.09	0.32	0.45	3.59	4.49	4.36	6.52	9.43	9.90	13.13
f. Plantains	354.14	402.30	407.72	441.08	483.30	464.22	440.92	411.71	446.77	751.05	821.30	895.07
6. Vegetables												
a. Garlic	3.99	4.41	3.02	3.04	3.86	4.39	5.34	8.39	3.86	4.09	3.87	6.71
b. Onions	114.23	111.46	97.48	70.94	95.87	94.07	76.78	56.67	33.66	34.48	45.57	57.87
c. Cabagge	57.97	55.23	110.81	72.31	92.96	77.97	81.28	61.59	45.92	40.98	43.41	46.16
d. Tomatoes	22.09	22.85	23.59	24.37	25.19	23.98	24.43	26.54	24.48	33.33	37.24	42.54
7. Fruits												
a. Avocados	23.96	22.98	27.39	30.79	23.77	23.35	11.67	27.20	24.32	29.30	31.93	39.22
b. Peaches	2.97	2.94	1.68	3.47	2.49	2.50	2.60	2.90	3.10	2.84	3.12	3.71
c. Lemons	24.06	24.43	23.24	19.78	15.31	15.42	13.22	7.84	8.03	28.42	37.43	21.09
d. Tangerines	10.51	11.32	10.10	13.56	11.06	12.95	5.27	4.49	16.90	12.09	18.26	31.82
e. Apples	1.63	2.79	3.26	3.06	4.54	4.74	5.62	5.57	3.78	19.00	22.86	23.22
f. Oranges	167.63	164.64	181.60	143.14	154.85	152.88	172.81	153.01	143.63	237.63	275.08	323.90
g. Naranjillas	39.21	51.36	47.40	74.19	25.15	22.81	27.87	28.11	26.71	91.57	66.04	44.13
h. Pineapples	54.92	62.34	55.30	55.09	57.28	59.10	55.97	73.06	44.58	97.60	233.44	130.04
i. Watermelon	9.11	8.08	19.93	8.26	5.47	6.49	7.12	4.70	8.21	9.16	14.13	20.49

Source: MAG 1965-1985; INEC/SEAN.

[a] Raw Cotton (fiber and seeds).
[b] Includes sugarcane for sugar and for other uses for 1965-1985. Data for 1986-1988 are for cane for sugar only.

Appendix Table 6.2 Production of Principal Crops, Ecuador, 1965-1988 (1,000 metric tons) (Continued, p. 2)

Crop / Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
1. Grains												
a. Paddy Rice	327.57	225.20	318.20	380.61	434.39	384.35	273.50	437.16	397.35	576.44	780.78	954.53
b. Hard Corn	164.63	136.48	182.33	196.71	232.62	269.28	184.53	269.02	282.69	316.17	296.62	307.65
c. Soft Corn	54.60	39.04	35.34	45.26	48.62	54.69	44.20	56.82	35.42	86.48	88.41	89.97
d. Wheat	39.67	29.03	31.25	31.11	41.43	38.53	26.91	25.17	18.46	32.88	31.37	34.20
e. Barley	40.80	21.76	20.72	24.35	27.09	35.43	29.46	24.95	26.72	43.68	43.48	50.82
2. Legumes (dry)												
a. Beans	26.00	18.78	23.20	26.27	29.70	28.55	20.28	26.05	24.92	21.53	21.80	25.57
b. Peas	4.95	4.48	6.60	7.45	7.47	7.26	4.71	5.07	4.69	5.53	3.57	3.35
c. Lentils	0.50	0.38	0.35	0.44	0.58	0.52	0.35	0.23	0.25	0.61	1.14	0.84
d. Broad beans	8.00	3.43	4.06	4.56	5.16	5.22	5.28	4.71	3.10	6.58	5.04	4.02
3. Tubers												
a. Potatoes	416.88	343.16	254.51	323.22	391.59	416.42	314.01	389.56	423.19	388.60	353.92	338.21
b. Cassava	223.54	167.98	182.56	229.31	236.79	183.93	194.79	239.22	228.81	118.01	131.19	123.14
c. Sweet potatoes	6.27	3.95	4.16	2.70	3.61	5.35	6.56	8.29	6.78	4.50	3.06	6.30
4. Oils												
a. Oilpalm	124.78	124.78	164.71	244.89	300.04	309.27	354.18	372.46	457.79	657.80	687.66	674.15
b. Cotton [a]	26.90	26.55	25.16	39.80	41.97	25.19	4.15	7.83	18.82	36.91	20.11	23.95
c. Soybeans	19.28	25.40	29.79	33.67	33.18	37.31	14.07	47.50	62.88	76.24	146.06	131.34
d. Castor beans	9.64	7.20	9.10	6.11	3.91	2.52	2.37	1.90	1.67	1.47	2.52	0.99
e. Peanuts	8.60	9.25	17.07	13.58	12.67	5.51	5.10	5.94	7.70	11.12	6.42	6.06
5. Exports												
a. Bananas	2,450.69	2,152.00	2,031.56	2,269.48	2,009.85	1,998.75	1,642.71	1,677.26	1,969.56	2,320.64	2,386.50	2,576.19
b. Cacao	72.12	72.08	77.41	91.21	80.46	96.95	45.90	48.67	130.77	91.39	57.53	85.11
c. Coffee	387.40	353.78	421.24	325.44	404.33	395.91	281.80	458.82	333.04	483.58	372.62	342.08
d. Sugarcane [b]	7,518.00	6,927.70	6,599.43	6,615.19	6,278.38	5,429.87	5,620.04	6,656.35	4,994.80	2,749.52	3,000.73	2,595.75
e. Manila Hemp	16.51	10.66	10.69	11.04	9.24	7.10	7.54	18.39	10.00	6.80	15.95	22.03
f. Plantains	769.49	796.51	673.01	750.98	761.39	753.52	687.21	744.00	945.50	775.53	848.42	959.08
6. Vegetables												
a. Garlic	2.30	1.06	1.11	1.91	2.06	2.81	2.84	2.71	2.71	1.54	1.55	1.50
b. Onions	33.03	24.40	26.41	30.10	42.14	41.67	40.67	50.72	55.47	36.86	44.23	55.88
c. Cabagge	43.27	26.47	20.84	24.75	25.36	22.84	26.39	31.63	25.91	14.01	10.44	9.65
d. Tomatoes	33.78	36.67	32.26	38.15	42.31	36.78	35.96	63.98	64.71	67.49	73.27	118.19
7. Fruits												
a. Avocados	40.46	31.33	28.99	29.05	30.61	31.08	29.56	32.57	28.37	20.29	20.03	16.37
b. Peaches	2.50	2.22	2.79	2.98	3.15	3.04	3.20	3.05	3.32	3.36	4.67	3.22
c. Lemons	15.52	11.81	15.70	17.79	16.26	15.81	14.14	16.86	22.02	23.73	12.16	11.06
d. Tangerines	27.66	27.57	28.37	30.84	34.92	33.49	29.10	31.06	34.30	21.80	11.94	15.69
e. Apples	27.66	30.52	30.74	30.88	33.93	34.63	35.13	29.44	29.88	30.72	15.57	15.01
f. Oranges	519.66	498.29	503.58	533.52	525.25	500.49	355.02	271.96	230.67	69.24	77.62	86.70
g. Naranjillas	22.42	13.89	13.28	7.79	11.50	12.76	15.54	11.67	18.51	21.22	6.20	16.77
h. Pineapples	118.12	125.35	124.97	135.01	140.19	136.75	92.29	65.07	70.05	65.49	30.97	22.90
i. Watermelon	15.47	29.17	18.68	31.68	33.55	14.71	14.09	26.66	35.25	33.92	92.37	135.99

Source: MAG 1965-1985; INEC/SEAN.

[a] Raw Cotton (fiber and seeds).
[b] Includes sugarcane for sugar and for other uses for 1965-1985. Data for 1986-1988 are for cane for sugar.

Appendix Table 6.3 Harvested Cropland and Pastures, Ecuador, 1965-1988 (1,000 hectares)

Crop / Year	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
I. Crops (Total)	1,751.13	1,817.49	1,894.56	1,776.95	1,700.56	1,679.60	1,681.69	1,637.53	1,568.63	1,661.83	1,665.59	1,730.42
A. Principal Crops	1,691.97	1,754.61	1,847.64	1,709.41	1,684.93	1,661.37	1,667.32	1,630.25	1,558.16	1,636.73	1,651.35	1,669.76
1. Grains	636.75	586.18	701.24	581.47	608.94	588.42	604.11	618.19	489.05	491.00	543.92	547.65
a. Rice	102.86	110.62	113.51	111.82	91.67	86.59	56.58	91.39	84.75	102.69	122.37	134.79
b. Hard corn	178.03	155.03	211.18	148.06	76.70	80.20	110.70	101.80	140.85	161.60	165.00	171.21
c. Soft corn	129.92	112.27	152.93	107.22	214.69	211.48	241.30	249.99	123.77	109.61	108.76	117.76
d. Wheat	68.90	65.04	79.58	79.34	100.23	76.23	75.56	56.05	46.50	56.26	76.23	52.35
e. Barley	157.04	143.22	144.04	135.03	125.65	133.92	119.97	118.96	93.18	60.84	71.56	71.60
2. Legumes (dry)	126.03	150.39	147.09	163.21	129.86	138.34	115.15	94.36	102.87	99.19	101.95	101.52
a. Beans	54.67	81.66	79.40	86.34	84.87	81.64	67.14	62.14	66.34	66.18	62.55	67.92
b. Peas	29.67	30.80	30.95	40.96	22.17	30.40	22.68	16.66	15.50	14.46	16.97	16.03
c. Lentils	4.71	2.54	3.15	2.32	2.08	2.29	2.62	2.30	3.58	3.70	3.56	3.19
d. Broad beans	36.98	35.39	33.59	33.59	20.74	24.01	22.71	13.26	17.45	14.85	18.87	14.38
3. Tubers	72.66	72.31	83.98	78.12	78.89	84.86	92.78	81.48	99.88	90.14	85.59	82.48
a. Potatoes	44.48	44.34	48.21	49.16	41.42	47.22	53.45	37.73	43.58	39.14	39.50	41.22
b. Cassava	25.02	24.79	33.62	26.68	34.60	34.79	37.04	40.67	54.11	48.89	43.35	38.49
c. Sweet potatoes	3.16	3.18	2.15	2.28	2.87	2.85	2.29	3.08	2.19	2.11	2.74	2.77
4. Oils	65.95	63.97	58.46	52.56	54.77	35.88	56.47	59.69	94.15	122.81	75.93	79.42
a. Oilpalm	0.73	1.24	1.38	1.93	2.93	4.82	6.41	7.85	8.59	10.41	11.58	14.37
b. Cotton	27.26	23.90	23.70	21.03	21.73	8.72	8.24	13.87	23.07	45.93	37.14	26.35
c. Soybeans	0.43	0.13	0.25	0.12	0.33	0.61	0.95	0.72	1.20	3.08	8.22	10.02
d. Castor beans	23.35	23.70	21.59	15.83	23.44	15.56	30.56	25.58	45.89	43.95	3.23	16.72
e. Peanuts	14.18	15.00	11.54	13.65	6.34	6.17	10.31	11.67	15.40	19.44	15.76	11.96
5. Exports	756.51	847.45	823.37	799.46	773.76	774.37	762.79	737.73	733.88	771.47	783.08	804.42
a. Bananas	210.35	186.68	202.71	195.09	190.17	193.56	181.05	170.74	161.90	151.78	124.63	120.42
b. Cacao	247.41	290.75	264.06	252.79	228.35	228.26	219.08	217.92	213.11	221.73	229.54	252.32
c. Coffee	165.90	217.76	208.34	191.23	214.46	214.83	214.63	221.33	227.90	231.89	230.67	246.69
d. Sugarcane [b]	96.93	112.53	108.01	121.83	104.98	99.94	108.74	88.42	89.17	100.81	114.64	91.29
e. Manila Hemp	0.22	0.25	0.12	0.43	0.60	1.85	2.10	3.30	6.52	7.37	8.18	10.85
f. Plantains	35.70	39.48	40.13	38.09	35.20	35.93	36.99	36.02	35.28	57.89	75.42	72.85
6. Vegetables	13.50	12.72	11.34	10.56	13.58	13.82	9.85	10.57	8.87	8.21	9.13	9.19
a. Garlic	2.10	1.14	0.90	0.90	0.69	0.69	0.72	1.03	0.70	0.67	0.66	0.90
b. Onions	7.23	6.67	6.46	5.73	9.53	9.69	5.79	5.69	4.50	3.87	4.34	4.03
c. Cabbage	2.06	2.10	2.16	2.34	2.28	2.29	2.09	2.12	1.75	1.62	1.84	1.66
d. Tomatoes	2.11	2.81	1.82	1.59	1.08	1.15	1.25	1.73	1.92	2.05	2.29	2.60
7. Fruits	20.57	21.59	22.16	24.03	25.13	25.68	26.17	28.23	29.46	53.91	51.75	45.08
a. Avocados	2.45	2.28	3.04	3.01	2.80	2.90	2.03	3.17	3.01	5.25	4.89	4.63
b. Peaches	0.80	0.69	0.47	0.65	0.58	0.59	0.67	0.76	0.74	0.66	0.64	0.64
c. Lemons	1.63	1.75	1.72	1.65	1.60	1.63	1.47	1.48	1.38	2.80	3.21	2.67
d. Tangerines	0.81	0.82	0.87	1.11	1.01	1.05	1.04	1.07	1.52	1.72	1.93	2.60
e. Apples	0.61	0.70	0.77	0.90	0.89	0.91	1.91	2.38	2.64	2.73	2.92	2.86
f. Oranges	7.49	7.90	7.64	8.40	8.93	9.10	10.41	11.04	11.87	12.64	13.69	16.63
g. Naranjillas	2.68	3.29	3.11	3.87	3.45	3.57	3.01	3.85	4.94	21.67	15.93	5.86
h. Pineapples	2.72	2.87	2.67	3.19	3.58	3.63	3.25	3.25	2.44	5.48	7.35	7.53
i. Watermelon	1.38	1.29	1.87	1.25	2.29	2.30	2.38	1.23	0.92	0.96	1.19	1.46
B. Other Crops	59.16	62.88	46.92	67.54	15.63	18.23	14.37	7.28	10.47	25.10	14.24	60.66
II. Pastures (Total)	1,519.20	1,624.25	1,778.28	1,840.50	1,832.50	1,832.70	2,201.30	2,189.90	2,314.26	2,661.89	3,003.50	3,412.00
A. Sierra Provinces	842.00	921.65	934.08	1,047.00	1,032.50	1,046.50	1,069.50	970.20	1,049.86	1,186.20	1,461.50	1,620.00
B. Coastal Provinces	466.50	484.00	597.00	500.00	535.00	549.20	751.00	791.50	875.25	927.40	1,042.00	1,290.00
C. Oriente & Galapagos	210.70	218.60	247.20	293.50	265.00	287.00	380.80	428.20	389.15	548.29	560.00	502.00
III. Total Land	3,270.33	3,441.74	3,672.84	3,617.45	3,533.06	3,562.30	3,882.99	3,827.43	3,882.89	4,323.72	4,729.09	5,142.42

Source: MAG 1965-1985; INEC/SEAN.

[a] Annual growth rate estimated with Exponencial Curve Fit: $y = ae^{bx}$, $a>0$; and $y>0$.
[b] Includes sugarcane for sugar and for other uses for 1965-1985. Data for 1986-1988 are for cane for sugar only.

Appendix Table 6.3 Harvested Cropland and Pastures, Ecuador, 1965-1988 (1,000 hectares) (Continued, p. 2)

Crop / Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1965/85 Annual Growth [a]
I. Crops (Total)	1,589.66	1,416.19	1,457.10	1,541.54	1,600.51	1,552.42	1,436.90	1,579.26	1,730.54	2,238.82	2,242.70	2,338.39	-0.81
A. Principal Crops	1,560.87	1,385.38	1,421.20	1,502.48	1,560.90	1,508.88	1,393.71	1,533.82	1,621.86	2,071.72	2,110.60	2,143.79	-0.88
1. Grains	454.95	324.73	390.79	410.85	441.81	414.33	356.21	439.36	415.20	770.88	821.10	813.82	-2.33
a. Rice	107.05	81.30	110.87	126.61	131.28	131.72	94.85	139.08	149.90	227.84	275.90	287.56	1.66
b. Hard corn	163.00	132.50	170.37	166.70	184.73	155.40	145.30	182.80	174.30	261.30	258.90	245.72	1.36
c. Soft corn	84.00	52.05	48.41	59.20	59.76	61.09	60.55	62.28	43.45	176.40	185.50	180.01	-6.71
d. Wheat	40.90	26.88	30.37	32.10	37.19	33.06	25.75	24.50	18.11	41.10	39.40	39.44	-6.74
e. Barley	60.00	32.00	30.77	26.24	29.85	33.06	29.76	30.70	29.44	64.24	61.40	61.09	-9.89
2. Legumes (dry)	85.56	55.05	65.58	70.67	75.51	71.16	53.65	59.77	51.94	65.33	69.50	68.19	-5.29
a. Beans	59.00	39.12	44.87	48.16	53.52	50.98	36.84	44.31	39.74	42.21	42.20	43.45	-3.46
b. Peas	10.30	8.61	13.13	13.97	14.00	12.48	8.56	8.60	6.79	13.03	14.60	12.92	-7.06
c. Lentils	1.16	0.84	0.67	0.67	0.92	0.83	0.71	0.43	0.56	2.18	2.20	2.89	-9.67
d. Broad beans	15.10	6.48	6.91	7.87	7.07	6.87	7.54	6.43	4.85	8.51	10.50	8.93	-9.63
3. Tubers	68.36	54.51	47.76	56.16	58.32	56.00	48.12	59.03	59.59	74.21	79.30	69.73	-2.46
a. Potatoes	36.00	29.64	26.89	30.38	31.60	35.10	26.74	33.49	36.58	53.60	56.10	47.49	-2.46
b. Cassava	31.02	23.82	20.04	25.17	26.00	19.92	20.10	23.99	22.21	19.90	22.40	20.85	-2.11
c. Sweet potatoes	1.34	0.85	0.83	0.61	0.72	0.98	1.29	1.55	0.80	0.71	0.80	1.39	-6.88
4. Oils	76.81	72.16	83.25	88.34	86.47	76.13	57.73	76.69	95.22	120.56	186.60	163.00	2.14
a. Oilpalm	14.26	14.26	17.64	25.67	26.00	26.80	28.54	29.19	34.24	44.00	48.10	52.52	19.66
b. Cotton	26.20	20.40	20.20	19.41	24.09	17.40	10.37	9.24	16.51	24.77	25.10	26.44	-1.52
c. Soybeans	14.83	16.93	22.23	24.94	21.10	21.32	10.05	28.36	34.66	39.30	81.10	72.65	34.80
d. Castor beans	9.52	9.26	10.05	6.71	4.34	3.11	2.63	2.10	1.62	1.40	2.80	1.96	-12.43
e. Peanuts	12.00	11.31	13.13	11.61	10.94	7.50	6.14	7.10	8.19	11.09	9.50	9.43	-1.95
5. Exports	818.74	826.20	781.31	819.67	839.71	834.10	822.87	844.91	948.09	992.21	930.30	979.10	0.52
a. Bananas	100.54	77.86	67.55	70.49	64.00	65.00	59.30	60.64	65.18	112.00	119.50	127.23	-7.31
b. Cacao	238.00	287.19	269.99	269.88	270.00	277.00	270.00	265.05	286.78	326.41	310.80	325.73	0.70
c. Coffee	260.00	270.06	261.64	288.00	320.90	321.88	338.97	344.98	426.97	420.50	383.10	381.13	3.53
d. Sugarcane [b]	109.30	104.28	103.08	107.75	104.36	92.26	79.91	88.85	87.20	42.20	44.20	44.07	-0.85
e. Manila Hemp	13.00	14.40	14.40	13.80	13.54	11.80	11.60	20.78	13.51	14.00	16.60	17.83	26.89
f. Plantains	97.90	72.41	64.65	69.75	66.91	66.16	63.09	64.61	68.45	78.10	56.10	83.11	4.27
6. Vegetables	8.32	7.03	6.94	7.56	9.38	9.03	9.06	11.75	12.55	15.54	14.80	15.66	-1.57
a. Garlic	0.35	0.20	0.23	0.40	0.41	0.54	0.53	0.52	0.51	0.95	0.60	0.42	-5.73
b. Onions	3.97	2.77	3.06	3.33	4.74	4.73	4.59	5.75	6.42	8.67	7.80	7.84	-2.70
c. Cabbage	1.46	1.10	1.13	1.27	1.36	1.45	1.52	1.74	1.48	1.12	0.70	0.62	-2.81
d. Tomatoes	2.54	2.96	2.52	2.56	2.87	2.31	2.42	3.74	4.14	4.80	5.70	6.78	3.88
7. Fruits	48.13	45.70	45.57	49.23	49.70	48.13	46.07	42.31	39.27	31.39	29.00	34.29	4.66
a. Avocados	2.66	2.71	2.73	2.82	2.89	2.94	2.95	3.27	3.39	3.46	3.20	3.71	0.85
b. Peaches	0.53	0.50	0.50	0.51	0.51	0.51	0.53	0.51	0.50	0.55	1.10	1.18	-1.65
c. Lemons	1.30	1.35	1.37	1.38	1.45	1.48	1.54	1.78	2.24	2.38	1.90	1.18	-0.05
d. Tangerines	3.27	3.29	3.33	3.37	3.40	3.40	3.46	3.10	3.15	2.05	1.40	1.99	9.16
e. Apples	3.27	3.13	3.15	3.20	3.20	3.23	3.12	2.85	2.83	2.89	2.39	3.74	8.86
f. Oranges	23.44	22.91	23.10	25.19	25.18	25.15	24.62	21.62	17.73	10.48	8.90	10.78	7.13
g. Naranjillas	4.75	2.53	2.51	2.20	2.51	2.48	2.92	2.86	3.36	3.92	2.20	3.53	-1.33
h. Pineapples	7.65	7.25	7.27	7.97	7.84	7.66	5.78	4.56	4.01	3.58	2.60	2.57	4.95
i. Watermelon	1.26	2.03	1.61	2.59	2.72	1.28	1.15	1.76	2.06	2.08	5.40	5.61	0.74
B. Other Crops	28.79	30.81	35.90	39.06	39.61	43.54	43.19	45.44	108.68	167.20	132.10	194.60	0.39
II. Pastures (Total)	3,500.00	3,516.42	3,921.92	4,016.77	4,217.59	4,419.76	4,375.35	4,377.33	4,432.70	4,477.59	4,885.10	4,873.90	6.23
A. Siera Provinces	1,670.00	1,674.10	1,670.78	1,704.50	1,794.18	1,858.83	1,901.41	1,942.46	1,891.00	1,958.03	1,831.90	1,829.40	4.64
B. Coastal Provinces	1,323.00	1,577.30	1,910.03	1,953.90	2,082.75	2,122.44	2,057.08	1,970.36	2,038.70	2,018.52	2,188.80	2,184.20	9.35
C. Oriente & Galapagos	507.00	265.02	341.11	358.37	340.66	438.49	416.86	464.51	503.00	501.04	864.40	860.30	3.12
III. Total Land	5,089.66	4,932.61	5,379.02	5,558.31	5,818.10	5,972.18	5,812.25	5,956.59	6,163.24	6,716.51	7,127.80	7,212.29	3.56

Source: MAG 1965-1985; INEC/SEAN.

[a] Annual growth rate estimated with Exponencial Curve Fit: $y = ae^{bx}$, $a>0$; and $y>0$.
[b] Includes sugarcane for sugar and for other uses for 1965-1985. Data for 1986-1988 are for cane for sugar only.

Appendix Table 6.4 Yields of Pricipal Crops, Ecuador, 1965-1988 (metric tons/hectares)

Crop / Year	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976
1. Grains												
a. Paddy Rice	2.30	2.26	2.11	1.24	2.99	2.85	3.55	2.71	3.27	3.46	3.67	2.93
b. Hard Corn	0.72	0.77	0.73	0.59	1.06	1.27	1.09	0.99	1.09	1.15	1.23	1.22
c. Soft Corn	0.46	0.50	0.48	0.39	0.66	0.79	0.58	0.68	0.81	0.70	0.83	0.90
d. Wheat	0.94	0.96	0.99	1.04	0.94	1.06	0.91	0.90	0.97	0.98	0.85	0.89
e. Barley	0.59	0.54	0.57	0.56	0.62	0.82	0.57	0.62	0.85	0.92	0.88	0.86
2. Legumes (dry)												
a. Beans	0.57	0.45	0.48	0.41	0.45	0.51	0.45	0.42	0.48	0.42	0.42	0.49
b. Peas	0.61	0.59	0.58	0.54	0.50	0.69	0.62	0.59	0.58	0.65	0.57	0.54
c. Lentils	0.36	0.32	0.31	0.37	0.55	0.41	0.28	0.39	0.43	0.61	0.53	0.56
d. Broad beans	0.63	0.58	0.59	0.59	0.53	0.75	0.65	0.71	0.71	0.78	0.83	0.91
3. Tubers												
a. Potatoes	8.78	7.83	8.27	10.39	11.03	11.47	12.74	12.55	12.37	12.86	12.64	13.34
b. Cassava	10.01	9.02	7.78	7.15	11.28	10.67	10.34	9.27	13.70	17.13	13.78	9.82
c. Sweet potatoes	2.58	2.48	3.65	3.02	3.94	4.05	2.98	2.89	3.82	5.03	4.96	4.88
4. Oils												
a. Oilpalm	2.79	3.40	4.62	4.72	4.52	4.38	4.91	5.67	6.79	7.29	8.16	7.76
b. Cotton	0.34	0.83	0.66	0.66	1.09	0.87	1.30	0.83	0.85	0.91	0.81	0.82
c. Soybeans	0.84	0.85	0.84	0.92	0.91	0.98	1.15	1.17	1.28	1.42	1.50	1.50
d. Castor oil	1.05	1.05	1.24	0.58	1.01	1.06	1.13	0.90	1.12	0.91	1.05	0.79
e. Peanuts	0.77	0.78	0.76	0.45	0.92	0.85	0.95	0.92	0.81	0.88	0.72	0.66
5. Exports												
a. Bananas	10.56	13.51	12.62	14.17	15.94	16.30	18.30	17.94	19.79	22.38	20.62	22.99
b. Cacao	0.19	0.17	0.23	0.20	0.21	0.23	0.32	0.27	0.29	0.41	0.32	0.21
c. Coffee	1.53	1.24	1.39	1.49	0.97	1.58	1.36	1.51	1.55	1.41	1.56	1.66
d. Sugarcane	83.43	80.02	69.70	78.21	51.99	56.15	51.01	63.07	61.42	65.94	67.37	69.46
e. Manila Hemp	0.73	0.76	0.75	0.74	0.75	1.94	2.14	1.32	1.00	1.28	1.21	1.21
f. Plantains	9.92	10.19	10.16	11.58	13.73	12.92	11.92	11.43	12.66	12.97	10.89	12.29
6. Vegetables												
a. Garlic	1.90	3.87	3.36	3.38	5.59	6.36	7.42	8.15	5.51	6.10	5.86	7.46
b. Onions	15.80	16.71	15.09	12.38	10.06	9.79	13.26	9.96	7.48	8.91	10.50	14.36
c. Cabagge	28.14	26.30	51.30	30.90	40.77	34.05	38.89	29.05	26.24	25.30	23.59	27.81
d. Tomatoes	10.47	8.13	12.96	15.33	23.32	20.85	19.54	15.34	12.75	16.26	16.26	16.36
7. Fruits												
a. Avocados	9.78	10.08	9.01	10.23	8.49	8.05	5.75	8.58	8.08	5.58	6.53	8.47
b. Peaches	3.71	4.26	3.57	5.34	4.29	4.24	3.88	3.82	4.19	4.30	4.88	5.80
c. Lemons	14.76	13.96	13.51	11.99	9.57	9.46	8.99	5.30	5.82	10.15	11.66	7.35
d. Tangerines	12.98	13.80	11.61	12.22	10.95	12.33	5.07	4.20	11.12	7.03	9.46	12.24
e. Apples	2.67	3.99	4.23	3.40	5.10	5.21	2.94	2.34	1.43	6.96	7.83	8.12
f. Oranges	22.38	20.84	23.77	17.04	17.34	16.80	16.60	13.86	12.10	18.80	20.09	19.48
g. Naranjillas	14.63	15.61	15.24	19.17	7.29	6.39	9.26	7.30	5.41	4.23	4.15	7.53
h. Pineapples	20.19	21.72	20.71	17.27	16.00	16.28	17.22	22.48	18.27	17.81	31.76	17.27
i. Watermelon	6.60	6.26	10.66	6.61	2.39	2.82	2.99	3.82	8.92	9.54	11.87	14.03

Source: MAG 1965-1985; INEC/SEAN.

[a] Annual growth rate estimated with Exponential Curve Fit: $y = ae^{bx}$, $a>0$; and $y>0$.

Appendix Table 6.4 Yields of Pricipal Crops, Ecuador, 1965-1988 (metric tons/hectares) (Continued, p. 2)

Crop / Year	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	Annual Growth[a] (%)
1. Grains													
a. Paddy Rice	3.06	2.77	2.87	3.01	3.31	2.92	2.88	3.14	2.65	2.53	2.83	3.32	1.66
b. Hard Corn	1.01	1.03	1.07	1.18	1.26	1.73	1.27	1.47	1.62	1.21	1.15	1.25	3.51
c. Soft Corn	0.65	0.75	0.73	0.76	0.81	0.90	0.73	0.91	0.82	0.49	0.48	0.50	2.96
d. Wheat	0.97	1.08	1.03	0.97	1.11	1.17	1.05	1.03	1.02	0.80	0.80	0.87	0.54
e. Barley	0.68	0.68	0.67	0.93	0.94	1.07	0.99	0.81	0.91	0.68	0.71	0.83	2.70
2. Legumes (dry)													
a. Beans	0.44	0.48	0.52	0.55	0.55	0.56	0.55	0.59	0.63	0.51	0.52	0.59	1.20
b. Peas	0.48	0.52	0.50	0.53	0.53	0.58	0.55	0.59	0.69	0.42	0.24	0.26	-0.17
c. Lentils	0.43	0.45	0.52	0.66	0.63	0.63	0.49	0.53	0.45	0.28	0.52	0.29	2.66
d. Broad beans	0.53	0.53	0.59	0.58	0.73	0.76	0.70	0.73	0.64	0.77	0.48	0.45	0.56
3. Tubers													
a. Potatoes	11.58	11.50	9.46	10.64	12.39	11.86	11.74	11.63	11.57	7.25	6.31	7.12	1.15
b. Cassava	7.21	7.05	9.11	9.11	9.11	9.23	9.69	9.97	10.30	5.93	5.86	5.91	-0.07
c. Sweet potatoes	4.68	4.65	5.01	4.43	5.01	5.46	5.13	5.35	8.48	6.34	3.83	4.53	4.17
4. Oils													
a. Oilpalm	8.75	8.75	9.34	9.54	11.54	11.54	12.41	12.76	13.37	14.95	14.30	12.84	7.50
b. Cotton	1.03	1.30	1.25	2.05	1.74	1.45	0.40	0.79	1.14	1.49	0.80	0.91	2.82
c. Soybeans	1.30	1.50	1.34	1.35	1.57	1.75	1.40	1.67	1.81	1.94	1.80	1.81	3.81
d. Castor oil	1.01	0.78	0.91	0.91	0.90	0.81	0.90	0.90	1.03	1.05	0.90	0.50	-0.63
e. Peanuts	0.70	0.82	1.30	1.17	1.16	0.73	0.83	0.84	0.94	1.00	0.68	0.64	1.32
5. Exports													
a. Bananas	24.38	27.64	30.07	32.20	31.40	30.75	27.70	27.66	30.22	20.72	19.97	20.25	5.32
b. Cacao	0.30	0.25	0.29	0.34	0.30	0.35	0.17	0.18	0.46	0.28	0.19	0.26	1.78
c. Coffee	1.49	1.31	1.61	1.13	1.26	1.23	0.83	1.33	0.78	1.15	0.97	0.90	-1.47
d. Sugarcane	68.78	66.43	64.02	61.39	60.16	58.76	70.33	74.92	57.28	65.20	67.89	58.90	-0.38
e. Manila Hemp	1.27	0.74	0.74	0.80	0.68	0.60	0.65	0.88	0.74	0.49	0.96	1.24	-1.50
f. Plantains	7.86	11.00	10.41	10.77	11.38	11.39	10.89	11.52	13.81	9.93	15.12	11.34	0.15
6. Vegetables													
a. Garlic	6.57	5.30	4.83	4.78	5.02	5.20	5.36	5.21	5.31	1.62	2.58	3.56	1.99
b. Onions	8.32	8.81	8.63	9.04	8.89	8.81	8.86	8.82	8.64	4.25	5.67	7.13	-2.69
c. Cabagge	29.64	24.06	18.44	19.49	18.65	15.75	17.36	18.18	17.51	12.51	14.91	15.56	-4.09
d. Tomatoes	13.30	12.39	12.80	14.90	14.74	15.92	14.86	17.11	15.63	14.06	12.85	17.43	0.70
7. Fruits													
a. Avocados	15.21	11.56	10.62	10.30	10.59	10.57	10.02	9.96	8.37	5.86	6.26	4.41	0.91
b. Peaches	4.72	4.44	5.58	5.84	6.18	5.96	6.04	5.98	6.64	6.11	4.25	2.73	2.64
c. Lemons	11.94	8.75	11.46	12.89	11.21	10.68	9.18	9.47	9.83	9.97	6.40	9.37	-0.69
d. Tangerines	8.46	8.38	8.52	9.15	10.27	9.85	8.41	10.02	10.89	10.63	6.53	7.88	-0.83
e. Apples	8.46	9.75	9.76	9.65	10.60	10.72	11.26	10.33	10.56	10.63	6.77	4.01	7.88
f. Oranges	22.17	21.75	21.80	21.18	20.86	19.90	14.42	12.58	13.01	6.61	8.72	8.04	-0.90
g. Naranjillas	4.72	5.49	5.29	3.54	4.58	5.15	5.32	4.08	5.51	5.41	2.82	4.75	-6.04
h. Pineapples	15.44	17.29	17.19	16.94	17.88	17.85	15.97	14.27	17.47	18.29	11.91	8.91	-0.95
i. Watermelon	12.28	14.37	11.60	12.23	12.33	11.49	12.25	15.15	17.11	16.31	17.11	24.24	6.72

Source: MAG 1965-1985; INEC/SEAN.

[a] Annual growth rate estimated with Exponential Curve Fit: $y = ae^{bx}$, $a>0$; and $y>0$.

Appendix Table 6.5 Harvested Area, Yields and Production for Principal Crops, Annual Averages, 1965-1969 and 1980-1985

Crop	1965-1969			1980-1985 [a]		
	Area (has) (Ao)	Yield (kgs/ha) (Yo)	Production (mt) (Po)	Area (has) (At)	Yield (kgs/ha) (Yt)	Production (mt) (Pt)
1. Grains						
Paddy Rice	106,096	2,179	231,224	135,718	3,005	407,886
Hard corn	153,800	774	119,046	172,786	1,453	251,079
Soft corn	143,406	497	71,201	57,156	840	48,021
Wheat	78,618	974	76,543	28,992	1,059	30,704
Barley	140,996	576	81,159	29,658	932	27,635
2. Legumes (dry)						
Beans	77,388	471	36,480	47,342	575	27,226
Peas	30,910	564	17,426	11,168	586	6,542
Lentils	2,960	382	1,129	682	579	395
Broad beans	32,058	584	18,723	6,618	688	4,554
3. Tubers						
Potatoes	45,522	9,260	421,532	33,430	11,619	388,431
Cassava	28,942	9,049	261,900	23,458	9,545	223,906
Sweet potato	2,728	3,135	8,552	932	5,745	5,354
4. Oils						
Oilpalm	1,642	4,012	6,588	28,380	11,750	333,464
Cotton	23,524	719	16,922	17,470	1,434	25,045
Soybeans	252	870	219	26,076	1,632	42,565
Castor beans	21,582	987	21,300	3,576	911	3,259
Peanuts	12,142	736	8,935	9,068	968	8,777
5. Exports						
Bananas	197,000	13,359	2,631,672	65,062	30,445	1,980,829
Cacao	256,672	200	51,339	273,742	325	88,998
Coffee	199,538	1,325	264,381	340,546	1,146	390,264
Sugarcane	108,856	72,670	7,910,566	96,084	62,502	6,005,442
Manila Hemp	324	746	242	14,686	742	10,895
Plantains	37,720	11,116	419,295	67,176	11,773	790,845
6. Vegetables						
Garlic	1,146	3,619	4,148	476	5,106	2,430
Onions	7,124	14,008	99,793	4,994	8,840	44,147
Cabbage	2,188	35,483	77,637	1,460	17,914	26,155
Tomatoes	1,882	14,043	26,428	3,124	15,661	48,924
7. Fruits						
Avocados	2,716	9,517	25,849	3,062	9,959	30,494
Peaches	638	4,236	2,702	508	6,120	3,109
Lemons	1,670	12,758	21,306	1,666	10,818	18,023
Tangerines	924	12,311	11,376	3,284	10,036	32,958
Apples	774	3,879	3,002	3,062	10,373	31,761
Oranges	8,072	20,274	163,654	22,974	17,506	402,179
Naranjillas	3,280	14,389	47,195	2,682	4,571	12,261
Pineapples	3,006	19,179	57,651	6,408	16,882	108,183
Watermelon	1,616	6,504	10,510	2,082	13,664	28,448

Source: Appendix Tables 6.3 and 6.4.

[a] Data for 1983 are excluded from the average because of extremely bad weather which caused abnormally low production.

Appendix Table 7.1 INHERI Expenses by Programs and Activities, 1985-1988 (thousands of current sucres)

Activity	Central Management	Water Management	Irrigation Management	Construction & Operation	Planning	Total
-- 1985 --						
Studies	899.8	979.1	150.0	70,518.1	370.0	72,917.0
Construction				1,927,868.6		1,927,868.6
Operation				31,398.0		31,398.0
Maintenance	1,129.3			44,276.5		45,405.8
Ag. Development				31,052.4		31,052.4
Adm. Expenses	174,134.4	20,498.3	3,020.5	353,716.9	10,520.8	561,890.9
Fixed Assets	42,416.1	1,618.8	76.7	244,416.5	1,159.0	289,687.1
Payment/Debt	87,019.4					87,019.4
Water Agencies		49,392.0				49,392.0
Total	305,599.0	72,408.2	3,247.2	2,703,247.0	12,049.8	3,096,631.2
	9.87%	2.34%	0.10%	87.30%	0.39%	100.00%
-- 1986 --						
Studies	275.0	5,646.6		153,722.8		159,644.4
Construction	2,427.1			2,456,583.7		2,459,010.8
Operation				38,359.1		38,359.1
Maintenance				64,108.2		64,108.2
Ag. Development				34,094.5		34,094.5
Adm. Expenses	220,466.6	38,277.1	5,617.0	528,631.7	18,884.2	811,876.6
Fixed Assets	8,175.1	4,134.2	17.1	190,738.2	248.9	203,313.5
Payment/Debt	80,929.8					80,929.8
Water Agencies		84,098.4				84,098.4
Total	312,273.6	132,156.3	5,634.1	3,466,238.2	19,133.1	3,935,435.3
	7.93%	3.36%	0.14%	88.08%	0.49%	100.00%
-- 1987 --						
Studies		5,731.5	195.0	92,712.3	1,296.5	99,935.3
Construction	46,280.0			2,414,315.3		2,460,595.3
Operation				54,205.4		54,205.4
Maintenance	16,612.9			73,168.4		89,781.3
Ag. Development				24,444.8		24,444.8
Adm. Expenses	253,174.0	36,577.8	7,088.1	724,135.7	23,823.6	1,044,799.2
Fixed Assets	72,856.8	2,252.7		151,212.9		226,322.4
Payment/Debt	94,855.1					94,855.1
Water Agencies		123,042.9				123,042.9
Total	483,778.8	167,604.9	7,283.1	3,534,194.8	25,120.1	4,217,981.7
	11.47%	3.97%	0.17%	83.79%	0.60%	100.00%
-- 1988 --						
Studies		1,259.3	520.0	105,391.3	2,800.0	109,970.6
Construction				3,611,569.0		3,611,569.0
Operation				60,047.6		60,047.6
Maintenance	3,652.3			74,572.9		78,225.2
Ag. Development				22,389.6		22,389.6
Adm. Expenses	371,782.3	52,381.3	5,912.8	1,042,005.7	25,769.4	1,497,851.5
Fixed Assets	61,124.5			85,174.5		146,299.0
Payment/Debt	67,804.6					67,804.6
Water Agencies		150,877.7				150,877.7
Total	504,363.7	204,518.3	6,432.8	5,001,150.6	28,569.4	5,745,034.8
	8.78%	3.56%	0.11%	87.05%	0.50%	100.00%

Source: INHERI Departament of Evaluation.

Appendix Table 7.2 INHERI Expenses by Programs and Activities, 1985-1988 (thousand of 1988 sucres)

Activity	Central Management	Water Management	Irrigation Management	Construction & Operation	Planning	Total
-- 1985 --						
Studies	2,260.2	2,468.1	378.1	177,762.9	932.7	183,810.1
Construction				4,859,794.7		4,859,794.7
Operation				79,148.5		79,148.5
Maintenance	2,846.8			111,612.7		114,459.5
Ag. Development				78,277.3		78,277.3
Adm. Expenses	438,960.1	51,672.4	7,614.1	891,653.9	26,521.0	1,416,421.4
Fixed Assets	106,923.0	4,080.7	193.3	616,128.1	2,921.6	730,246.8
Payment/Debt	219,359.6					219,359.6
Water Agencies		124,508.0				124,508.0
Total	770,357.7	182,729.1	8,185.6	6,814,378.0	30,375.3	7,806,025.7
	9.87%	2.34%	0.10%	87.30%	0.39%	100.00%
-- 1986 --						
Studies	563.5	11,570.5		314,993.8		327,127.7
Construction	4,973.4			5,033,791.9		5,038,765.3
Operation				78,601.7		78,601.7
Maintenance				131,364.3		131,364.3
Ag. Development				69,863.1		69,863.1
Adm. Expenses	451,758.7	78,433.7	11,509.8	1,083,220.6	38,695.7	1,663,618.4
Fixed Assets	16,751.6	8,471.4	35.0	390,842.1	510.0	416,610.2
Payment/Debt	165,833.5	0.0				165,833.5
Water Agencies		172,326.2				172,326.2
Total	639,880.6	270,801.8	11,544.8	7,102,677.5	39,205.7	8,064,110.5
	7.93%	3.36%	0.14%	88.08%	0.49%	100.00%
-- 1987 --						
Studies		9,068.9	308.5	146,697.2	2,051.4	158,126.1
Construction	73,228.1			3,820,133.8		3,893,361.9
Operation				85,768.4		85,768.4
Maintenance	26,286.3			115,773.2		142,059.6
Ag. Development				38,678.6		38,678.6
Adm. Expenses	400,593.3	57,876.5	11,215.4	1,145,788.7	37,695.7	1,653,169.6
Fixed Assets	115,280.2	3,564.4		239,261.8		358,106.4
Payment/Debt	150,087.8					150,087.8
Water Agencies		194,688.9				194,688.9
Total	765,475.7	265,198.6	11,523.9	5,592,101.8	39,747.1	6,674,047.2
	11.47%	3.97%	0.17%	83.79%	0.60%	100.00%
-- 1988 --						
Studies		1,259.3	520.0	105,391.3	2,800.0	109,970.6
Construction				3,611,569.0		3,611,569.0
Operation				60,047.6		60,047.6
Maintenance	3,652.3			74,572.9		78,225.2
Ag. Development				22,389.6		22,389.6
Adm. Expenses	371,782.3	52,381.3	5,912.8	1,042,005.7	25,769.4	1,497,851.5
Fixed Assets	61,124.5			85,174.5		146,299.0
Payment/Debt	67,804.6					67,804.6
Water Agencies		150,877.7				150,877.7
Total	504,353.7	204,518.3	6,432.8	5,001,150.6	28,569.4	5,745,034.8
	8.78%	3.56%	0.11%	87.05%	0.50%	100.00%

Source: INHERI Departament of Evaluation.

Appendix Table 7.3 INERHI Human Resources and Salaries 1985-1988

Categories	Employees		Total Salaries		Average Salaries (sucres)	
	Number	Share (%)	Amount (S/.1,000)	Share (%)	Current Prices	Constant 1988 Prices
-- 1985 --						
Management	31	1.61	8,904.0	3.26	287,226	723,491
Profesional	346	17.98	72,184.8	26.40	208,627	525,508
Technical	120	6.24	17,534.4	6.41	146,120	368,060
Administrative	194	10.08	26,502.0	9.69	136,608	344,101
Unskilled labor	1,233	64.09	148,272.0	54.23	120,253	302,904
Total	1,924	100.00	273,397.2	100.00	142,098	357,930
-- 1986 --						
Management	32	1.49	10,091.0	2.94	315,344	646,196
Profesional	340	15.88	80 739.0	23.51	237,468	486,614
Technical	159	7.43	26,250.0	7.64	165,094	338,308
Administrative	253	11.82	38,426.0	11.19	151,881	311,232
Unskilled labor	1,357	63.38	187,857.0	54.71	138,436	283,679
Total	2,141	100.00	343,363.0	100.00	160,375	328,637
-- 1987 --						
Management	35	1.61	14,502.0	3.25	414,343	655,606
Profesional	433	19.97	127,623.6	28.64	294,743	466,365
Technical	112	5.17	21,357.6	4.79	190,693	301,729
Administrative	231	10.65	40,300.8	9.05	174,462	276,048
Unskilled labor	1,357	62.59	241,761.3	54.26	178,159	281,897
Total	2,168	100.00	445,545.3	100.00	205,510	325,174
-- 1988 --						
Management	35	1.61	14,592.0	2.58	416,914	416,914
Profesional	432	19.93	141,176.4	25.01	326,797	326,797
Technical	112	5.17	27,766.2	4.92	247,913	247,913
Administrative	232	10.70	53,737.8	9.52	231,628	231,628
Unskilled labor	1,357	62.59	327,308.4	57.97	241.200	241,200
Total	2,168	100.00	564,580.8	100.00	260,415	260,415

Source: INERHI Department of Evaluation.

Appendix Table 7.4 Principal Characteristics of INERHI Irrigation Projects in Operation, 1989

Project	Province	Command Area (Superficie Dominada) (hectares)	Irrigable Area (Superficie Regable) (hectares)	Irrigated in 1987 (hectares)	Volume of Water Contracted in 1987 (1000 m3)	Volume per Hectare Irrigated (m3/ha)	Value of Water Contracted in 1987 (S/.1000)	Project Efficiency (c/b) (%)	Project Efficiency (d/c) (%)	Degree of Completion[a] (%)	Families Benefited (number)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)
Total		139,630	79,289	52,004	994,763	19,128.6	142,076	56.79	65.59	79.4	42,832
1. Montufar	Carchi	4,000	2,800	2,238	37,126	16,588.8	4,482	70.00	79.93	96.8	870
2. San Vicente de P.	Carchi	600	400	360	11,353	31,536.0	1,173	66.67	90.00	100.0	452
3. Ambuqui	Imbabura	1,500	1,325	929	29,297	31,536.0	3,027	88.33	70.11	81.5	117
4. Salinas	Imbabura	2,400	2,100	2,070	55,979	27,043.2	5,963	87.50	98.57	96.8	72
5. Tabacundo I(Wells)	Pichincha	2,000	1,798	278	528	1,900.8	243	89.90	15.46	100.0	133
6. Pisque	Pichincha	14,880	6,275	6,082	153,442	25,228.8	20,647	42.17	96.92	93.8	3.065
7. Tumbaco	Pichincha	3,060	1,926	1,342	42,321	31,536.0	5,470	62.94	69.68	72.5	2.309
8. Lat./Sal./Ambato	Cotopaxi	9,270	8,400	6.438	130,578	20,282.4	18,416	90.61	76.64	98.0	14.312
9. Jimenez-Cevallos	Cotopaxi	700	700	627	13,576	21,651.8	1,886	100.00	89.57	100.0	634
10. Canal del Norte	Cotopaxi	1.350	1,000			NA		74.07	0.00	67.0	319
11. Pujili	Cotopaxi	223	201			NA		90.13	0.00		189
12. Pachanlica	Tungurahua	1,000	600	481	3,792	7,884.0	732	60.00	80.17	89.0	1.043
13. Garcia Moreno	Tungurahua	1,600	1,000	770	5,585	7,253.3	1,119	62.50	77.00	90.2	1.300
14. Patate	Tungurahua	1,200	700	400	4,807	12,016.4	787	58.33	57.14	66.7	500
15. Chambo	Chimborazo	9,600	6,300	4,896	108,080	22,075.2	14,953	65.63	77.71	56.7	9.000
16. Cebadas	Chimborazo	750	600	482	10,640	22,075.2	1,472	80.00	80.33	100.0	186
17. Yurac-Yacu	Chimborazo	300	300			NA		100.00		96.2	200
18. Vinchoa	Bolivar	400	400			NA		100.00		79.8	395
19. Machangara	Azuy	1.357	832	752	14.034	18,662.4	2,020	61.31	90.38	73.8	4,366
20. Tablon de Oña	Loja	1,000	1,000			NA		100.00	0.00	0.0	150
21. Macara	Loja	4,670	1,800	1,165	36,639	31,449.6	4,738	38.54	64.72	86.1	396
22. La Papaya	Loja	700	700			NA		100.00		83.0	150
23. La Era	Loja	500	400	81	2.100	25,920.0	281	80.00	20.25	100.0	200
24. El Ingenio	Loja	510	400			NA		78.43	0.00	90.7	350
25. Paquishapa	Loja	400	400			NA		100.00		88.6	?
26. Chucchucchir	Loja	250	250			NA		100.00		100.0	300
27. Quinara	Loja	510	400	85	2,056	24,192.0	279	78.43	21.25	100.0	125
28. Vilcabamba	Loja	300	300			NA		100.00	0.00	100.0	250
29. Milagro	Guayas	20,000	11,420	3,150	99,449	31,571.1	16,201	57.10	27.58	89.8	340
30. Chilintomo I	Los Rios	2,500	1,100	388	6,705	17,280.0	984	44.00	35.27	51.9	118
31. Manuel J. Calle	Guayas	50,000	22,000	18,864	224,765	11,915.0	36,914	44.00	85.75	58.1	267
32. Azucar	Guayas	500	243			NA		48.60		80.5	
33. Banco de Arena	Guayas	600	269	14	145	10,368.0	25	44.83	5.20	28.6	4
34. Chacras-Huaqui.	El Oro	300	250	112	1.766	15,768.0	266	83.33	44.80	61.9	120
35. El Tablon	El Oro	700	700					100.00		100.0	100

Source: INERHI Department of Operations.

[a] Calculated by dividing total expenditures through 1988 by planned projects costs (see Appendix Table 7.10).

Appendix Table 7.5 Principal Characteristics of Irrigation Projects in Operation, 1989

Entity/Project	Province	Command Area (Superficie Dominada) (hectares)	Irrigable Area (Superficie Regable) (hectares)	Irrigated in 1987 (hectares)	Project Efficiency (c/b) (%)	Project Efficiency (d/c) (%)	Families Benefited (number)
	(a)	(b)	(c)	(d)	(e)	(f)	(g)
A. GRAND TOTAL		510,735	445,244	417,959			48,405
B. Public Grand Total		180,735	115,244	87,959			48,405
C. Private		330,000	330,000	330,000	100.00	100.00	
D. INERHI		139,630	79,289	52,004	56.79	65.59	42,832
E. CEDEGE (Guayas R. Basin)		9,000	4,700	4,700	52.22	100.00	450
1. Babahoyo	Los Rios	9,000	4,700	4,700	52.22	100.00	450
F. CRM (Manabi)		3,500	2,650	2,650	76	100	1,500
1. Poza Honda	Manabi	3,500	2,650	2,650	75.71	100.00	1,500
G. CREA (Azuay, Canar, & Morona Santiago)		4,200	4,200	4,200	100.00	100.00	1,783
1. Cooperativa Surja	Canar	1,500	1,500	1,500	100.00	100.00	150
2. Checa-La Dolorosa	Azuay	800	800	800	100.00	100.00	500
3. Cochapata	Azuay	700	700	700	100.00	100.00	300
4. Paute	Azuay	660	660	660	100.00	100.00	780
5. Gualaceo	Azuay	540	540	540	100.00	100.00	53
H. Provinces		16,315	16,315	16,315	100.00	100.00	1,160
1. Pasaje-Machala	El Oro	7,000	7,000	7,000	100.00	100.00	550
2. Guabo	El Oro	3,000	3,000	3,000	100.00	100.00	180
3. Talaguro-Trabladeras	El Oro	1,000	1,000	1,000	100.00	100.00	80
4. Arenillas	El Oro	1,000	1,000	1,000	100.00	100.00	350
5. Others	Loja, Cotopaxi	4,315	4,315	4,315	100.00	100.00	
I. Municipalities		6,600	6,600	6,600	100.00	100.00	680
1. Pagua	El Oro	1,400	1,400	1,400	100.00	100.00	140
2. Belisario Quevedo	Cotopaxi	1,200	1,200	1,200	100.00	100.00	200
3. Salcedo	Cotopaxi	1,000	1,000	1,000	100.00	100.00	190
4. Tabacundo	Pichincha	715	715	715	100.00	100.00	150
5. Others (11)	Various, Mainly Sierra	2,285	2,285	2,285	100.00	100.00	
J. Others		1,490	1,490	1,490	100.00	100.00	
1. Ministry of A.		1,000	1,000	1,000	100.00	100.00	
2. INIAP		250	250	250	100.00	100.00	
3. CAME (Military Farms)		240	240	240	100.00	100.00	

Source: INERHI Department of Operations; Unpublished records of the regional agencies.

Appendix Table 7.6 INERHI Irrigation Projects under Construction, January 1989

Project	Province	Planned Command Area (hectares)	Families Benefited (number)	Planned Termination Date	Project Costs (Current sucres) Total (million)	To December 1988 (million)	Per Hectare (sucres)	Project Costs (1988 sucres) Total (million)	To December 1988 (million)	Per Hectare (sucres)	Internal Rate of Return (Feasability Study)
TOTAL		62,318	21,736		32,579.0	9,057.1	522,786	72,446.8	15,646.5	1,162,534	N/A
1. San Isidro Espejo	Carchi	600	420	1990	186.5	111.3	310,833	455.8	272.0	759,629	14.4
2. Monte Olivo	Carchi	600	200	1993	129.0	24.3	215,000	256.4	48.3	427,346	N/A
3. Santiaguillo-Cuambo	Imababura	170	56	1989	50.2	44.4	295,294	177.2	156.7	1,042,175	22.5
4. Poalo y Montecalio	Cotopaxi	250	300	1990	3.1	3.1	12,400	3.2	3.2	12.800	N/A
5. Ambato-Huachi-Pelileo	Tungurahua	9,885	8,000	1990	4,007.4	3,607.4	405,402	4,821.6	4,340.3	487.766	N/A
6. Pillaro	Tungurahua	8,870	5,504	1995	4,284.6	161.7	483,044	22,276.2	840.7	2,511,410	15.1
7. Quimiag	Chimborazo	700	1,500	1989	881.1	562.3	1.258,714	2,000.1	1,276.4	2,857.234	N/A
8. Santa Fe	Bolivar	820	400	1991	448.6	335.4	547,073	215.2	160.9	262,445	32.1
9. Marcopamba	Bolivar	200	50	1994	59.1	1.3	295,500	59.1	1.3	295,500	37.4
10. San Lorenzo	Bolivar	400	300	1991	139.5	69.5	348,750	127.3	63.4	318,140	36.0
11. Santa Isabel	Azuay	2,000	800	1991	822.0	659.6	411,000	1,228.9	986.1	614,444	30.0
12. Patococha	Canar	1,618	345	1989	439.8	332.6	271,817	804.4	608.3	497,133	23.6
13. Campana-Malacatos	Loja	900	350	1991	219.3	138.8	243,667	767.6	485.8	852,833	6.6
14. Chiriyacu-Lucero	Loja	1,600	650	1995	620.0	145.7	387,500	2,763.0	649.3	1,726,862	N/A
15. Santiago	Loja	1,200	300	1995	592.0	111.4	493,333	1,760.1	331.2	1,466,715	N/A
16. Rio Playas	Loja	420	200	ND	48.0	0.0	114,286	48.0	2.0	114,286	N/A
17. Airo-Florida	Loja	350	150	1991	169.7	70.1	484,857	526.3	217.4	1,503,680	N/A
18. Jorupe-Cangochara	Loja	1,000	450	1997	106.6	14.5	106,600	347.0	47.2	347,001	4.3
19. Sanambay-Jimbura	Loja	250	300	1993	40.7	11.8	162,800	247.3	71.7	989,217	14.0
20. Palmas-Mercadillo	Loja	200	200	ND	9.9	4.8	49,500	73.8	35.8	369,188	N/A
21. San Vicente	Los Rios	2,500	500	1994	1.475.4	389.6	590,160	4,611.4	1,217.7	1,844,553	N/A
22. Ines-Maria	Guayas	3,100	236	1992	303.0	13.5	97,742	1,173.8	52.3	378,659	34.8
23. Ducos-Rajaro	El Oro	1,685	300	1991	235.8	160.8	139,941	406.2	277.0	241.067	19.9
24. Tahuin	El Oro	7,400	225	1994	11,491.0	1,257.9	1,552,838	11,461.8	1,254.7	1.548,888	17.9
25. Jubones Phase I	El Oro	15,600	350	ND	5.816.7	825.3	372,865	15,835.4	2,246.8	1,015,090	18.6

Source: INERHI Department of Operations.

Appendix Table 7.7 Irrigation Projects under Construction, January 1989

Entity/Project	Province	Planned Command Area (hectares)	Families Benefited (number)	Project Costs (millions) 1988 Dollars	1988 Sucres (S/.436.19 per $)
A. GRAND TOTAL		108,109		1,102.43	480,867.00
B. INERHI		62,318	21,736	166.09	72,446.80
C. CEDEGE		32,691		881.21	384,374.99
1. Daule-Peripa Phase I	Guayas	17,000		403.00	175,784.57
2. Santa Elena Phase I	Guayas	15,691		466.71	203,574.23
3. Samborondon (Drainage)	Guayas	0		11.50	5,016.19
D. CRM		13,100		55.13	24,045.21
1. Poza Honda Rehabilitat	Manabi	6,500		53.75	23,445.21
2. Nine Small Dams	Manabi	3,600		1.03	450.00
3. Jama	Manabi	2,000		0.23	100.00
4. Briceño	Manabi	1,000		0.11	50.00

Source: INERHI Department of Operations; Unpublished records of the regional agencies.

Appendix Table 7.8 INERHI Irrigation Projects under Design or Serious Study, January 1989

Project	Province	Stage of Study or Design	Planned Command Area (hectares)	Families Benefited (number)	Project Costs (Current Sucres) Total (million)	To December 1988 (million)	Per Hectare (sucres)	Project Costs (1988 Sucres) Total (million)	To December 1988 (million)	Per Hectare (sucres)	Internal Rate of Return (Feasability Stage)
TOTAL			132,116	24,001	159,162.8	270.7	1,204,720	201,563.5	679.6	1,525,656	
1. Artezon-Mira-El Angel	Carchi	Pre-Feas.	9,000	5,400	1,300.0	7.6	144,444	11,392.1	66.6	1,265,789	
2. Alor-El Rosal	Carchi	Design	350	140	350.0	4.9	1,000,000	928.6	13.0	2,653,061	14.4
3. Cordova-Pimampiro	Imbabura	Design	1,240	466	600.0	0.0	483,871	600.0	0.0	483,871	21.6
4. Tabacundo II (Tunnel)	Pichincha	Feas.	8,889	1,254	4,888.4	18.5	549,938	4,888.4	0.0	549,938	12.6
5. Cangagua	Pichincha	Feas.	4,650	1,327	1,090.0	0.0	234,409	1,090.0	0.0	234,409	15.3
6. Perucho	Pichincha	Feas.	1,677	610	356.1	0.0	212,343	356.1	0.0	212,343	
7. Mayon-Calderon	Pichincha	Pre-Feas.	2,600	1,500	390.0	0.0	150,000	390.0	0.0	150,000	21.0
8. Alumis	Cotopaxi	Design	1,060	533	689.8	54.8	650,755	3,134.3	249.0	2,956,896	
9. Chaupi Paloma	Cotopaxi	Feas.	10,700	6,000	5,500.0	1.9	514,019	27,789.5	9.6	2,597,147	
10. Chalupas	Cotopaxi	Feas.	18,600	ND	9,300.0	0.0	500,000	9,300.0	0.0	500,000	
11. Nagsiche	Cotopaxi	Feas.	1,700	821	220.0	17.7	129,412	926.0	74.5	544,699	19.8
12. Tamboyacu	Cotopaxi	Feas.	1,500	800	127.6	0.1	85,067	765.6	0.6	510,400	
13. Mocha-Tisaleo	Tungurahua	Feas.	3,000	1,600	1,800.0	0.0	600,000	1,800.0	0.0	600,000	
14. Guano	Chimborazo	Feas	1,510	470	1,130.0	0.0	748,344	1,130.0	0.0	748,344	11.7
15. Licto	Chimborazo	Feas.	1,640	ND	842.7	126.2	513,841	1,428.3	213.9	870,925	24.1
16. Zapotillo Bajo	Loja	Feas.	2,000	ND	620.0	0.9	310,000	5,373.3	7.8	2,686,667	
17. Banco de Arena	Guayas	Feas.	12,800	1,870	650.0	30.1	50,781	963.1	44.6	75,244	
18. Churute	Guayas	Feas.	5,000	360	696.0	8.0	139,200	696.0	0.0	139,200	17.5
19. Catarama	Los Rios	Feas.	5,800	850	8,612.2	0.0	1,484,862	8,612.2	0.0	1,484,862	
20. Jubones Phase II	El Oro	Design	38,400	ND	120,000.0	0.0	3,125,000	120,000.0	0.00	3,125,000	18.4

Source: INERHI Department of Operations.

Appendix Table 7.9 Irrigation Projects under Design or Serious Study, January 1989

Entity/Project	Province	Stage of Study or Design	Planned Command Area (hectares)	Families Benefited (number)	Project Costs (millions) 1988 Dollars	Project Costs (millions) 1988 Sucres (S/.436.19 per $)
A. GRAND TOTAL			294,308		1,121.92	489,370.63
B. INERHI			132,116	24,001	462.10	201,563.50
B. CEDEGE			68,192		470.72	205,323.60
1. Daule-Peripa Phase III	Guayas	Design	33,000		46.71	20,373.00
2. Santa Elena Phase II	Guayas	Design	27,192		412.69	180,011.70
3. Pedro Carbo	Guayas	Feasability	8,000	972	11.32	4,938.90
C. CRM			18,000		66.00	28,788.54
1. Carrizal-Chone[a]			18,000		66.00	28,788.54
D. PREDESUR			76,000		123.10	53,694.99
1. Puyango-Tumbes	Loja	Design-Const.	70,000		110.10	48,024.52
2. Zapotillo Alto	Loja	Design	6,000		13.00	5,670.47

Source: INERHI Department of Operations; Unpublished records of the regional agencies.

[a] Cost is for La Esperanza dam only.

Appendix Table 7.10 Costs of INERHI Irrigation Projects in Operation, 1989

Project	Costs of Infrastructure								1988 Operations and Maintenance Costs	
	Per Project (million sucres)						Per Hectare (1988 sucres)			
	Current Prices			1988 Prices a						
	Planned Projects Costs	Expended: Before 1966	Expended: Total Thru 1988	before b 1966	1966-1988	Total	Irrigable	Under Irrigation	Total (S/.1,000)	Per Irrigated Hectare (S/./ha)
TOTAL	6,790.3	1,607.5	5,436.5	54,171.1	21,142.0	75,313.1	949,855	1,448,217	4,310.10	6,328
1. Montufar	320.0	144.0	309.6	4,853.4	1,991.6	6,845.0	2,444,632	3,058,521	6,373.40	2,848
2. San Vicente de P.	62.4	0.0	62.4	0.0	337.9	337.9	844,625	938,472	3,584.96	9,958
3. Ambuqui	220.9	0.0	180.1	0.0	1,307.0	1,307.0	986,415	1,406,889	8,018.68	8,632
4. Salinas	111.3	82.7	107.7	2,788.3	454.7	3,243.0	1,544,281	1,566,662	5,807.13	2,805
5. Tabacundo I(Wells)	98.6	0.0	98.6	0.0	425.5	425.5	236,635	1,530,468	2,498.61	8,988
6. Pisque	466.4	358.9	437.6	12,094.7	1,050.7	13,145.3	2,094,873	2,161,350	17,433.73	2,866
7. Tumbaco	136.9	66.7	99.2	2,246.4	327.8	2.574.2	1,336,563	1,918,197	4,696.82	3.500
8. Lat./Sal./Ambato	1,014.5	64.1	994.5	2,160.5	3,857.2	6,017.7	716,389	934,711	8,483.81	1,318
9. Jimenez-Cevallos	28.0	0.0	28.0	0.0	89.1	89.1	127,300	142,121	612.05	976
10. Canal del Norte	115.4	0.0	77.3	0.0	158.0	158.0	158,020	NA	1,588.78	
11. Pujili		0.0	54.0	0.0	147.4	147.4	733,483	NA	1,530.63	
12. Pachanlica	72.7	0.0	64.7	0.0	354.2	354.2	590,250	736,279	2,458.17	5,111
13. Garcia Moreno	106.0	0.0	95.6	0.0	325.5	325.5	325,530	422,766	947.08	1,230
14. Patate	62.1	0.0	41.4	0.0	116.7	116.7	166,743	291,800	650.06	1,625
15. Chambo	1,469.1	322.9	833.0	10,881.5	2,927.6	13,809.1	2,191,913	2,820,476	13,073.11	2,670
16. Cebadas	60.1	0.0	60.1	0.0	384.9	384.9	641,533	798,589	1,836.42	3.810
17. Yurac-Yacu	42.2	0.0	40.6	0.0	57.3	57.3	190,967	NA		
18. Vinchoa	24.7	0.0	19.7	0.0	54.1	54.1	135,325	NA		
19. Machangara	205.9	47.9	151.9	1,612.9	612.5	2,225.3	2,674,663	2,959,202	3,289.19	4,374
20. Tablon de Oña	40.3	0.0	34.8	0.0	266.9	266.9	266,870	NA	622.90	
21. Macara	315.7	69.7	271.7	2,349.5	977.7	3,327.2	1,848,428	2,855,940	12,881.02	11,057
22. La Papaya	70.7	0.0	58.7	0.0	333.5	333.5	476,400	NA	1,007.95	
23. La Era	29.0	0.0	29.0	0.0	169.8	169.8	424,575	2,096,667	1,713.76	21,157
24. El Ingenio	41.1	0.0	37.3	0.0	241.6	241.6	604,050	NA		
25. Paquishapa	72.0	0.0	63.8	0.0	225.0	225.0	562,475	NA	391.14	
26. Chucchucchir	15.6	0.0	15.6	0.0	77.7	77.7	310,960	NA		
27. Quinara	51.1	0.0	51.1	0.0	504.9	504.9	1,262,200	5,939,765	2,231.17	26,249
28. Vilcabamba	29.8	0.0	29.8	0.0	168.3	168.3	561,133	NA	720.53	
29. Milagro	563.9	301.6	506.4	10,162.4	1,830.2	11,992.5	1,050,135	3,807,156	6,636.89	2,107
30. Chilintomo I	101.4	0.0	52.6	0.0	184.1	184.1	167,355	474,459	1,388.88	3,580
31. Manual J. Calle	565.7	149.0	293.8	5,021.5	764.3	5,785.9	262,993	306,714	12,001.36	636
32. Azucar	130.0	0.0	104.7	0.0	185.8	185.8	764,403	NA	268.94	
33. Banco de Arena	42.7	0.0	12.2	0.0	35.5	35.5	132,045	2,537,143		0
34. Chacras-Huaqui.	118.0	0.0	73.0	0.0	92.5	92.5	370,000	825,893	2,245.66	20,051
35. El Tablon	46.0	0.0	46.0	0.0	104.7	104.7	149,600	NA		

Source: INERHI Department of Operations.

a Deflated by the Consumer Price Index.

b Assumes that all expenditures before 1966 were realized in 1965 (deflated by the CPI for 1965). To the extent investments were made before 1965, the value in 1988 prices is underestimated.

Appendix Table 7.11 Subsidies to Public Irrigation Projects

Entity	Operating Systems			Under Construction			Under Design and Study		
	Irrigable Area (Superficie Regable)	Subsidy (millions 1988 prices)		Planned Command Area	Subsidy (millions, 1988 prices)		Planned Command Area	Subsidy (millions 1988 prices)	
	(hectares)	(sucres)	(dollars)	(hectares)	(sucres)	(dollars)	(hectares)	(sucres)	(dollars)
Public Total	115,244	9,901.2	22.7	108,109	9,288.2	21.3	294,308	25,285.5	58.0
1. INERHI(National)	79,289	6,812.1	15.6	62,318	5,354.1	12.3	132,116	11,350.7	26.0
2. CEDEGE (Guayas R. Basin)	4,700	403.8	0.9	32,691	2,808.6	6.4	68,192	5,858.7	13.4
3. CRM (Manabi)	2,650	227.7	0.5	13,100	1,125.5	2.6	18,000	1,546.5	3.5
5. PREDESUR (South Ecuador)	0.00	0.0	0.0	0	0.0	0.0	76,000	6,529.5	15.0
6. All Others	28,605	2,457.6	5.6	0	0.0	0.0			

Source: Appendix Tables 7.5, 7.7 and 7.9 for irrigable and command areas, and estimate of subsidy per irrigable hectare of S/.85,915 from Section VII.

Appendix Table 7.12 Differences in the Value of Irrigated and Unirrigated Land of Similar Quality for Operational Irrigation Projects, March, 1989

System in Operation	Value per Hectare (thousand sucres)			Comments
	Irrigated Project Land	Dry Land of Similar Quality	Difference	
INERHI				
1. Montufar	900	300	600	JAC INERHI Officials, May/11/89, Carchi
	500	200	300	JAC INERHI Officials, May/11/89, Carchi
	600	250	350	JAC INERHI Officials, May/11/89, Carchi
	700	400	300	JAC INERHI Officials, May/11/89, Carchi
	750	400	350	JAC INERHI Officials, May/11/89, Carchi
	1,300	500	800	JAC INERHI Officials, May/11/89, Carchi
2. San Vicente de P.	1,800	450	1,350	JAC INERHI Officials, May/11/89, Ibarra
3. Ambuqui	1,800	450	1,350	JAC INERHI Officials, May/11/89, Ibarra
4. Salinas	1,000	350	650	JAC Real Estate Agent(El Comercio),4/18/89, Quito
5. Tabacundo I(Wells	500	250	250	INERHI Officials, February 1989, Cayambe
6. Pisque	400	200	200	INERHI Officials, February 1989, Pisque Headquarters
7. Lat./Sal./Ambato	1,000	300	700	MDW Centro Agricola 4/13/89, Ambato, (Range)
	1,500	500	1,000	MDW Centro Agricola 4/13/89, Ambato, (Range)
	1,400	1,000	400	MDW Centro Agricola 4/13/89, Second Opinion
8. Chambo	800	250	550	JAC INERHI Officials, May/12/89, Riobamba
	2,500	800	1,700	JAC INERHI Officials, May/12/89, Riobamba
9. Cebadas	1,000	350	650	JAC INERHI Officials, May/12/89, Riobamba
10. Milagro	600	200	400	JAC INERHI Officials, 4/27/89, Milagro Project
	360	200	160	JAC INERHI Officials, 4/27/89, Milagro Project
	800	250	550	JAC INERHI Officials, 4/27/89, Milagro Project
11. Manuel J. Calle	800	400	400	JAC INERHI Officials 4/28/89, Project Director (Range)
	550	300	250	JAC INERHI Officials 4/28/89, Project Director
CRM				
1. Pozo Honda	400	80	320	JAC CRM Officials, 4/10/89, Portoviejo (Range)
	600	100	500	JAC CRM Officials, 4/10/89, Portoviejo (Range)
CEDEGE				
1. Babahoyo	500	250	250	JAC CEDEGE Officials, 4/27/89, Project Director

Source: Informal survey conducted during January-May of 1989.

Appendix Table 12.1 Primary School Enrollments by Grade, Year and Area, 1980-1981 Through 1988-1989

Year	Grade						Total Primary	
	First	Second	Third	Fourth	Fifth	Sixth		Seventh [a]
1980-81								
Urban	159,391	132,934	125,922	118,775	107,977	101,008	746,007	135,368
Rural	229,224	160,085	131,513	108,331	85,792	73,306	788,251	24,225
1981-82								
Urban	162,650	139,093	129,101	122,248	112,404	105,409	770,905	142,294
Rural	222,119	162,677	134,895	112,685	92,224	77,061	801,661	26,575
1982-83								
Urban	173,255	143,232	134,850	127,648	119,753	109,546	808,284	148,034
Rural	222,728	161,217	133,257	111,607	93,013	80,616	802,439	28,369
1983-84								
Urbano	177,607	147,404	138,430	132,897	123,377	116,274	835,989	148,995
Rural	217,395	164,397	150,019	120,805	101,802	87,157	841,575	25,658
1984-85								
Urban	182,392	153,010	142,806	138,343	128,433	120,413	865,397	146,695
Rural	210,990	153,030	134,870	118,962	101,667	87,692	807,211	27,267
1985-86								
Urban	194,554	159,113	148,697	141,252	132,355	123,732	899,703	145,732
Rural	221,703	161,689	139,090	122,876	105,424	91,482	842,264	26,450
1986-87								
Urban	206,540	164,435	152,623	145,181	134,978	126,153	929,910	149,898
Rural	220,652	167,742	141,004	124,356	107,220	95,778	856,752	26,828
1987-88								
Urban	204,293	170,995	159,312	152,214	139,721	131,151	957,636	142,242
Rural	222,621	173,875	147,792	129,125	112,255	99,832	885,500	27,728
1988-89								
Urban	207,778	176,689	166,861	158,647	145,604	138,026	993,605	146,291
Rural	223,105	173,198	153,085	133,990	117,591	103,255	904,224	26,898

Source: Unpublished data from MEC, Division of Statistics.

[a] First year of secondary school.

Appendix Table 12.2 Secondary School Enrollments by Grade, Year and Area, 1980-1981 Through 1988-1989

Year	Grade					
	Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth
1980-81						
Urban	135,368	102,631	86,611	85,461	64,424	50,989
Rural	24,225	15,134	10,899	5,704	3,367	2,211
1981-82						
Urban	142,294	110,425	93,188	90,750	69,107	53,175
Rural	26,575	17,695	12,051	6,684	4,067	2,623
1982-83						
Urban	148,034	114,593	99,317	97,922	73,097	55,889
Rural	28,369	20,271	14,173	7,717	4,861	3,337
1983-84						
Urbano	148,995	117,791	104,187	103,117	77,269	59,914
Rural	25,658	20,076	16,175	8,612	5,839	4,098
1984-85						
Urban	146,695	116,347	102,387	104,361	78,361	60,616
Rural	27,267	19,168	15,826	9,779	6,228	4,295
1985-86						
Urban	145,732	117,553	103,915	104,333	81,114	64,982
Rural	26,450	20,010	15,170	9,927	7,233	5,003
1986-87						
Urban	149,898	124,390	112,327	109,278	87,127	71,073
Rural	26,828	21,356	17,463	10,572	7,620	6,441
1987-88						
Urban	152,242	126,063	115,379	114,625	88,013	74,109
Rural	27,728	21,866	18,241	11,567	8,599	6,899
1988-89						
Urban	146,291	121,755	111,780	110,201	88,095	72,247
Rural	26,898	21,705	17,948	11,408	8,317	6,582

Source: Unpublished data from MEC, Division of Statistics.

Appendix Table 12.3 Current and Constant Expenditures of INIAP and its Relation with Agricultural GDP, 1965-1988; (thousands of sucres)

Year	Total Expenditures INIAP		Agricultural GDP	Share
	Current Prices	Constant 1975 Prices[a]	(Constant 1975 Prices)	(%)
1965	18,227.3	44,566	13,072,000	0.34
1966	16,373.1	37,639	13,260,000	0.28
1967	20,306.2	44,629	14,154,000	0.32
1968	19,468.8	40,987	14,751,000	0.28
1969	26,353.3	51,673	14,662,000	0.35
1970	36,361.3	65,281	15,710,000	0.42
1971	51,514.7	86,001	16,497,000	0.52
1972	62,532.6	102,011	17,160,000	0.59
1973	82,288.6	126,793	17,340,000	0.73
1974	118,739.1	130,626	18,894,000	0.69
1975	164,329.6	164,330	19,333,000	0.85
1976	155,740.0	137,945	19,892,000	0.69
1977	166,102.7	125,172	20,360,000	0.61
1978	183,074.5	127,845	19,575,000	0.65
1979	191,223.4	114,987	20,133,000	0.57
1980	267,391.6	134,571	21,198,000	0.63
1981	263,168.7	115,831	22,647,000	0.51
1982	291,754.9	108,986	23,101,000	0.47
1983	332,872.9	89,651	19,891,000	0.45
1984	468,284.4	90,595	22,007,000	0.41
1985	536,813.4	79,340	24,178,000	0.33
1986	661,726.5	81,044	26,656,000	0.30
1987	658,275.6	58,213	27,766,000	0.21
1988	865,245.7	50,118	30,289,000	0.17

Source: Unpublished data from INIAP, Department of Planning and Agricultural Economics.

[a] The annual average rate of growth in INIAP expenditures in constant prices between 1965-1975 was 17.4 percent, while they declined by 7.3 percent between 1976-1988 (based on exponential curve fit of the form $Y = ae^{bx}$, where $a>0$ and $Y>0$).