

AGENCY FOR INTERNATIONAL DEVELOPMENT WASHINGTON, D. C. 20823 BIBLIOGRAPHIC INPUT SHEET	FOR AID USE ONLY
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1. SUBJECT CLASSIFICATION	A. PRIMARY	Economics
	B. SECONDARY	Agricultural Economics

2. TITLE AND SUBTITLE

Farm growth in Brazil, final report: introduction, summary and conclusions

3. AUTHOR(S)

(101) Ohio State Univ. Dept. of Agr. Economics and Rural Sociology

4. DOCUMENT DATE 1975	5. NUMBER OF PAGES 97p.	6. ARC NUMBER ARC
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7. REFERENCE ORGANIZATION NAME AND ADDRESS

Department of Agricultural Economics and Rural Sociology,
Ohio State University, 2120 Fyffe Road, Columbus, Ohio 43210

8. SUPPLEMENTARY NOTES (*Sponsoring Organization, Publishers, Availability*)

Chapters 1 and 12: Introduction to research and conclusions.

9. ABSTRACT

See attached sheet.

10. CONTROL NUMBER PN--AAB-431	11. PRICE OF DOCUMENT
12. DESCRIPTORS	13. PROJECT NUMBER
	14. CONTRACT NUMBER CSD-2501 Res.
	15. TYPE OF DOCUMENT

AGRICULTURAL DUALISM AND BRAZILIAN DEVELOPMENT

This research clearly demonstrated the disparities in agricultural growth between groups of farmers in Brazil, especially in the wheat region, and noted the broader interregional disparities which historically existed and appear to be even more accentuated in recent years. This process of growth has contributed to increased dualism in Brazilian agriculture: highly capitalized mechanized farms with low labor/land ratios, and under capitalized traditional small farms using large amounts of labor and little new technology. The dilemma appears to be the classic one of growth versus distributive equity, a theme of increasing importance in developing countries. As noted above, the policies affecting Brazilian agriculture to the greatest extent in the post World War II period are associated into two major sub-periods of development strategies in the country: the first characterized by general neglect and occasional discrimination against agriculture, especially in the 1947-61 period of intense import substitution industrialization, resulted in agricultural growth largely along the extensive margin; the second, beginning in the mid-1960's and continuing to the present, represents a period in which policies have been aimed at agricultural modernization and expanded traditional and nontraditional exports. In the first period, the objectives for agriculture were limited primarily to producing an adequate supply of reasonably priced food for urban wage earners and secondarily, generate foreign exchange to finance the importation of the industrial raw materials and capital goods. The assistance granted to agriculture consisted largely of improving extension and marketing services. Since the mid-1960's much greater emphasis has been given to modernization, and accelerating the growth of output and exportation. Emphasis on research increased in the early 1970's. Generally Brazil has been quite successful in meeting its economic objectives. In fact, the high growth rates since 1968 have caused people to speak of the "economic miracle" and make comparisons with countries like Japan. This euphoria may be a bit premature, particularly in view of current energy problems, but clearly the performance has been exceptional in the past few years, in large part due to expert decision making. The emphasis, at least in agriculture, however, has been largely on growth rather than growth with equity. Given the state of the economy when the military took power in 1964, it is easy to understand this orientation. But it is also necessary to call attention to the potential structural problems arising from this approach which may hamper future economic growth and development. The experience of other countries has demonstrated the difficulty in achieving equity, in spite of good intentions, once great inequities have arisen. Perhaps some loss in growth rate occurs when increased equity is pursued, but the results of this and other research, which suggest relatively constant returns to scale in agriculture over a wide range of output levels, imply that the losses might not be that great. If more broadly based growth is desired, the challenge to policy makers is clear and complex. It requires a fundamental rethinking of how millions of Brazilian farmers respond to policies. The tendency has been to view policy making as essentially a "top-down" activity with relatively little feedback about the dynamics of policy impacts. The observed inequalities in resource use, income and growth logically result. A growth-with-equity strategy would have to take into account the heterogeneity of farms and farmer response. Policy making would then involve identifying groups of farmers that are relatively more homogeneous and developing a specific set of policy incentives for each group. The recent efforts of the quasi-public national agricultural research institute (EMBRAPA) to develop region and crop specific technological packages is a promising attempt clearly in the right direction. The scientists and technicians of this institution are to be commended for this

initiative and their appreciation of the complexities of the agricultural development process. Another clear implication of this research is the crucial role which product and factor pricing has on the pattern of farm growth. Brazilian policy makers have consistently espoused the role of the market in allocating resources, yet continuously intervene in the market process in order to influence prices for some specific objective. Generally such intervention has been directed towards increasing the use of certain inputs, expanding output of selected products, or reducing consumer prices. The resulting distortions have helped meet the objectives, at least in the short-run, but have also contributed to resource misallocation and an unequal pattern of participation in the growth process by various groups of farmers. These inefficiencies and inequities could well frustrate future broad based rapid growth. Furthermore, the slow growth in effective demand of the marginalized segment of the rural population may frustrate the continued growth of the industrial sector. Solely removing pricing distortions, as important as that may be, may not constitute, however, the necessary and sufficient conditions for broader based agricultural development. Structural change needs to be attacked simultaneously. This research has shown how differential resource endowments and access to resources and policy incentives contributes to uneven farm growth. Land reform, credit for land purchases, effective land taxation, and improvements in the land market may be necessary to form the basis for more equitable growth where agricultural production is still largely a function of combining land with labor. More yield increasing technologies are also required so that increases in income are not restricted just to enterprise changes or mechanization. Rural education, now lamentably inadequate, must be improved and universalized so that farmers are better prepared to seek out and understand new information as well as provide a more productive source of labor when they choose urban employment. Extension workers must be provided with a larger stock of technological alternatives and must be freed of a myraid of administrative functions and a bias to concentrate their efforts on large farms. Lastly, signs are beginning to appear in Brazil that the past emphasis on the macro approach to the study of agricultural problems is waning and a new interest is emerging in the study of the microeconomics of the agricultural sector. The research reported in this volume has made a small dent in this vast uncharted field. Hopefully it will encourage some of the extremely talented young Brazilian men and women now studying at home and abroad to delve into the problems faced by farms and rural markets which have only been touched upon here. Studies related to such problems as the determinants of consumption and savings, creation of employment, returns from new technology, bottlenecks in input and product markets, impact of inflation and income distribution, exchange rate and other trade policy influences on agricultural trade, and financial market contributions to capital allocation and savings accumulation represent a few of the most crucial items in a long list of research priorities. Of immediate importance is the initiation of a nationwide system for the collection of farm level time series data absolutely essential to effective economic research. This research and the rapidly growing literature on economic and agricultural growth and development in Brazil show that the sleeping giant of the southern hemisphere awoke with a start in the latter half of the twentieth century and shows great potential for becoming a commanding influence in the economy and politics of Latin America. It holds untapped and underutilized agricultural resources that could become one of the important breadbaskets to help feed the hungry world. By achieving high growth rates for several years, it has demonstrated a capability to effectively draw some of these resources into production. But if it is to

realize its true economic potential and maintain long term high growth rates, it must begin to more effectively harness its most valuable resource, a resource largely overlooked in recent years - the growing quantity and quality of its peoples. When that occurs, we can justifiably refer to the "Brazilian Economic Miracle."

FINAL REPORT

**June, 1975
Chapters 1 and 12**

FARM GROWTH IN BRAZIL

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Under Research Contract AID/csd-2501

between

The United States Agency for International Development

and

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PREFACE

In 1969 the U.S. Agency for International Development through its Technical Assistance Bureau contracted with the Research Foundation of The Ohio State University to conduct an "Analysis of Capital Formation and Technological Innovation at the Farm Level in LDC's," (hereafter referred to as the Capital Formation Project). USAID financial support covered the period July 1, 1969 through October 31, 1974.

Responsibility for the Capital Formation Project rested with the faculty of the Department of Agricultural Economics and Rural Sociology. Norman Rask was the research team leader throughout the life of the project. Richard Meyer served in Brazil as Project Chief of Party coordinating the extensive primary data collection and preliminary analysis efforts. Upon return to Columbus, he served as a member of the research team and with Norman Rask coordinated the writing of this monograph which constitutes the final report of the project. Members of the research team responsible for specific areas of project research included Dale Adams, David Francis, Terry Glover, Donald Larson and Inderjit Singh.

The principal project objectives were: (1) To investigate and describe capital formation and utilization at the farm level, including the impact of technological change on the need for capital and on the capital formation process, and (2) To evaluate the implications and impact of selected policies designed to stimulate capital formation. Research was initiated in Brazil and was limited to that country when conditions prevented expanding the research to India as originally planned.

The farm firm was the principal unit of analysis for the investigation and was viewed as the primary building block in the chain of production and marketing firms involved in development of the agricultural sector. The research procedure was to discover, measure and better understand the impact on farm firm decisions of major changes in government programs, world market conditions, and new technology. Such analysis required extensive farm level data and little existed in Brazil. As a result, collaborative research arrangements were established with several Brazilian institutions. The institutions were selected because of their knowledge of particular agricultural regions and expertise to assist in designing survey instruments and in collecting the data through personal interviews with farmers.

Utilization of the research results and improvement of local research capabilities were also important considerations. Thus during the course of the research, several efforts were made to communicate and interpret preliminary results for several Brazilian agencies and professionals and the local USAID Mission through seminars, meetings, and informal contacts. Furthermore, students and faculty at each of the collaborating institutions were involved in questionnaire design, sampling, interviewing, data manipulation and analysis, and in all cases a set of data was retained by the local institution as part of data banks that were being developed.

In any project of this scope many individuals play key roles and many institutions make significant contributions. We would like to mention some of those without whom the research could not have been initiated or conducted. In USAID/Washington Dr. Erven Long was an

instrumental force in the project's inception and provided counsel throughout its duration. Members of the USAID/Washington Technical Assistance Bureau who assisted were: Dr. Douglas Caton, Dr. Larry Witt, Dr. Arthur Coutu, Dr. Harold Jensen and Dr. Lehman Fletcher. In the USAID Mission to Brazil, William Ellis, Mission Director; Michael N. Galli, Deputy Chief of ARDO; William Rodgers, Chief of ARDO; Dr. Harlan Davis, Agricultural Economist; Ralph Miller, Deputy Chief USAID/PASA; Dr. Stanley Krause, Agricultural Economist; and David Cohen, Program Office; as well as several other members of ARDO and the USAID staff provided much appreciated in-country support and administrative backstopping.

The Central Bank and the Ministry of Agriculture served as official contact with the Brazilian government and provided encouragement for the initial studies. In particular Ary Burger, Director of the Central Bank provided valuable assistance. The Instituto de Estudos e Pesquisas Economicas da Universidade Federal do Rio Grande do Sul was the first institution to conduct a survey under the Project. We owe a great deal to the foresight and effort of Mauricio Filchtiner, Director and Eli de Moraes Souza, Chief of the Agricultural Economics and Rural Sociology Section, in getting that survey underway and to several other staff and students that so successfully completed subsequent surveys and analysis on the data collected in that state. Closely related to this first effort, a survey was conducted in the state of Santa Catarina in conjunction with the Instituto de Pesquisas e Estudos Economicos da Universidade Federal de Santa Catarina with Carlos Jose Gevaerd playing an important role in that work. An old friend and distinguished col-

league, Paulo F. Cidade de Araujo, was instrumental in assisting with the research that was conducted in Ribeirao Preto in the state of Sao Paulo in 1970. Several other staff members and students in the Departamento de Ciencias Sociais Aplicadas of the Escola Superior de Agricultura "Luiz de Queiroz," including Joaquim J. de Camargo Engler who later became head of the department, were very supportive of the several economic and sociological studies conducted in Sao Paulo, and were patient and much appreciated counselors and hosts to the several OSU staff that resided in and passed through Piracicaba. The research conducted in the state of Minas Gerais owed much to Helio Tollini, then Director of the Instituto de Economia Rural, Universidade de Minas Gerais in Vicosa; H. Evan Drummond, Ph.D. student at Purdue University; and Julian H. Atkinson, Chief of Party of the Purdue-Vicosa Institution Building Project.

While analysis of the data collected in these four states moved forward, the USAID Mission contracted with Ohio State University to provide support to the newly created Escritorio de Analise Economica e Politica Agricola of the Ministry of Agriculture. The first director of that office, Francisco Vera Filho, and his successor, Alberto Veiga, along with Iby Pedroso organized a survey in the state of Ceara which collected data similar to the type collected in the four other states and made it available to the Project. Faustino de Albuquerque Sobrinho of the Universidade Federal do Ceara and Roger Fox of the University of Arizona - Ceara Institution Building Contract were instrumental in making local arrangements. The Banco do Nordeste contributed resources and staff to that survey as well.

Special appreciation is also extended to the many interviewers and drivers in each survey region that spent long, hot, dusty hours locating and interviewing farmers. The Brazilian farmers we interviewed displayed great patience and excellent cooperation by completing long interviews as accurately and thoroughly as possible. To them we extend special thanks.

The research that went into this report involved many staff and students at both OSU and several of the institutions just mentioned. The training of graduate students was an integral aspect of the Project, both in the U.S. and Brazilian Universities and will no doubt remain one of its chief benefits long after the findings of this research become outdated.

Clearly, the research findings summarized in this report emanate from a successful team effort. However, it is appropriate to recognize explicitly those individuals most directly responsible for major parts of the report.

Chapter 2	Douglas Graham
Chapter 3	Richard Meyer
Chapter 4	Norman Rask and Richard Meyer
Chapter 5	Norman Rask
Chapter 6	Terry Glover
Chapter 7	Donald Larson and Richard Meyer
Chapter 8	David Francis
Chapter 9	Donald Larson
Chapter 10	Dale Adams
Chapter 11	Inderjit Singh and Choong Yong Ahn

Chapters 1 & 12 Group Effort

In addition, significant contributions to the Project were made by several other OSU faculty members, in particular Bernard Erven, John Sitterley, Francis Walker and Kelso Wessel. Kelso Wessel was a member of the OSU Institution Building Project at ESALQ, Piracicaba, during the initial phase of data collection in the state of São Paulo. He worked with Brazilian faculty and graduate students on questionnaire construction, survey design, and supervision of some of the interviewing.

Mrs. June Blind and Ms. Malinda Brenner shared most of the typing of the final version and were ably assisted by several other secretaries in the department on earlier drafts. Ms. Barbara Durman, and Mrs. Margie Butz were responsible for data organization and storage. Mark Hinnebusch did much of the computer programming during the latter part of the Project. The Statistics Laboratory helped with figures, tables and overload typing, while Ms. Marilyn Chute served as a most capable administrative assistant throughout the life of the Project.

While more than forty graduate students have assisted with the processing and analysis of data and many have used portions of the data for their own M.S. theses and Ph.D. dissertations, 9 individuals who were then Ph.D. candidates, deserve special recognition for contributions to the overall Project: John Stitzlein, William Nelson, Gerald Nehman, Hagop Kayayan and Solon Guerrero each spent a year or more in Brazil assisting with data collection and processing; Roger Baur and Choong Yong Ahn assisted with data processing and analysis in Columbus. Joaquim J. de Camargo Engler and Iby Pedroso worked with their respective institutions in data collection and used part of the data for their dissertations.

We would also like to express appreciation to G. Edward Schuh and Pan A. Yotopoulos for highly useful detailed comments each made on an earlier draft of this report. J. K. McDermott also contributed a helpful reaction as did several people in Brazil during a round of seminars conducted in October, 1974. Of course, the authors assume sole responsibility for the contents. The views and opinions expressed do not necessarily represent the views of any persons or institutions in Brazil or the U.S. that collaborated with the Project.

David Boyne
Project Supervisor

TABLE OF CONTENTS

PREFACE	1
TABLE OF CONTENTS.....	ix
LIST OF TABLES.....	xv
LIST OF FIGURES.....	xxii
CHAPTER 1 -- INTRODUCTION	1-1
BACKGROUND	1-1
OBJECTIVES AND ORGANIZATION OF RESEARCH	1-5
A FIRM HOUSEHOLD GROWTH MODEL	1-7
The Model	1-10
Dynamic Feedback	1-12
Policy Avenues to Accelerate Growth	1-14
Pricing Policies and Price Responsiveness	1-14
Credit Policies	1-16
Tax Policies	1-18
Marketing Structure and Efficiency	1-19
Agricultural Infrastructure	1-20
Technology, Research and Extension	1-21
Changing the Structure of the Agricultural Resource Base	1-23
Off Farm Investment and Employment Opportun- ities	1-24
Industrialization of the Non-farm Sector	1-25
Sociological Determinants of Firm Growth	1-26
SOME CONCLUDING CAVEATS	1-27
Simplicity of Analytical Framework	1-27
Brazil as a Case Study	1-29
BIBLIOGRAPHY	1-31
CHAPTER 2 -- A REVIEW OF BRAZILIAN ECONOMIC POLICY & ECONOMIC GROWTH, 1947-1974	2-1
INTRODUCTION	2-1
THE IMPORT SUBSTITUTION STAGE, 1947-1963	2-3
Aggregate Performance and Structural Change	2-3
Capital Intensity	2-9
Efficiency	2-11
Foreign-Government Domination	2-13
THE POLICY MILIEU OF THE ISI STAGE OF BRAZILIAN ECONOMIC GROWTH, 1947-63	2-16
1947-53: Early Balance of Payments Strategy and Industrial Growth	2-16
1955-60: Foreign Investment and Government Activity	2-18
Major Distortions Introduced by the Growth Strategies of the Fifties.	2-25

TABLE OF CONTENTS -- Continued

CHAPTER 2 -- Continued

The Scenario of Economic Stagnation and Policy Making in the Early Sixties, 1961-1963.	2-27
STABILIZATION AND THE RESTRUCTURING OF ECONOMIC POLICY, 1964-1967.	2-34
Institutional Reforms, 1964-1967.	2-37
Stabilization Performance, 1964 to 1967: Frustrations and Enigmas.	2-44
THE ECONOMIC MIRACLE: PERFORMANCE AND POLICY 1968-1974.	2-48
Monetary Policy and Economic Expansion.	2-48
The Opening Up of the Economy	2-51
Capital Inflows and the Foreign Debt.	2-55
Money and Capital Market Growth	2-57
The Role of the Government in the Economy, Income Inequality and Dependency.	2-63
Summary	2-73
BIBLIOGRAPHY	2-77

CHAPTER 3 -- AGRICULTURAL POLICIES AND GROWTH, 1947-1974. 3-1

INTRODUCTION	3-1
AGRICULTURAL DEVELOPMENT STRATEGY	3-2
KEY FEATURES OF AGRICULTURAL GROWTH	3-7
POLICY INSTRUMENTS FOR AGRICULTURE	3-25
Product Oriented Programs.	3-26
Factor Pricing Programs.	3-36
Trade Policies	3-44
National and Regional Investment Programs.	3-47
Agricultural Taxation.	3-52
AGRICULTURAL POLICY ISSUES.	3-54
BIBLIOGRAPHY.	3-60

CHAPTER 4 -- FARM LEVEL DATA BASE. 4-1

PROCEDURE FOR SELECTING THE DATA BASE	4-6
QUESTIONNAIRE DESIGN AND TYPE OF DATA COLLECTED	4-11
Current Capital Investment	4-12
Capital Acquisitions and Technological Improvements	4-12
Firm-Household Cash Flow	4-13
DETAILED REGIONAL DESCRIPTIONS.	4-13
Wheat-Soybean-Cattle Region - Southern Brazil.	4-15
General Characteristics of Wheat Production	4-16
Survey Areas.	4-19
Eastern Escarpment Subregion	4-19
Central Plateau Subregion.	4-20
Western Rangeland Subregion.	4-20

TABLE OF CONTENTS -- Continued

CHAPTER 4 -- Continued

Ribeirao Preto Region - Sao Paulo -	
Southeastern Brazil	4-25
General Characteristics.	4-25
Survey Areas	4-27
Annual Crops.	4-28
Perennial Crops	4-31
Cattle Ranching	4-31
Data Classification	4-32
Farm Size.	4-32
Farm Type.	4-32
BIBLIOGRAPHY	4-35

CHAPTER 5 -- FARM LEVEL CAPITAL INVESTMENT PATTERNS

SOUTHERN BRAZIL 1960-1969	
	5-1
INTRODUCTION	5-1
FARM CAPITAL STRUCTURE - 1969.	5-3
FARM LEVEL CAPITAL INVESTMENT AND ITS	
FINANCING - 1960-1969.	
	5-6
Comparisons Between Subregions.	5-10
Comparisons Within Subregions	5-12
Land Renting.	5-16
PATTERNS OF CAPITAL INVESTMENT AND TECHNOLOGICAL	
CHANGE - 1960-1969	
	5-20
Patterns of Machinery Investment.	5-21
Improved Crop Practices	5-26
INCOME FLOW AND RESOURCE TRANSFER.	5-29
SUMMARY.	5-34
Impact of Public Policy on Farm Level	
Capital Growth.	5-35
BIBLIOGRAPHY	5-39

CHAPTER 6 -- FARM LEVEL PRODUCTION PROCESSES: SOUTHERN AND SOUTHEASTERN BRAZIL

	6-1
INTRODUCTION	6-1
THE RELATIONSHIP OF INPUTS	6-3
Input Use Patterns of the Sample Farms.	6-4
Some Explanations for the Choice of Current	
Inputs and Labor Employed Per Hectare	6-8
INPUT PRODUCTIVITY AND RETURNS TO SCALE.	6-13
The Production Model.	6-13
The Production Processes and Input Productivity	6-14
Partial Productivity	6-19
Fixed Capital.	6-20
Labor.	6-25
Land	6-27

TABLE OF CONTENTS -- Continued

CHAPTER 6 -- Continued

Returns to Scale and Output Expansion	6-29
A Generalization and Returns to Scale.	6-31
MECHANIZATION AND LABOR EMPLOYMENT: FURTHER	
ANALYSIS	6-40
The Capital/Labor Ratio	6-40
The Capital-Labor Model	6-41
BRAZILIAN AGRICULTURAL POLICY AND THE FARM LEVEL	
PRODUCTION PROCESS	6-49
Credit.	6-50
Mechanization.	6-50
Labor Employment and Mechanization	6-52
Expansion of Output via Wheat and Sugar Policies.	6-55
Central Plateau and Rangeland Subregions	6-55
Sugar Cane Production in Ribeirao Preto.	6-56
BIBLIOGRAPHY	6-58

CHAPTER 7 -- THE ECONOMICS OF FERTILIZER USE 7-1

INTRODUCTION	7-1
FERTILIZER PRODUCTION AND USE IN BRAZIL.	7-3
FERTILIZER POLICIES, PRICES AND DISTRIBUTION	7-9
Fertilizer Policies	7-9
Fertilizer Distribution and Marketing	7-11
Fertilizer and Product Price Trends	7-14
DEMAND FOR FERTILIZER IN SAO PAULO	7-16
The Models.	7-16
Traditional Model.	7-17
Adjustment Model	7-18
The Data and The Variables	7-19
Regression Results	7-20
YIELD RESPONSE TO FERTILIZER	7-29
Experimental Results.	7-30
Farm Level Yield Response	7-31
FERTILIZER USE AND FARM LEVEL GROWTH	7-37
BIBLIOGRAPHY	7-42

**CHAPTER 8 -- SOCIAL CHARACTERISTICS RELATED TO THE
ADOPTION AND USE OF AGRICULTURAL
TECHNOLOGY. 8-1**

INTRODUCTION	8-1
ADOPTION AND TECHNOLOGY INDICES.	8-2
FINDINGS	8-4
Structural Variables and the Technology Index	8-4
Family Size	8-6
Individual Variables.	8-10

TABLE OF CONTENTS -- Continued

CHAPTER 8 -- <u>Continued</u>	
Education	8-11
Level of Technological Information	8-12
Size of Farm	8-13
Intervening Variables	8-17
Ethnicity	8-17
Migration Status	8-18
Factor Analyses of Individual Characteristics	8-20
Agricultural Service Personnel	8-22
SUMMARY AND POLICY IMPLICATIONS	8-24
APPENDICES	8-28
BIBLIOGRAPHY	8-44
CHAPTER 9 -- AGRICULTURAL MARKETING FIRMS: THEIR CHARACTERISTICS AND PERFORMANCE IN THE RIBEIRAO PRETO REGION OF SAO PAULO.	
INTRODUCTION	9-1
THE PROBLEM.	9-3
Marketing Infrastructure	9-3
Product Market Systems	9-5
Input Market Systems	9-6
Area of Study	9-8
CHARACTERISTICS OF FIRMS INTERVIEWED	9-9
Number and Type of Firms	9-9
Size of Firms	9-12
Products and Services Offered	9-13
CAPITAL STOCK AND CREDIT USE 1961 to 1970.	9-16
Capital Stock	9-16
Credit Availability and Use	9-18
Capital Investments and Source of Funding	9-21
Capital Productivity and Factor Proportions	9-25
EVALUATION OF MARKET GROWTH AND PERFORMANCE.	9-27
Infrastructure Availability	9-27
Number of Firms	9-27
Employment and Facilities	9-29
Sales Growth	9-31
Products and Services	9-34
Sales and Margins	9-35
Farmer Evaluation of Market Performance	9-41
Conclusions	9-44
APPENDIX A	9-47
BIBLIOGRAPHY	9-52

TABLE OF CONTENTS -- Continued

	<u>Page</u>
CHAPTER 10 -- RURAL FINANCIAL MARKETS, FARM LEVEL GROWTH AND CAPITAL FORMATION IN BRAZIL	10-1
AGRICULTURAL GROWTH, CAPITAL FORMATION AND FINANCIAL MARKETS.	10-2
RURAL FINANCIAL MARKETS IN BRAZIL.	10-3
Formal Financial Markets.	10-4
Growth in Formal Lending.	10-5
Formal Lending Policies	10-7
Implicit Gross Income Transfers.	10-9
Informal Rural Financial Markets.	10-11
CREDIT USE PATTERNS AT THE FARM LEVEL.	10-11
Credit-Use Measures	10-12
Relative Importance of Formal and Informal Credit Markets	10-13
Changes Over Time.	10-17
Distributional Effects of Expanded Formal Credit	10-20
Characteristics of Borrowers.	10-24
Demand-Side Concentration	10-27
Farm Level Data.	10-27
Supply-Side Credit Concentration.	10-31
Expensive Concessional Credit.	10-33
Credit Supply Recoil	10-34
IMPLICATIONS OF BRAZILIAN EXPERIENCE	10-36
BIBLIOGRAPHY	10-45
CHAPTER 11 -- THE MACROECONOMICS OF PRODUCTION: A DYNAMIC MODEL OF THE WHEAT PRODUCING AREAS IN RIO GRANDE DO SUL	11-1
INTRODUCTION	11-1
The Background.	11-5
THE WHEAT REGION IN RIO GRANDE DO SUL.	11-11
THE MODEL.	11-16
MODEL RESULTS (1960-70).	11-19
Model Evaluation.	11-20
Land Use and Cropping Patterns.	11-23
Changes in Farm Technology.	11-24
Capital Utilization and Investments	11-26
On-Farm Investments.	11-26
Capital Utilization.	11-30
Growth of Total Farm Capital Stock	11-32
Credit Use.	11-37
Farm Employment	11-40
Total Output and Factor Productivities.	11-42
Land Productivity.	11-42
Labor Productivity	11-44
Capital Productivity	11-44
Income Distribution	11-47
Summary of Results.	11-49

TABLE OF CONTENTS -- Continued

	<u>Page</u>
CHAPTER 11 -- Continued	
MODEL SIMULATION AND POLICY ANALYSIS.	11-50
Model Simulations as "Hypothetical History"	11-50
Alternative Policy Assumptions	11-54
Impact of Policy Changes.	11-57
Total Output.	11-57
Land Use.	11-61
Employment.	11-61
Capital Utilization and Borrowings	11-63
Income Distribution.	11-67
Evaluating Policy Choices	11-68
Domestic Resource Costs of Import Sub- stitution	11-70
Other Costs	11-76
Some Policy Implications and Conclusions	11-78
BIBLIOGRAPHY.	11-82
 CHAPTER 12 -- SUMMARY AND CONCLUSIONS.	
INTRODUCTION.	12-1
SUMMARY OF FINDINGS	12-4
Brazilian Agricultural and Economic Policies and Growth, 1947-1974	12-4
Farm Level Capital Investments and Technological Change	12-8
Study of Farm Level Productivity	12-9
Studies in Farm Level Technology Use and Adoption	12-11
Study of Marketing Firms	12-12
Rural Financial Markets and Farm Level Growth.	12-13
Modeling Regional Growth	12-14
ECONOMIC POLICIES AND FARM LEVEL GROWTH	12-16
AGRICULTURAL DUALISM AND BRAZILIAN DEVELOPMENT.	12-22
 PUBLICATIONS LIST	
	PL-1

LIST OF TABLES

		<u>Page</u>
TABLE 2-1	Data on Growth and Structural Change in the Brazilian Economy for Selected Years 1947-1973.	2-4
2-2	Percentage Distribution of Total Manufacturing Output by Selected Sectors, 1949/69 (1949 Prices)	2-7
2-3	Rank in Import Substitution and Growth and Shares of Grovenment and Foreign Business in Growth, 1949-1962	2-14
2-4	Selected Data on Brazilian External Debt Conditions 1947-66	2-21
2-5	Government Expenditures, Transfers (and Subsidies), Taxes and Cash Deficit as a Percent of GDP, 1947-1972	2-23
2-6	Performance of Key Macro-Economic Indicators, 1960-73	2-35
2-7	Selected Data on Real Minimum Wages in Brazil 1958-1973	2-45
2-8	Export Data and Information on Foreign Debt, 1967-1973 (\$000,000)	2-53
2-9	Performance of Financial Savings, 1962-1972	2-61
2-10	Selected Data on Income Distribution in Brazil	2-67
TABLE 3-1	Regional Growth Rates and Share of Agricultural Output 1947-65	3-9
3-2	Number of Farms (1950-1970) and Cultivated Area (1960-1970) by Region	3-11
3-3	Percent Distribution of Land by Farm Sizes 1950, 1960, 1967	3-13
3-4	Total Number of Tractors, Farms Per Tractor (1950-1970) and Area Cultivated Per Tractor 1960-1970) by Region	3-16
3-5	Population Occupied in Agriculture and Cultivated Hectares Per Person by Region, 1960-1970	3-18
3-6	Brazilian Exports: Total and Principal Agricultural Products 1946-1972	3-20
3-7	Income Changes and Concentration, 1960/1970	3-22
A 3-1	Number of Farms and Cultivated Area for Selected States, 1960-1970	3-57
A 3-2	Number of Tractors and Farms Per Tractor (1950-1970) and Area Cultivated Per Tractor (1960-1970) for Selected States	3-58
A 3-3	Population Occupied in Agriculture and Cultivated Hectares Per Person in Selected States 1960-1970	3-59

LIST OF TABLES -- Continued

		<u>Page</u>
TABLE 4-1	Brazilian Farm Data Set Description	4-4
4-2	Production of Selected Commodities in Ribeirao Preto, 1970	4-29
4-3	Number of Sample Observations in Selected Subregions According to Farm Type and Farm Size	4-34
TABLE 5-1	Percentage Distribution of Farm Capital by Form of Capital, Subregion, Farm Type, and Farm Size 1969	5-4
5-2	Farm Capital Composition Per Hectare of Agricultural Land by Subregion, Farm Size, and Farm Type, Southern Brazil - 1969	5-7
5-3	Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing and Type of Capital in Each Agricultural Subregion, Southern Brazil, 1960-1969	5-11
5-4	Accumulative Adoption Percentages for Specified Technological Practices, Wheat Region, Southern Brazil - 1960-1969	5-28
5-5	Annual Cash Flows per Hectare of Agricultural Land, by Subregion, Farm Size and Farm Type Southern Brazil - 1969	5-32
5-6	Annual Net Cash Flows Per Hectare of Agricultural Land, by Region, Farm Size and Farm Type, Southern Brazil, 1969	5-33
A 5-1	Farm Resource and Financial Summary Data, by Region Farm Size and Farm Type, Brazil, 1969-70	5-40,5-56
A 5-2	Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing, Type of Capital, and Farm Size-Type, Central Plateau Subregion, Southern Brazil, 1969	5-57,58
A 5-3	Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing, Type of Capital, and Farm Size-Type, Western Rangeland Subregion, Southern Brazil, 1969	5-59
A 5-4	Land Ownership and Rental Changes by Farm Size and Type Central Plateau Subregion, Southern Brazil, 1960-69	5-60
A 5-5	Land Ownership and Rental Changes by Farm Size and Type, Western Rangeland Subregion, Southern Brazil, 1960-1969	5-61

LIST OF TABLES -- Continued

		<u>Page</u>
TABLE 6-1	Input Use Ratios by Region, Type, and Size, Southern and Southeastern Brazil, 1969 and 1970	6-5
6-2	Estimates of the Cross Sectional Production Functions by Subregion and Farm Type, Southern and Southeastern Brazil, 1969 and 1970	6-16
6-3	Marginal and Average Products, and Production Elasticities for Four Inputs by Subregion, Farm Type and Size	6-21
6-4	Estimates of the Generalized Cobb-Douglas Production Functions by Subregion, Farm Type and Size, Southern and Southeastern Brazil, 1969 and 1970	6-34
6-5	Estimated Returns to Scale and Optimum Output for Generalized Production Functions Exhibiting Varying Returns to Scale by Subregion and Farm Type	6-38
6-6	Estimated Relationships Between Capital/Labor Ratios and Wages by Subregion, Type and Size	6-44
TABLE 7-1	Brazil Fertilizer Use, Importation and Production 1964-1972	7-4
7-2	Nutrient Consumption in Central Brazil, 1969	7-6
7-3	Percent of Brazil's Surveyed Farmers Using Fertilizer	7-8
7-4	Regression Results: Demand for Fertilizers in the State of Sao Paulo, 1949-71	7-21
7-5	Regression Results: Demand for Fertilizers in the State of Sao Paulo 1949-60	7-24
7-6	Regression Results: Demand for Fertilizers in the State of Sao Paulo 1966-71	7-26
7-7	Recommended and Actual Use of Fertilizer 1969/70 and 1971/72 Agricultural Year	7-33
7-8	Cobb-Douglas Regression Estimates for Annual Crop Yields, Ribeirao Preto Region, 1971/72 Agricultural Year	7-36
A 7-1	Average Cost Components of Fertilizer in Brazil	7-41
TABLE 8-1	Agricultural Information Sources Ranked as "Most Important to Farmers" by Farmers in Ribeirao Preto, 1972	8-14
A 8-1	Guttman Scale of Structural Differentiation, DIRA of Ribeirao Preto, Sao Paulo, Brazil	8-29
A 8-2	Guttman Scale of Professionalism in Local Leadership, DIRA of Ribeirao Preto, Sao Paulo, Brazil	8-30
A 8-3	Summary Statistics and Analysis of Variance: Mean Family Size by Level of Education of Farm Operator in Sao Paulo	8-31

LIST OF TABLES -- Continued

		<u>Page</u>
A 8-3	Summary Statistics and Analysis of Variance: Mean Family Size by Level of Education of Farm Operator in Sao Paulo	8-31
A 8-4	Results of Farm Data Economic Comparisons (Analysis of Variance) for Three Ethnic Groups of Annual Crop Farmers, Sao Paulo, 1969/70 Agricultural Year	8-34
A 8-5	Rotated (Oblique) Factor Loadings for Individual and Farm Level Variables of Farm Respondents in Rio Grande do Sul and Santa Catarina, 1969-70 Agri- cultural Year	8-35
A 8-6	Adoption Groups and Characteristics of Factor I, Economic Resources, Table A 8-5, 1969/70 Agricultural Year	8-36
A 8-7	Adoption Groups and Characteristics of Factor II, Age, Table A 8-5, 1969/70 Agricultural Year	8-37
A 8-8	Adoption Groups and Characteristics of Factor III, Adoption, Table A 8-5	8-38
A 8-9	Comparison of Major Problems with Purchase of Farm Inputs as Reported by Farmers and Governmental Extension Agents in Sao Paulo, 1972, 1969/70 Agricultural Year	8-39
A 8-10	Factors Most Frequently Listed by Farmers and Agricultural Service Personnel When Asked, "What is most important to increasing production?" in Sao Paulo, 1972	8-41
A 8-11	Factors Most Frequently Listed by Farmers and Agri- cultural Service Personnel When Asked, "What is most important to managing the farm with maximum profit?" in Sao Paulo, 1972	8-42
A 8-12	Agricultural Information Sources Ranked as "Most Important to Farmers" by Farmers and Agricultural Service Personnel in Sao Paulo, 1972	8-43
TABLE 9-1	Number and Type of Marketing Firms Studied by Muni- cipio, Ribeirao Preto Region, Sao Paulo, 1970	9-11
9-2	Distribution of Marketing Firms by Sales Categories, Ribeirao Preto Region, Sao Paulo, 1970	9-14
9-3	Average and Total Sales by Type of Marketing Firm Ribeirao Preto Region, Sao Paulo, 1970	9-14
9-4	Number and Percentage of Firms Interviewed Classified According to the Major Product or Input Sold, Ribeirao Preto Region, Sao Paulo, 1970	9-15
9-5	Services Provided to Farmers by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-17
9-6	Average Composition of Capital Stock by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-19

LIST OF TABLES -- Continued

		<u>Page</u>
9-7	Frequency of Credit Use by Type of Marketing Firm in the Ribeirao Preto Region, Sao Paulo, 1970	9-20
9-8	Major Reasons Given By Non-User Marketing Firms Against Borrowing Money, Ribeirao Preto Region, Sao Paulo, 1970	9-22
9-9	Relative Importance of Investment in Land and Buildings, Capital Improvements, Machinery and Equipment and Average Annual New Investment Among Marketing Firms, Ribeirao Preto Region, Sao Paulo, 1970	9-24
9-10	Frequency and Type of Investment Activity Outside The Marketing Firm by Type of Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-26
9-11	Selected Measures of Resource Productivity and Factor Proportions Among Marketing Frims, Ribeirao Preto Region, Sao Paulo, 1970	9-28
9-12	Total Number of Surveyed Firms in Operation and Year of Entry of Surveyed Firms by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1960-1970	9-30
9-13	Growth in Total Number of Persons Employed and Constructed Area by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1960, 1965, 1970	9-32
9-14	Number of Firms and Reported Annual Sales of Fertilizers Ribeirao Preto Region, Sao Paulo, 1962 to 1970	9-33
9-15	Number of Firms and Reported Annual Sales of Tractors, Ribeirao Preto Region, Sao Paulo, 1962 to 1970	9-33
9-16	Average Total Sales and Gross Marketing Margins, by Type of Marketing Firm, Ribeirao Preto Region, Sao Paulo, 1970	9-37
9-17	Regression Results: Marketing Margins in Relation to Total Sales, Ribeirao Preto Region, Sao Paulo, 1970	9-38
9-18	Regression Results: Marketing Margins As a Function of Time, State of Sao Paulo, 1948-1972	9-40
9-19	Major Problems Reported by Farmers with Purchase of Farm Inputs and Sales of Farm Products in Ribeirao Preto Region, Sao Paulo, 1972	9-43
A 9-1	Marketing Margins for Selected Fertilizer/Inputs and Rice, State of Sao Paulo, 1948-72	9-50
A 9-2	Additional Needs Declared by Marketing Firms When Asked What They Needed in Order to Increase Their Sales by 50%, Ribeirao Preto Region, Sao Paulo, 1970	9-51

LIST OF TABLES -- Continued

		<u>Page</u>
TABLE 10-1	Measures of Institutional Agricultural Credit Use in Brazil 1960-1972	10-6
10-2	Estimated Implicit Income Transfers to Users of Agricultural Credit in Brazil 1960-1972	10-8
10-3	Four Measures of Credit Use Among 86 Agricultural Borrowers, State of Sao Paulo, Brazil 1970-1971	10-14
10-4	Number of Farmers and Number and Value of Formal and Informal Loans Held by Farmers in Various Study Areas of Brazil, 1965 to 1972	10-16
10-5	Number and Values of Various Types of Loans Held by 338 Farmers in Southern Brazil in 1965 and 1969 by Landownership Size Groups	10-18
10-6	Number of Farmers Using Various Types of Credit in 1965 and 1969 by Landownership Size Groups -- 338 Farms in Southern Brazil	10-19
10-7	Changes in Credit Use 1965 to 1969 by Loan Portfolio Size Among 338 Farmers In Southern Brazil	10-23
10-8	Number of Borrowers and Credit-to-Productive Cash-Expense Ratios by Loan Portfolio Size Groups, 382 Farmers in Sao Paulo, Brazil, 1970	10-30
A 10-1	Number and Value of Various Types of Loans Held by 954 Farmers in Southern Brazil, With Ratios and by Value of Total Loan Portfolio Held, 1965	10-41
A 10-2	Number and Value of Various Types of Loans Held by 732 Farmers In Southern Brazil, with Ratios, and by Value of Total Loan Portfolio Held, 1969	10-42
A 10-3	Number and Value of Various Types of Loans Held by Farmers in Sao Borja, Rio Grande do Sul, Brazil, with Ratios and by Value of Total Loan Portfolio Held, 1969	10-42
A 10-4	Number and Value of Various Types of Loans Held by 382 Farmers in Sao Paulo, Brazil, With Ratios and by Value of Total Loan Portfolio, 1970	10-43
TABLE 11-1	Farm Size Distribution in the Wheat Region of Rio Grande do Sul in 1967	11-13
11-2	Prices for Wheat and Beef in Brazil and in International Markets (1960-1970)	11-15
11-3	Quasi-Fixed Capital Stock (Capital Formation in Farm Power) by Farm Size (in 1,000 CR\$ at 1970 Prices): Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-34
11-4	Total Value of Land in Use by Farm Size (in million CR\$ at 1970 Prices): Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-35

LIST OF TABLES -- Continued

		<u>Page</u>
11-5	Estimated Total Capital Stock (Quasi-Fixed Capital Stock + Value of Land in Use) by Farm Size (in Million CR\$ at 1970 Prices): Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-36
11-6	Yearly Change in Total Capital Stock and Gross Output (in Million CR\$ at 1970 Prices) by Farm Size: Wheat Region in the State of Rio Grande do Sul, Southern Brazil (1960-1970)	11-46
11-7	Incremental Capital-Output Ratios (ICOR at Constant 1970 Prices) by Farm Size: Wheat Region in the State of Rio Grande do Sul Southern Brazil (1960-1970)	11-46
11-8	Compound Growth Rates of Total Value of Gross Output Under Alternative Policy Programs (1961-1970)	11-60
11-9	Gini Ratios Associated with the Distribution of Net Farm Incomes	11-68
11-10	Value of Total Output Under Alternative Policy Programs Compounded at 5 Percent Per Annum	11-71
11-11	Domestic Resource Costs for Wheat Production in the Wheat Region in 1970.	11-73
11-12	Domestic Costs and Equivalent Import Costs of Wheat Production at 1970 Prices	11-75

LIST OF FIGURES

		<u>Page</u>
FIGURE	4-1 Brazil - Farm Level Survey Areas by Major Geographical Regions	4-8
	4-2 Agricultural Subregions in the States of Rio Grande do Sul and Santa Catarina, Southern Brazil, 1969	4-21
	4-3 Agricultural Subregions, Ribeirao Preto, Sao Paulo, Southeastern Brazil, Data Set VI	4-30
 FIGURE	 5-1 Accumulative Capital Investment Outlays Per Average Hectare Operated According to Type of Capital, Source of Financing, and Farm-Size Type, Central Plateau Sub-region, Southern Brazil, 1960-1969	 5-13
	5-2 Accumulative Ten Year Capital Investment Outlays by Cruzeiros Per Average Hectare Operated and Percent According to Source of Financing, Type of Capital, and Farm Size-Type, Western Rangeland Subregion, Southern Brazil, 1969	5-14
	5-3 Annual Index of Land Owned and Operated, Three Subregions, Southern Brazil, 1960-1969	5-17
	5-4 Annual Index of Land Owned and Operated by Farm Size and Type, Central Plateau Subregion Southern Brazil, 1960-1969	5-18
	5-5 Annual Index of Land Owned and Operated by Farm Size and Type Western Rangeland Subregion, Southern Brazil, 1960-1969	5-19
	5-7 Annual Machinery Investment Per Hectare of Land Operated by Farm Size and Type, Central Plateau Subregion Southern Brazil, 1961-68	5-23
	5-8 Annual Machinery Investment Per Hectare of Land Operated by Farm Size and Type, Western Rangeland Subregion Southern Brazil, 1961-1968	5-25
	5-9 Percentage of Crop Farms Using Specified Crop Practices by Farm Size and Year of Initial Use Central Plateau Subregion, Southern Brazil, 1960-69	5-30
 FIGURE	 7-1 Indices of Real Prices of Fertilizers and Crops and Fertilizer Use in the State of Sao Paulo 1948-71	 7-15
 FIGURE	 8-1 Differences in Savings as the Result of Differences in Family Size	 8-8

LIST OF FIGURES -- Continued

	<u>Page</u>
FIGURE 11-1 & 11-2	Principal Wheat Producing Regions, Rio Grande do Sul 11-12

CHAPTER I

INTRODUCTION

BACKGROUND

Economic development models and strategy in the past have treated the industrial sector as the modern, dynamic sector and agriculture as a traditional, stagnant reservoir for surplus labor. Agriculture was given a relatively passive role of contributing sufficient amounts of cheap capital, labor and foodstuffs to fuel the industrial engine of growth. Although some controversy developed over balanced versus unbalanced growth, in practice little attention was given to making agriculture an equal dynamic partner in the growth process. Consequently, many economic policies affecting agriculture in the developing countries were motivated by a desire to accelerate industrialization rather than develop the agricultural sector in its own right.

Brazil is an excellent example of a developing country that followed this general development strategy through the import substitution and industrialization policies employed during the two decades immediately after World War II. Through foreign exchange controls, import restrictions, low interest rates, indirect taxation, and factor and product price controls, Brazil attempted to squeeze agriculture in order to accelerate industrial growth. Only enough stimulus was given to agriculture to maintain low food prices, generate some surplus for export, and create a market for domestically produced tractors, fertilizer and other inputs. With its large resource base, broad domestic markets and favor-

able economic policies, industrialization proceeded quite rapidly so that by the mid-1950's a large proportion of consumer durables were produced domestically, and some progress toward capital goods production was evident. Agriculture, however, remained relatively backward, and food and fiber supplies barely kept pace with demand. In the 1960's the sluggishness of agricultural output, increasing employment problems, and greater income inequality in several developing countries including Brazil led to a reexamination of development strategies that continually emphasized industrialization at the expense of agricultural development. More attention was focused on the role of agricultural development in overall growth, and on the determinants of agricultural growth, technological change, and diffusion of innovations.^{1/} Some evidence suggested that past policies aimed at accelerating industrial growth may have actually retarded the build-up of productive capacity in agriculture. Furthermore, the tendency to adopt a piecemeal rather than an integrated comprehensive approach to the problems of agricultural development appeared to have distorted the growth which did occur resulting in inefficient resource use and increasing income differentials between groups of farms and farming regions. Within this economic environment, the capitalization and modernization of agriculture has been limited because, contrary to the assumption of many policymakers, few profitable investment alternatives existed before the technological breakthroughs associated with the "green revolution". Policies such as concessionally priced agricultural credit de-

^{1/} For an excellent survey of key literature regarding agricultural development, see [18].

signed to stimulate agricultural production and investment often resulted in leakages to nonagricultural uses where the rate of return was higher or to increased investment in fixed capital, especially land, which generated capital gains for the owner but had little social payoff. Fragmentary evidence suggests that many of these features of development and growth have occurred in Brazil in the post World War II period.

Now that more attention is being focused on agriculture's contribution to economic development, the paucity of theoretical and empirical work on the behavior of agricultural decision making units has become evident. Yet the economic development literature has not focused on the economic and non-economic factors which determine and influence their behavior. It is clear that more effective and efficient policy making designed to accelerate agricultural growth and spread the benefits more broadly throughout the sector is dependent upon a clearer understanding of non-governmental decision-units, the interaction among them, and between them and the aggregate economy [3, 4].

Undoubtedly much of the micro theory and research covering both the agricultural and nonagricultural sectors has relevance for advancing our knowledge about economic growth and development. A key feature is, however, lacking. It has long been recognized that analysis of the behavior of farm firms represented special complexity due to the inter-^{2/}relation of production and consumption decisions. Yet much of the theoretical and empirical work on developing countries assumes a separation of producing and consuming units, so production and consumption decisions

^{2/} For examples of this concern in U.S. Agriculture see [9, 15].

can be treated independently.^{3/} But the farm firm is at once a producing and consuming unit, and each farm household as a decision unit faces a unique and complex set of decisions concerning production and investment opportunities constrained by consumption desires, and financial and resource constraints. The limitations of our knowledge about microeconomic behavior is closely related to a lack in our understanding of firm level growth processes in general, and specifically the process of building up farm productive capacity broadly defined here as capital formation. The interaction between firm households and various agricultural and economic policies is understood only in broad terms with little knowledge about detail. It is generally accepted that the extent to which farmers invest time and resources to increase productive capacity is largely dependent on the expected rates of return which in turn are influenced by factor proportions, technological changes, innovations, and public policies. New productive opportunities and the incentives provided by policies guide investment behavior along certain paths through their influence on decisions of individual farm families. The key role of farm capital is clearly evident not in just the narrow sense of fixed capital investment, but broadly understood as all those physical and human factors which determine farm production. Improvements in farm management, the careful use of new inputs, and investments in human capital may be as important as land clearing, drainage and irrigation, new buildings and improved machinery and livestock.

^{3/} A recent exception is found in [37] and references to some earlier attempts in this area are found in the article. Recent developments in the area of human capital and especially the work of Becker on allocation of time [6] offer other fruitful approaches to the problem.

Many of the policies employed in developing countries implicitly assume that opportunities are readily available for the build-up of productive capacity in agriculture. In many countries, including Brazil, this has led to a reliance on broad market oriented policies. Policy emphasis has been placed upon reducing the farms financial constraint through subsidized credits and on improving the farmers rate of return by controlling factor and product prices. Less attention has been devoted to longer term structural changes including research, extension and rural education to improve the capacity to create profitable technology and promote its rapid adoption. Now there is increased awareness that 1) the economic environment needs to be more carefully examined, and the important role of policy in altering that environment more clearly understood, and 2) the technology most readily available to agriculture must be evaluated for its impact on resource use and farm income. The slow build-up of agricultural productive capacity may be attributed, in part, to the lack of a more favorable long-term environment in which farm households are stimulated to invest more time and resources, and in part to the absence of modern technology clearly superior to existing techniques at the farm level.

OBJECTIVES AND ORGANIZATION OF RESEARCH

The research reported here attempts to contribute to the understanding of the complex nature of the relationship between new technologies and economic policies and firm-household behavior. The specific objectives are to: (1) investigate and describe this broadly defined process of growth and capital formation at the farm level in Brazil, and (2) evaluate the impact of technological change and selected economic policies on this process.

Brazil offers a good opportunity to study the complexities of the farm growth process because economic policies and post World War II growth and development reveal several important processes and problems of economic growth and capital formation. Furthermore, many of the policies used in Brazil are similar to those frequently used in other developing countries so that many aspects of the Brazilian experience lend themselves to generalization. The magnitude of the resource transfers associated with many policies and the observed contrasts between those farms greatly affected by these policies and those largely untouched provides a unique opportunity to study the relationship between policies and micro level growth.

This report is organized in the following way. The balance of this chapter describes the conceptual framework within which the process of farm-level growth is analyzed and relates individual research efforts which follow to this framework. Chapters 2 and 3 give a background of post World War II economic strategy and policies in Brazil with special emphasis on agricultural policies and growth during the 1960's. Chapter 4 describes the type of data collected for the research and also briefly describes the agricultural regions from which the data were drawn. A discussion of the changes in farm technology and productive capacity on the farms surveyed is presented in Chapter 5. Chapter 6 reports on resource productivity studies which document the economic reasons for the changes noted in Chapter 5. The results of these changes in resource use and productivity are presented for several agricultural subregions, and by types and sizes of farms. Special emphasis is given in both Chapters 5 and 6 to the problems associated with agricultural labor and mechan-

zation. Chapter 7 deals with the economics of fertilizer use as one of the few technological inputs along with mechanization used on an extensive scale in Brazil to accelerate productivity. Chapter 8 treats the sociological aspects of firm growth, especially the adoption of new technology. The relationship between on-farm and off-farm growth is treated in Chapter 9 with special emphasis on agricultural marketing firms, their growth, structure, and efficiency. Agricultural credit at concessional interest rates has been another important policy instrument in Brazil and the effects of this policy instrument and its broader ramifications are treated in Chapter 10. Chapter 11 reports on an attempt to integrate the various dimensions of the firm-household decision unit through a recursive programming model using a regional aggregate. Finally, Chapter 12 reports the principal findings and policy implications of the broad set of issues treated. Appendices are included at the end of some chapters which contain detailed supplementary information.

A FIRM HOUSEHOLD GROWTH MODEL

The key to better understanding of farm level growth and development clearly rests with improved knowledge about firm-household decision processes including the manner in which these processes are affected by policy. The following partial equilibrium conceptual framework of firm-household decision making guided the research effort reported here. Within the firm household, the interdependent nature of decisions to produce, invest, consume, and save is central to the growth process. This interdependence exists with regard to current decision choices; furthermore, the choices made in the current period are conditioned by outcomes of decisions in previous periods. For example, production decisions re-

garding type and amount of inputs to use and outputs to produce are directly related to consumption desires, financial resources for operating expenses and amount of family labor available for on-farm employment. Likewise, production opportunities in one period are related to previous investments outlays, while current investment outlays compete with liquidity required for current production and consumption. The attractiveness of non-farm investments and financial savings offer yet another claim on current liquidity. The interaction of these relationships ultimately result in the micro-level growth process observed as an evolving structure of farm capitalization, resource use, output, consumption and off-farm investments and savings.

The substantial differences observed in the growth of individual farm firms are due, in part, to the fact that each firm household faces a unique set of constraints (resource, financial, technological, and managerial) internal to the firm which condition, limit, and orient the decision process. For example, the relative and absolute amounts and quality of productive resources (land, capital, labor) set the broad limits within which production technologies can be profitably employed and hence the type of growth which occurs. The cost of mechanization relative to land/labor ratios is one example, and small farms with abundant labor resources may value the opportunity cost of labor quite differently than large farms.

Finally, there are factors outside of the firm household that further condition the decision process. The structure and efficiency of the marketing system as well as the effect of government policies together act as external forces on the firm to influence behavior and alter constraints. The marketing system determines the availability of inputs and access to

output markets, and the efficiency of the system as expressed by marketing margins affect the price signals transmitted to farm firms. Agricultural and economic policies affect firms both through the marketing system by altering these price signals, and through the creation and dissemination of new and improved technology which alters production and investment opportunities. Since the resource constraint structure is unique to each firm household, there are substantial differences in farmer response to markets and policies. As a general rule, it would be expected that firms which are most commercialized and monetized will be most affected by changes in markets and policies.

In the research reported here, a two-part methodology was used to unravel the complexities of this micro-level growth process in the Brazilian experience.^{4/} First, the underlying structure of each individual process was investigated both with respect to individual resource endowments as well as external forces and intervention. Particular emphasis was directed toward analysis of production and investment decisions and the impact of policies on these decisions. Secondly, a dynamic model was developed to integrate these decision processes within the firm-household, including a dynamic feedback mechanism to explicitly link present to past decisions. This model was operationalized with farm size decomposition in one region of Brazil, (Chapter 11).

Given this general framework, the following section and chapters deal with the development of a conceptual model, firm level production and investment studies, studies of the impact of market and policy forces, and

^{4/} Econometric techniques have been proposed to test these relationships [5, 37] and programming tools in [3, 26, 33].

finally a model to integrate firm-household decision making.

The Model

Consider the following conceptual model of farm level decision making in which individual firm households are assumed to maximize short-run profits subject to resource and financial constraints in any given production period.

$$(1) \text{ Max. } \pi = \sum_j p_j Q_j - \sum_i \sum_j q_i a_{ij} Q_j$$

Subject to:

Resource Constraints

$$(2) \sum_j a_{ij} Q_j \leq R_i$$

and Financial Constraints

$$(3) \sum_j \sum_i q_i a_{ij} Q_j = F + B - C - I - Td + Y$$

where $j = 1, \dots, m$
 $i = 1, \dots, n$

Q_j = j^{th} farm output;

p_j = price received by the farm for the j^{th} output;

q_i = price paid by the farm for the i^{th} input;

a_{ij} = input-output coefficient measuring the amount of the i^{th} input used per unit of the j^{th} output;

R_i = initial on-farm endowment of the i^{th} resource (quasi-fixed and fixed);

F = initial firm-household endowments of financial resources (cash + financial savings);

B = Current net borrowings by firm-household (current borrowing less debt repayment);

C = Current consumption expenditures by the firm-household (on-farm and non-farm goods);

I = Current investment expenditures by the firm-household (on-farm and off-farm investments);

T_d = Direct taxes levied on firm-household;

and Y = Off-farm incomes earned by members of the firm-household.

In this framework equation (1) measures the current short-run profits accruing to the firm-household. These profits are measured by gross revenues less the costs of production to the firm-household. These profits are, of course, constrained by the initial resource endowments (R_1) of fixed and quasi-fixed factors of production including land of varying quality, and farm machine and other capacities. These constraints are defined in equation (2). Further, the firm-household faces a financial constraint wherein given its initial resources of cash and financial savings (F), it has to meet outlays for production, consumption (C), investments (I), and direct taxes (T_d). Its only means of augmenting its current financial resources is its ability to borrow (B), and earn off-farm incomes (Y). This constraint is described in equation (3).

The definition of the firm-household decision process by the set of equations in (1) - (3) includes several simplifying assumptions.

- 1) All firm-households are independent of each other;
- 2) All firm-households are price takers in both input and output markets so that each faces a perfectly elastic demand for its output and a perfectly elastic supply of all inputs. (Only then can we consider input and output prices as given in the current period);
- 3) Current consumption and investment expenditures are independent of current output and revenues (though not necessarily independent of past output and revenues);

- 4) Current endowments of financial, quasi-fixed and fixed resources are independent of current output and revenues; and
- 5) Current level of borrowings are independent of current output.

Dynamic Feedback

These assumptions above, of course, present a simple one-period static model of firm-household decisions and do not permit investigation of the problem of farm-level behavior wherein growth is the outcome of dynamic forces. In order to analyze the dynamic properties of the system (1) - (3), a set of feedback functions have to be added that allow us to relate the current parameters of the farm problem to a set of past decisions made by (i) the firm household, (ii) in the market and (iii) by the government or other control agencies.

Associated with these past decisions three broad types of dynamic feedback can be identified: (1) decision feedback, (2) market feedback and (3) policy feedback. By decision feedback we mean the impact of past decisions by the firm household that effect the parameters of its own current decisions; by market feedback we mean the impact of other decision makers (other firm households, firms or agencies) in input and output markets that determine through current input and output prices the farm's current decisions; by policy feedback we mean the impact of past policy decisions on the current policy environment within which the firm household operates. The problems of defining market and policy feedback are complex and numerous and are treated only implicitly and indirectly in a much broader context later.

Focusing on the decision feedback within the firm household, the concern is essentially with the two sets of constraints - the resource

and the financial. The question is now the firm households own cumulative decisions in conjunction with market and policy forces, assumed to be exogenous and given, have an impact on its current decisions, and how they allow the farmer to extend his physical and financial resources so as to expand output and productivity.

This question is essentially one of asking how the variables on the right hand side of the constraint equations (2) and (3) depend upon past decisions. Again simplifying, the following decision feedback functions can be written in broad abstract terms:

$$(4) F = f(\pi_{-1}, Y_{-1})$$

$$(5) B = b(R_{-1}, \pi_{-1}, i)$$

$$(6) C = c(\pi_{-1}, Y_{-1})$$

$$(7) I = I(i, (d\pi/dI)_{-1})$$

$$(8) R_i = r_i(R_{i-1}, I_{i-1}, R_{j-1})$$

$$(9) Y = \bar{Y}$$

$$(10) T_d = \bar{T}_d$$

This set of feedback functions essentially relates the firm household's current financial resources and consumption outlays to its lagged on-farm and off-farm earnings in equations (4) and (6); its current borrowing ability to the size of its lagged resource endowments, farm earnings and the current interest rate in (5); its current on-farm and off-farm investment opportunities to the lagged rate of return to on-farm investments and the current interest rate in (7) and its current resource endowments to its lagged resource endowments and investments in (8), while off-farm employment opportunities and hence incomes and direct taxes are assumed to be exogenous and given in (9) and (10).

Again, it is apparent that in writing these decision feedback functions several simplifying assumptions have been made. For example, various types of on-farm and off-farm investments are aggregated together and related to a common rate of return to on-farm investments only, whereas in reality several types of investments and rates of return may be operative. The consumption of farm produced and nonfarm products are aggregated and related to the same set of factors when this may not be the case.

Whatever the shortcomings introduced by these simplifications, a salient feature of the system of equations (1) - (10) is that they portray a dynamic decision process that is by and large cumulative; one in which the financial and resource constraints to farm level growth and expansion can be removed or relaxed through a variety of decisions, some endogenous and others exogenous to the decisions made by the firm household.

Policy Avenues to Accelerate Growth

For policy makers interested in accelerating the process of farm level growth and capital formation, an obvious question is what exogenous factors can be brought to bear on the firm household decision process and what are their likely impacts? In what follows, several policy instruments suggest themselves and in reference to the model outlined above, an attempt is made to outline how they are likely to impinge on the process of farm-level growth.

Pricing Policies and Price Responsiveness

Pricing policies play a major role in effecting the process of farm level growth as they affect farm profits directly [19, 23, 24]. A relative increase in the price of a given output (p_j) will provide an incen-

tive to increase its production (Q_j) while a relative decrease in the price of a given input (q_j) will lead to its greater use, ceteris paribus. The impact of a change in any input price depends upon its relative importance in the input mix and hence on the technology in use (the relative size of the a_{ij} coefficients), while the impact of an output price change depends upon its relative weight in the output mix, and thus on its relative demand in the market.

The extent to which different farms are price responsive varies but enough evidence has now been accumulated to show that production decisions are price responsive in LDC's, especially when care has been taken to account for adjustment lags due to factors such as uncertainty, learning and the fixity of capital stocks (resource constraints). Furthermore, it has been shown that by and large "the general form and direction of this response is consistent with price theory and that even peasants in traditional agriculture respond to market incentives when sufficient incentives exist" [11].

Price policies often have two broad objectives. The first focuses principally on reducing price uncertainty and risk faced by farmers. Average relative price relationships are maintained, but attempts are made to level out the year-to-year fluctuations. Farmers' price expectations are then stabilized and optimum resource use over time is more readily possible. A second set of price policies aim at altering input and output price relationships, at least in the short-run. Subsidies are given for a specific input to increase its use, and depending on its productivity, output will expand. In the process, the financial constraint is relaxed due to the lower input price and the increased output. Similarly, output

prices can be set at artificially high levels to encourage the production of specific products, with broader policy objectives in mind. Such is the case of reducing imports of foodstuffs by setting domestic prices above international levels in order to encourage domestic self-sufficiency. Likewise, some prices may be controlled below equilibrium levels to reduce consumer prices, which act as a tax and causes a shift in output mix, in the long run.

Thus, pricing policies in input and output markets, either directly through price controls or indirectly through the use of indirect taxes and subsidies can be a most powerful tool for generating as well as retarding farm-level growth, especially where specifically binding resource and financial constraints are removed. As will be emphasized later, several types of pricing policies have been used very extensively and effectively in Brazil to meet certain objectives.

Credit Policies

Even where the appropriate incentives to expand farm production exist, such expansion may be limited by the shortage of adequate financial resources. Credits and credit policies can be used to relax this constraint.^{5/} Credit policies relate not only to the amounts of credits made available to farmers but also the terms on which credits are made available. In this regard, the use of credits is tied to specific uses in many LDC's to encourage the use of "modern" inputs. Whether tied credit actually limits the use of borrowed funds to specific inputs and only partially relaxes the

^{5/} Much of the recent literature on agricultural credit policies and programs is found in the analytical and country papers prepared for the U.S.A.I.D. Spring Review of Small Farmer Credit, Washington, D. C., July, 1973.

financial constraints or whether they only free the farmer's own resources for use elsewhere is an empirical question for additional study.

A further issue in this context is the need to know the nature of credit demand. A low level of credit use could be the result of either stringent supply conditions or a low level of effective demand for credit on the part of the farm households. Schultz effectively argued that where the rates of return are very low, few incentives exist for on-farm investments and hence savings, and that only a dramatic change in these rates of return would lead to cumulative investments and growth [31]. A similar demand problem has been cited in relation to the use of credit policies and it has been reasonably argued that in many cases the expansion of credit supplies needs to be tied to the availability of new and more profitable technologies before credit policies can become an effective instrument to stimulate farm-level growth [17].

Another related issue focuses on the problems of "access" to credit and credit markets. It has been pointed out that institutional suppliers of credits relate the loans they give to factors such as "ability to pay" and "credit risk" as they are themselves profit maximizers in turn. As a result, the farmer's "ability to borrow" becomes related to the size of his resource endowments and size of his operational revenues - as indicated in equation (5)-rather than to the productivity of capital. Thus, the supply factors tend to limit access to credit by small farmers even when their rates of return are high at the margin. Where such factors are operative, credits tend to be cumulatively discriminating and a misallocation of resources occurs over time with the attendant problem of a growth in interfarm and interregion income inequalities. The problem is accen-

tuated in countries that control interest rates below equilibrium in credit markets and force lending institutions to ration credit through non-price criteria. In this situation, credit allocation becomes even more inequitable and small farmers frequently suffer additional discrimination. The operation, effectiveness and discriminatory nature of rural capital markets often becomes critical to the farm level growth process, as it is often the financial constraint that is initially the most critically binding.

Again as pointed out in later discussions, credit policies have played a critical role in the farm sector in Brazil and some of the problems relating to tied credits, credit demand and credit access in rural capital markets have been operative, but our knowledge regarding the empirical content and impact of these problems has been minimal.

Tax Policies

Taxes on inputs, output, income, and assets affect the incentives to produce, the output mix, resource use and consumption and investment decisions of the firm household [8, 20]. Taxes on the value of specific outputs, such as export taxes, reduce the price received by farmers (p_j), thereby affecting the relative profitability of outputs causing a shift in output mix. Income taxes, however, reduce the profitability of all outputs. Taxes on specific inputs alter the relative cost of inputs and encourage the substitution of cheaper for more expensive inputs. It is argued, for example, that the unused land held by large landowners could be forced into production by increasing the opportunity cost of holding it idle by raising land taxes. Land would become a factor of production and would be less important as a means of holding wealth and a hedge against inflation. In

some regions, a wealth tax on cattle could encourage a reduction in herd size and overgrazing.

Export taxes and the implicit tax of overvalued exchange rates have been important in Brazil as a means to transfer resources from agriculture to industrialization, and as a brake to slow accelerating exports causing domestic price increases. Income and land tax reforms were initiated in the mid-1960's to increase tax revenues and intensify land use, but these policies appear to have been less important to farm household behavior than price and credit policies.

Marketing Structure and Efficiency

If agricultural growth is to proceed at a rapid rate, a comprehensive agricultural marketing system must be developed to process and distribute agricultural products, and channel increasing quantities of industrially produced inputs to the farming sector [1, 28, 29, 34]. Off farm growth of the marketing system specifically and agricultural infrastructure generally becomes a key factor in influencing farm level growth.

Government intervention in the marketing sector is frequently directed at three main problems: 1) the creation of market systems to handle agricultural outputs and inputs, 2) improving the efficiency of existing systems, and 3) introducing and improving market information. Construction of physical facilities is at the center of the first approach where the lack of certain inputs like improved seeds, fertilizers, chemicals and machinery retard agricultural growth, and the absence of certain storage, processing and transportation facilities prevents some regions from successfully competing in the production of some outputs. The second approach involves improving the efficiency of systems that already exist, sometimes through

new modern facilities, improved management, and control over transactions between buyers and sellers. This effort is designed to increase the prices received by farmers for outputs (p_j), and to reduce the prices of purchased inputs (q_i) by improving the efficiency and reducing the margins of marketing firms. The last approach attempts to assist farmers to take advantage of opportunities that already exist. Improved market information can help integrate markets by making buyers and sellers aware of markets outside their normal marketing regions. Interregional price inequalities can diminish as trading increases across regional lines, resulting in higher value for farm output and intensified resource use.

All three approaches have been used in Brazil and a vast amount of resources spent, but little is known about the economic impact on the marketing system and on farm resource use and output.

Agricultural Infrastructure

Agricultural marketing systems are only a small subsector of the total agricultural infrastructure which often needs to be created as part of agricultural growth and development. Whereas markets may be essentially privately owned or owned by users as in the case of farmer cooperatives, the high cost long term nature of roads and transportation facilities, communication, irrigation, rural electrification, and rural education requires more direct government involvement and investment [25, 36]. Investments in transportation and communications have been most important, especially in a large country like Brazil with vast distances and fragmented markets, in bringing new areas into agricultural production. New areas with good soil fertility coupled with cost-reducing advances in transportation can produce expanding supplies of output at stable prices for

growing urban populations. The combination of lower production costs on cheaper naturally fertile land and lower marketing margins through transportation efficiencies encourage a shift in enterprise mix from extensive to intensive agriculture in regions previously too distant from consuming centers.

Irrigation and other land improvement efforts expand output when the productivity of the land increases sufficiently to offset its increased cost as a factor of production. Rural electrification improves the quality of rural life and opens up new alternatives for labor saving equipment and new output increasing techniques, while investment in human capital through rural education helps provide the ability to decode information about new production technology [35]. Thus it contributes to diffusion of technology and may encourage farmers to more actively seek out new techniques.

It will be shown later that the majority of Brazilian public investment has gone into transportation and communication which, along with marketing, have contributed to expanding the agricultural frontier.

Technology, Research and Extension

Within this category of activities, many governments, surprisingly, have emphasized extension rather than research. The assumption seems to have been that improved technology is available and profitable at existing product/factor price ratios. Such an assumption also seems to have been predominant in defining U.S. aid activities during the 1950's. The policy implication logically followed that farmers were at most irrational or at best slow adopters, and great gains could be achieved by speeding adoption of practices used by the most advanced farmers or in experimental trials.

Schultz's [31] work among others helped disprove the irrationality argument and the experience with the green revolution technologies, especially in Asia, have demonstrated that the rapid adoption of technology does occur, when it is clearly profitable. The Hayami and Ruttan research [14] emphasizes the key relationship between factor prices and creation of new technology. If markets affectively determine factor prices, then the problem of providing new technologies to encourage farm level growth rests mainly on the need to support frequently neglected local research programs and the training of skilled reseachers to staff them. Importation of technological packages and their adaptation to local environments as well as development of local techniques clearly overshadow short-term price manipulations and agricultural extension as a means to speed farm level growth. But since profound institutional changes are frequently involved, the creation of indigenou research capabilities has been slow and the long time lags between experimentation and farm level impact mask some of the real developments that have taken place.

Furthermore the optimism surrounding recent technological breakthroughs associated with the green revolution has waned for several reasons. First, many countries and regions do not have the type of agro-climatic conditions to which the new technologies are ideally suited and have not done enough to adapt them to local conditions and have limited capacity to do so. Secondly, second and third generation problems such as inadequate markets and infrastructure and increasing income inequalities between large and small farmers, and between land owners and renters have often brought social instability in the wake of technological breakthroughs [12]. Thirdly, these technologies are heavy users of energy in

the form of fuel and fertilizer. Recent international price increases of these inputs and the reliance on international controls for their supply have reduced the profitability of the new practices and introduced a growing element of uncertainty in their use. For these reasons, strong local research programs are required to develop locale-specific technologies consistent with the resource endowment of each country. The rapid adoption of imported techniques may have limited impact, and even unexpected and undesirable results for long term farm level growth, if these additional aspects are ignored.

Changing the Structure of the Agricultural Resource Base

A policy avenue which probably has the most direct political impact, and hence often meets with opposition, is that of restructuring the agricultural sector through reform of the land tenancy system. Several issues have been addressed by this policy in developing countries. The first has been to reduce the surplus underutilized land held by large landowners which may have low productivity and therefore low opportunity cost as presently held and operated, but which generates high capital gains for its owners. Another has been to enlarge and regroup small holdings in order to achieve economies of scale. Thirdly, expanded and more secure landholdings are assumed to encourage operators to take more risks in adopting new technologies.

A major reservation with the use of this policy avenue which changes the structure of the on farm resource base is that a rapid and profound change may so disrupt present patterns of resource use that production, at least in the short run, will fall. Even though production may not be seriously affected, on-farm consumption may rise faster than production so

marketed surpluses will fall. It is clear that all the issues involved in structural changes of the farm level resource base bear heavily upon the question of the behavior of farm firm-household units before and after such reform.

As will be shown later, Brazil has not used this policy instrument to any great extent, and the major changes which have occurred in the agricultural resource base can be attributed to other policies.

Off Farm Investment and Employment Opportunities

The discussion on the role of agricultural infrastructure and markets above, stressed the impact on firm growth through agricultural production. Another major relationship, however, involves the investment of human and financial resources. The rate of return on off farm financial investments obviously affects on farm investment behavior, at least for those farmers sufficiently integrated into the urban non-farm economy to perceive such opportunities. Some countries like Korea and Taiwan have appreciated the potentially important role of agricultural savings in developing capital markets, and have endeavored to capture a larger share of agricultural savings through increased rates paid to savers [2]. In so doing they have relieved the capital constraint evident in developing economies, and may have prevented some of the excessive capitalization of agriculture which can occur in the absence of profitable off farm investment opportunities.

Likewise the availability of seasonal and part time off-farm employment opportunities influences the use of labor on farms. Increased opportunities for family labor effectively raises its opportunity cost on the farm and causes a reduction in on-farm employment. At the same time the

earnings from off-farm employment can relax the financial constraint on consumption and investments, and ease the demand for scarce agricultural credit. The reduction in farm labor use and increased financial resources together can accelerate the modernization of agriculture through the adoption of labor saving technology and mechanization. Mechanization can also contribute to increased output through higher yields, increased double cropping, etc. Labor displaced by mechanization increases the labor supply to industry which can reduce the industrial wage bill and facilitate industrial growth.

Industrialization of the Non-farm Sector

A final feature of the interrelationship between farm and non-farm growth has yet to be identified. Earlier we emphasized how the price and availability of new inputs was related to agricultural output. Although the marketing system's capability to distribute these inputs is of obvious importance, an elastic supply of cheap inputs, at least in the long run, is the cornerstone of agricultural growth. Outside of agricultural seeds which frequently must be developed through public sector programs, little specific attention has been given to the availability of other inputs like fertilizer and machinery [30]. Only when the foreign exchange cost of their importation becomes prohibitive do policy makers focus on developing domestic supply industries with support for research and development programs for new inputs. Yet it is widely held that farmers in many developing countries face much higher input prices than those in developed countries.

An abundant supply of attractive inexpensive consumer goods can also influence farm household behavior. On the one hand, consumption expenditures can increase and compete with investments for scarce financial re-

sources. Thus there is a shift between immediate and postponed consumption. At the same time, attractive consumer goods may provide the incentive to expand investments and the use of unemployed resources, especially family labor input, to increase output and raise incomes for future consumption [18].

Sociological Determinants of Firm Growth

The emphasis on the conceptual model of firm household behavior and the policy avenues described above are heavily oriented to economic issues. Noneconomic factors are also important in conditioning, accelerating and retarding farm-level growth. These factors in themselves justify a full blown noneconomic model but the state of the arts does not facilitate the easy integration of well developed economic and noneconomic dimensions in a single model. The objective of this research, therefore, focused on the narrower issue of adoption of technology, and represents a modest effort to bring sociological factors to bear on firm household behavior.

Three types of sociological variables were included in this analysis. Variables related to the individual farmer constitute one type and frequently include age, ethnic background, education, religion and experience of the farmer. These variables are typically expected to influence attitudes towards innovation, risk-taking, saving and consumption and thus reflect predisposition to accept and utilize new ideas.

Variables referring to the farm family represent another closely related type. For example, family size is frequently associated with income levels, and savings and consumption behavior. Given farm size, an increase in family size represents at once a potential increase in on-farm

labor use and increased competition between consumption and investment. Furthermore, the family is the most important socializing force in developing countries and has a powerful influence over resource allocation.

Community level variables represent a third, and some argue, more important level of variables frequently overlooked in research on economic development [13]. At least two issues are important here. The community is another important socializing force, and the more isolated and traditional the region, the more important appears to be the influence of the community. Seeking out and adopting new technology can be influenced by the kind of reaction and support the individual farmer receives from his peers. Secondly the complexity and institutional diversity of a community is directly related to the type and complexity of technology, markets, and services from which the individual farmer can choose in his local community. Community leadership is important both in determining local sources and uses of resources as well as affecting the allocation of resources shared among communities. An aggressive leadership can create opportunities and attract facilities for a community beyond that expected for its size thereby influencing the economic environment for the agricultural hinterland.

Not enough resources could be allocated to do extensive research on these issues but enough work was completed to provide insights into their importance in farm level growth and capital formation.

SOME CONCLUDING CAVEATS

Simplicity of Analytical Framework

It is clear that the broad conceptual model of farm level growth outlined above falls far short of a complete theory explaining firm-household behavior in developing countries. A great deal of additional em-

empirical and theoretical work must be done before we can clearly specify the nature, direction, and magnitude of all the pertinent relationships. It appears, however, that the model captures the main features of firm-household behavior as it is presently understood. Furthermore, our understanding of the relevant development literature suggests that the policies selected above and associated impacts are among those most frequently found in developing countries. It is imperative, therefore, that an attempt be made to determine how these policies interact with and are filtered through individual households to produce the outcomes which are vaguely observed, little understood, and seldom measured.

Conceptual oversimplification, of course, has its dangers. One of the problems which appears to have frustrated other attempts to quantify and predict farm level outcomes in response to certain policy instruments and adjustments is that for methodological simplicity researchers have narrowed their focus to one or few partial policies and outcomes. The exploratory nature of some research requires such a partial approach, yet in the real world of developing agriculture, the farmer is faced with simultaneous policies and influences -- some complementary, some contradictory -- which ultimately determine his response, and the sector's aggregate response. In an effort to avoid some of these shortcomings, a set of methodologies were employed sometimes to the same sets of data to gain additional insights and perspectives. For example in Chapter 5, changes in resource use on farms and resource flows between farms is traced out in historical fashion. Later the productivity of resource use is tested on many of the same sets of farms by the use of production functions in Chapter 6. And finally in Chapter 11, a programming model is used to analyze competition for resources among farms in one region,

by explicitly focusing on the interrelated nature of production, consumption, savings and investment decisions in the firm household.

Brazil as a Case Study

Several references have been made above to the use of certain policies in Brazil. The next two chapters document the evolution of Brazil's economic and agricultural policies during the post World War II period. and it will be made clear that the inherent richness of information in the Brazil experience makes it an ideal case to study from which generalizations can be made. Furthermore, the magnitude of the resource flows and changes in output associated with these policies facilitates measurement even with crude and incomplete data. At the same time certain farmers and regions have been largely left behind in the growth process. A third and extremely important reason for selecting Brazil was the existence of a basic cadre of well-trained highly motivated researchers interested enough in the project to surmount innumerable research barriers.

There was one serious disadvantage in selecting Brazil, however, for this type of study. Many of the features of the firm-household decision process described above could be most easily and thoroughly studied only with time series data. In Brazil, however, there are only a handful of farms for which there are farm records for any length of time. Thus two basic strategies were followed in the cross sectional surveys which generated most of the data: 1) some farmers who had been interviewed for a previous project 4 years earlier were reinterviewed to determine changes over time, and 2) data were obtained in all farm interviews covering income and expenses for a complete production year plus historical data on questions such as acquisition of land and machinery and the use of improved

technology. This approach provided a reasonable approximation of key time series variables and proved adequate for much of the analysis. In several places, however, readers will undoubtedly identify where good quality time-series data would have provided the means for more robust tests of the issues and hypotheses under study. One of the conclusions reached in this research is that thorough measurement of many variables requires more detailed and complex data collection procedures perhaps only possible through a long-term relationship with the informants. But this raises the possibility of interaction between the researcher and farmer leading to modified behavior due to a desire to provide the "right" answers and "improved" responses.

With these cautions in mind, we now proceed to the various studies that form the main body of our research.

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CHAPTER 12

SUMMARY AND CONCLUSIONS

INTRODUCTION

During much of the post World War II period, Brazil has pursued a general strategy of development similar to many developing countries. The industrial sector has been considered the modern, dynamic sector, while the agricultural sector has been relegated to a more passive role of contributing sufficient amounts of cheap capital, food and labor to fuel the industrial engine of growth. Foreign exchange controls, import restrictions, indirect taxation, and product price controls generally detrimental to the agricultural sector have been only partially offset by low interest rates on credit and factor subsidies as agriculture has been effectively squeezed to extract a surplus for industrialization. Structural changes such as agrarian reform, improvements in rural education, and increased support for research and extension have been minimal compared to frequent intervention into markets designed to maintain a delicate balance between low food prices for consumers and sufficient stimulus to farmers to expand output.

In spite of this neglect and outright discrimination, agriculture has grown at a sufficiently rapid rate to prevent sharp rises in food prices although periodic supply crises have occurred because of adverse climate and uncertain market conditions.

Beginning in the mid-1960's, a belief emerged among policy makers in several developing countries that more attention had to be given to

agriculture if the sector was to contribute to rapid economic growth rates, to supply foodstuffs to rising urban populations and to provide employment and adequate levels of living in rural areas until industrialization could absorb more manpower. More attention was focused on clearly defining the role of agricultural development in economic development, and on the determinants of agricultural growth, technological change and diffusion of innovations. This viewpoint toward agriculture also began to emerge in Brazil at the end of the 1960's.

Now that more attention is being focused on agriculture, the paucity of theoretical and empirical research on the behavior of farmers has become evident. The economic development literature preoccupied with the macro economics of growth contains relatively little on the economic, social and political factors which influence the decisions of millions of agricultural households which typically exist in the farm sector of a developing country. Yet the response of these farm households to their economic and social environment is the key to a proper understanding and analysis of agricultural growth and development.

The research reported on in this volume represents a modest attempt to improve our understanding of this agricultural growth process in Brazil with a focus on the complex nature of the relationship between new technologies, economic policies and farm firm-household behavior. The specific objectives of this research are to: (1) investigate and describe the process of growth and capital formation at the farm level in Brazil, and (2) evaluate the impact of technological change and selected economic policies on this process. The partial equilibrium conceptual framework of firm-household decision-making developed in Chapter 1 guided

most of the research effort. The central concept used was one of interdependence between decisions to produce, invest, consume and save and its effect on current farm behavior, as well as the way in which current decisions were conditioned by previous outcomes. This interdependence ultimately results in an evolving structure of farm capitalization, resource use, output, consumption, and off-farm investments and savings at the firm level.

Following the introduction of this conceptual framework in Chapter 1, a thorough review of Brazilian post World War II economic and agricultural policies and growth is included in Chapters 2 and 3. In these chapters, the overall economic and social context in which agriculture operated is described. These chapters provide the necessary background for understanding why certain detailed studies were conducted as reported in Chapters 4 through 11 and how the empirical results obtained could be related to the environment faced by agricultural households. A two-part methodology was employed to unravel the complexities of the farm level growth process. First, the underlying structure of each individual process was investigated both with respect to individual resource endowments as well as external forces and market intervention. Particular emphasis was directed toward analysis of production and investment decisions and the impact of policies on these decisions. Secondly, a dynamic model was developed to integrate these decision processes within the firm-household including a dynamic feedback mechanism to explicitly link present to past decisions. The model permitted asking the counterfactual question "What would have occurred if policies other than those actually employed had been followed?" and thus gave insights into the

gains and losses of the actual growth strategy followed in one agricultural region.

The next section of this chapter summarizes the principal findings of the research beginning with an overview of general economic and agricultural policies and performance followed by the specific farm level findings of this research.

SUMMARY OF FINDINGS

Brazilian Agricultural and Economic Policies and Growth, 1947-1974

The post war era in Brazil can be divided roughly into two periods: the 1947-1963 period of inward looking import substitution industrialization, and the post-1964 period characterized by more outward looking export expansion and diversification of the economy. Emphasis is on this latter period which coincides with the period covered by the farm-level research reported on in this report:

1. Industrial growth has been consistently emphasized following World War II and intensive import substitution began in earnest in the early 1950's. Most consumer goods were domestically produced by the mid-1950's, and some inroads were being made into the capital goods sector. Factor pricing policies have generally encouraged capital intensive techniques in industrialization resulting in low rates of labor absorption.
2. The government has assumed an expanding role in the economy by owning control in basic sectors like steel, electricity, and petroleum, and by using a wide array of policy instruments to control relative prices in many factor and product markets.

3. Expansion and diversification of exports has been facilitated from 1968 onwards through tax deductions, special credits, and a "crawling peg" exchange rate with periodic mini-devaluations tending to reduce the overvaluation of the exchange rate and speculation in the currency markets.

4. Other institutional innovations since 1964 include centralization of economic policy making at the federal level, indexing of financial instruments and government bonds, massive incentives for the capital market and creation of the Central Bank in order to more adequately control banking and the money supply, and creation of development funds as a source of capital for government investments and to aid private investment.

5. Distributional concerns have been secondary to the drive for rapid growth in recent years. Huge quantities of foreign capital inflow and rising indebtedness have resulted, while income has become more concentrated.

6. The post 1964 political model has been bureaucratic and authoritarian. A unique system of periodically transferring leadership within the military hierarchy has provided a means to periodically study and change policies. Recently limited popular participation in the election of opposition political figures has been permitted.

The overall performance of the economy, the policies used to stimulate growth, and the political and institutional means of policy making described above have conditioned the treatment given to the agricultural sector in the post war period. The pre and post 1964 periods mentioned above are characterized by corresponding changes regarding agriculture,

but the rather clear distinctions observed for the economy as a whole have not been reflected in such sharp contrast in agriculture. The main features of the agricultural growth processes and policy instruments can be summarized as follows:

1. The agricultural sector has experienced a systematic pattern of discrimination as part of the Brazilian strategy to transfer resources to the rapidly expanding industrial sector. In spite of this unfavorable treatment, agriculture has grown at a rate approximately equal to domestic demand with some surplus left over for export.

2. Most of the output expansion has occurred through increased use of land and labor. Yields have grown slowly and are low for many crops compared to several other major producing countries.

3. Until recent years, the country has underinvested in research, extension, and rural education. Structural reform has lagged while frequent intervention in factor and product markets has been undertaken largely with a view to benefitting consumers rather than producers. The broad objectives of policies have remained stable but frequent short-run adjustments have been made in specific instruments.

4. The state of Sao Paulo stands out as an important exception to the above generalizations. Agriculture has made an important contribution to the state's economy even though the share of agricultural output is falling. Agricultural growth rates have been high and yield increases much larger than found in other states. Historically, agricultural research and extension have been given more emphasis and on occasion the state's budget for these activities has exceeded the entire federal budget for the same items.

5. Agricultural policies have frequently benefited certain commodities (wheat, coffee, sugar cane), regions (South, Center West), and groups of farmers (large, monetized, commercial), more than others. These policies have contributed to widening disparities in intra-sectoral and inter-regional income levels and growth rates of income.

6. The principal policy instruments in agriculture during the post 1964 period have been: a) product oriented programs with minimum prices for domestic food crops; fixed prices for coffee, sugar cane and wheat; and price ceilings for meat and milk; b) factor pricing programs designed to reduce the cost of capital through subsidization of modern inputs like seeds, fertilizer, and machinery, and providing agricultural credit generally at negative real rates of interest, while minimum wages and social welfare legislation have increased real labor costs above equilibrium levels; c) trade policies which have frequently given preferences to agricultural inputs but discriminated against exports through controls and overvalued exchange rates; d) national and regional investment programs which emphasized infrastructure investments by the public sector in roads, marketing facilities, and communication, and encouraged private sector investments in reforestation and in opening new cattle ranches in the Central-West and Amazon; and e) agricultural taxation the incidence of which was felt more in indirect than direct taxes, and which contributed little to intensified resource use at the farm level.

Through these several policies the federal government had achieved a wide range of means to intervene in agricultural factor and product markets by the 1970's. The role of the government had become so pervasive that it was no longer easy to understand and predict the impact

of any one policy change on farm level growth. But it was obvious that the more commercialized the individual farm household, the more its behavior was going to be influenced by sometimes complementary, sometimes conflicting public policies. The summaries of Chapter 4 through 11 which follow indicate the nature of some of these policy impacts.

Farm Level Capital Investments and Technological Change

The purpose of this specific study was to document the capital investment and technological change process on farms during the period 1960-69. The sample farms were drawn from the states of Rio Grande do Sul and Santa Catarina in Southern Brazil, and represent the broadly defined wheat - soybean - cattle subregion. The major findings were as follows:

1. There was substantial growth in farm level capital (and hence production capacity) on most farms in this period but the composition of farm capital and its change over time showed wide variation.

The greatest capital investments were made on crop farms, where annual operating expenses and machinery investments showed the largest increases. In small farm regions where mixed farming predominates, land and buildings have been emphasized, while land and livestock still represent most of the capital on livestock farms.

2. Credit was the most important factor in the financing of machinery purchases and operating expenses, while farm level savings were most important in financing land and building improvements.

3. The size of large farms has increased substantially and the rate of adoption of new technologies has been directly related to farm

size.

12-9

Large crop farmers have expanded their operational units by buying and renting land from small crop farms, mixed farms and livestock farms. Large farmers began adopting machinery and other new cropping practices earlier than small farmers and reached almost 100 percent usage at an earlier date.

4. At the end of the decade (1969) large crop farms were experiencing the greatest levels of cash flows.

Differences in annual cash inflow and outflow per hectare were consistent with the above changes in resource use. Crop farms, and especially large crop farms, had the highest inflow due to farm production and receipt of new credit, but also had the highest outflow for operating costs, capital purchases, debt retirement and land rental.

Study of Farm Level Productivity

The purpose of this study was to investigate the choice of input use and constraints, technological differences, the productive potential of inputs in the production process, and the issue of mechanization and its influence on labor employment. The sample farms were drawn from the state of Sao Paulo, Santa Catarina and Rio Grande do Sul. Analysis of data covering the agricultural year just prior to the time of interview revealed the following findings:

1. There were substantial differences in factor proportions (both fixed and variable resource use proportions) among farms of different sizes and types.

Current input expenditures per unit of land were several times higher on crop farms than on mixed or livestock farms. Likewise the ratio of

fixed capital to labor was much higher, except on rangeland cattle farms. Labor-land ratios were highest in regions where farms were smallest and most homogeneous, and lowest on crop and rangeland cattle farms.

2. Capital productivity was generally low.

Generally the partial productivity analysis showed it was not profitable for farmers to make additional fixed capital investments of the type made in the recent past. For example, additional buildings, livestock and traditional implements do not appear feasible in the small farm region, while additional machinery does not appear profitable on mechanized crop farms given current use levels of land. Current capital inputs could profitably be expanded, however, but on no group of farms was the shadow price particularly high. This analysis assumes, of course, constant technology and price ratios.

3. Labor and land productivities varied considerably among farm types and labor resources were not optimally distributed.

Considering wage costs only, labor market imperfections seem apparent as additional labor could generally be employed on large farms, but was already being used at excessive levels on small farms where family labor was predominant.

4. With the exception of sugar cane farms, few significant economies of scale exist.

Significant increasing returns were observed over a considerable range of output levels for farmers supplying sugar cane to sugar mills. Constant returns to scale were found on most other farms except for small crop and small livestock farms where diseconomies were observed.

5. Evidence of limited capital-labor substitution was apparent.

Estimates of the elasticity of substitution between capital and labor suggested that policies to affect capital and labor costs do alter capital/labor ratios, but any trend to greatly displace labor may have been limited because the farms were becoming more crop intensive.

Studies in Farm Level Technology Use and Adoption

The purpose of these studies was to help explain the reasons for changes in technology employed on farms. The sample farms were drawn from Sao Paulo, Santa Catarina and Rio Grande do Sul. The major findings were the following:

1. There has been rapid adoption of biological technology, especially chemical fertilizers, and new wheat varieties. This adoption process has significantly raised operating costs.

Within the current input category of farm expenditures, chemical fertilizers have become increasingly important. Frequently they are part of a package of inputs including improved seed, lime, and chemicals for disease and pest control. The adoption of this package raises operating costs, and modern inputs become more important relative to traditional ones. It was shown that at the farm level, most groups of farms had a substantial number of farmers that had adopted fertilizer but usage was largely concentrated in the South and in the state of Sao Paulo, and higher proportion of large farms used it relative to small farms.

2. There has been substantial farmer response to fertilizer price changes, but there appears to be limited crop yield response to fertilizers. Thus, where fertilizer is available and adopted, the profitability of increased use is open to question.

Within Sao Paulo, farmers appeared to be quite responsive to fertilizer price changes, but there was a relatively large difference between short and long term price elasticities caused by a low coefficient of adjustment. The analysis could not detect any significant yield response to fertilizer application levels, and low response could be one reason for slow adjustment to price changes.

3. Sociological variables related to individual characteristics of the farmer appear to help explain adoption of technology in addition to economic variables.

Sources of technical information varied among farm groups. Representatives of private marketing firms were especially important sources of technical information for small farmers, and a disparity in perception of major farm problems was noted between farmers and extension agents.

Study of Marketing Firms

Marketing firms were studied to determine how they contributed to and benefited from farm level growth. This study was undertaken in the state of Sao Paulo. The principal findings were as follows:

1. The number and size of marketing firms expanded rapidly to provide a wide and growing variety of competitive outlets, production inputs and services to farmers and sales of these firms benefited from the availability of concessionary credit for farmers.

Sales of tractors and fertilizers increased rapidly especially after 1966 when the supply of credit at negative real interest rates was increased for farm purchases of modern inputs.

2. Capitalization of these firms has been similar to that of farm firms.

Most of the increased investment (primarily expansion of facilities) made by the marketing firms was financed internally, while a large proportion of operating expenses were financed through credit.

3. Marketing margins have increased for some products.

Marketing margins appear to have increased for some products, and margins appear to be independent of firm size. Thus the contribution of marketing firms has been largely through increased availability of outlets, inputs and services, and passing along economies realized outside the sector rather than through improved internal efficiency. Simply enlarging firm size does not appear to offer great promise as a means to increase farm level product prices or reduce input costs to farmers.

4. Marketing firms have played an important role in stimulating increased adoption of new technology.

The firms have heavily advertized the use of inputs, have sold inputs on time payments, and helped farmers to acquire formal credit.

Rural Financial Markets and Farm Level Growth

The role of credit was noted several places above in relation to firm growth. Thus developments in rural financial markets were studied to evaluate their crucial role in accelerating and orienting farm level growth. Data from sample farms from all study regions were used in this analysis including the states of Rio Grande do Sul, Santa Catarina, Sao Paulo, Minas Gerais and Ceara. The principal findings were as follows:

1. There has been a dramatic increase in the use of agricultural

credit in recent years and all of the increased credit supplies have been channeled through formal credit institutions.

Credit availability has improved through increased funds for agricultural lending channeled through a wide network of banking institutions and cooperatives. At the same time, informal credit sources have declined in relative importance.

2. Negative real rates of interest which generally prevailed for loans from formal credit institutions resulted in substantial income transfers to credit users and could have been responsible for distortions in the allocation of capital and credit including the concentration of credit among a small proportion of farmers.

Negative rates of real interest on agricultural loans have resulted in a substantial income transfer to credit users. A distortion in distribution of credit would be expected with negative interest rates as lenders are forced to non-price rationing of supplies in the face of excess demand. As a result, a small proportion of farmers have absorbed a large part of the credit used by a particular size group of farms, and thus have financed most of their investments and operating expenses through borrowing rather than internal savings. Many farmers who do not obtain formal credit finance their operations through informal credit, but these sources have declined in relative importance with the increase in formal credit supplies.

Modeling Regional Growth

A programming model of the wheat - soybean - cattle subregion of the state of Rio Grande do Sul was developed to (1) integrate the firm-household decision model in a dynamic context, (2) to track the trend

of regional development with specific emphasis on the distributive impact, and (3) to simulate the dynamic impact of specific policies, especially those relating to price and credit programs.

The model effectively tracked regional growth in its ability to capture the main components of the process of economic transformation experienced in the region. As such, it confirmed many of the findings of the other studies and guided the interpretation of results in the entire report. Through counterfactual analysis it was possible to test the probable impact of alternative policies. The specific findings were the following:

1. Initial farm resource endowments have substantial impact on both choice of technology and rate of farm level growth. These initial differences were accentuated by the impact of credit and wheat price incentives. Major incentive benefits accrued to large farms resulting in increasing farm level income disparities.

The focus of the analysis rested on high wheat price supports and credit subsidies. When credit subsidies were eliminated and interest rates simulated at a 10 percent real rate, growth in wheat production, use of credit and capitalization was substantially reduced on medium and large farms. Small farms were largely unaffected.

2. The wheat price incentive program would not have been as effective in accelerating growth without accompanying credit subsidies.

Simulations with current wheat prices but more restrictive credit policies showed the crucial role of credit in facilitating the shift from livestock to wheat production.

3. While the import substitution policy was highly successful in

promoting domestic wheat production, a larger growth might have occurred if international prices had prevailed for all commodities.

When all price and credit intervention was removed (international prices were simulated for wheat, cattle, and soybeans), growth in wheat production, mechanization and credit use on medium and large farms were more sharply reduced than when only interest rate changes were introduced. In addition, the raising of beef prices caused an increase in beef production under improved technology. Again small farms showed little change since they were largely unaffected by the special policy programs.

ECONOMIC POLICIES AND FARM LEVEL GROWTH

The individual studies summarized above contribute to a better understanding of the overall pattern of farm level growth. In the "wheat" region of southern Brazil, for example, price and credit policies greatly accelerated the growth of output by encouraging a shift from range livestock to mechanized wheat and soybean production. Although all groups of farmers reacted to these incentives, the major benefits went to medium and large farmers who started with a larger resource base, had greater access to policy incentives (especially credit), were the first to adopt new techniques and enterprises, and managed their resources in such a way as to achieve more rapid growth. A similar comprehensive test was not made for the Ribeirao Preto region of Sao Paulo, the other major study area, but other research suggests a similar type of process has occurred.

From this research we can develop some general conclusions about the relationships between economic policies and their impact on farm-household behavior. Although some of these conclusions may be particularly rele-

vant for Brazil, the broad features are probably appropriate for many developing countries.

- 1) Product and input incentives have been strong determinants of farm level growth.

When underutilized resources existed, such as land and labor in Rio Grande do Sul, these incentives prompted a rapid shift from livestock to wheat production with a resulting increase in value of gross output and farm incomes. The rapidity with which these changes occurred provide additional empirical support for the basic Schultzian hypothesis of rationality of farmers in developing countries and suggest high supply response for individual products and commodities.

- 2) Factor pricing policies, and especially those relative to capital inputs, have accelerated farm level capital formation and hence productive capacity.

In the presence of underutilized farm resources and an abundant supply of capital inputs and credit, farmers rapidly adopted new production inputs, such as fertilizers and machinery, and made land and building improvements. The relative importance of land declined in the total farm capital structure. In some cases, overcapitalization has even occurred on some farms.

- 3) Farm level response to product and factor price changes has been varied because of the heterogeneity of initial resource endowments on individual farms.

Wide ranges in farm sizes, family labor supply, topography, soils and climate conditioned the extent to which farmers responded to new price ratios, enterprises, inputs, and technologies. Small farms in the

escarpment, for example, faced difficult resource constraints in trying to respond to favorable wheat prices. The intensity with which they must operate their land to earn minimal levels of family income, their relatively high labor/land ratios, and the steep topography of the region almost completely precluded mechanized land extensive enterprises. Thus differences in initial factor proportions and resource endowments determined the choice of technology and hence the distribution of benefits accruing from different technologies. In some cases noneconomic characteristics of individuals and rural communities also affected adoption of technologies.

- 4) Changes in factor and product prices and markets have not been neutral with respect to farm size and type. Farmers with larger initial resource endowments have generally been favored.

Production incentives for wheat, a land extensive crop, benefited farms with large tracts of underutilized land or land previously dedicated to relatively less profitable enterprises. Marketing firms and financial markets in the private sector also tended to favor larger farmers due to the cost structure of providing services, inputs and credit to small operators. Furthermore larger farms provided better security for lending institutions.

- 5) Factor and product price incentives in the absence of yield increasing (land-saving) technologies tended to accentuate a dualistic form of agricultural growth.

Farmers attempted to increase output of enterprises made relatively more profitable by incentives, wheat in the case of Rio Grande do Sul. Given the relatively slow increase in supply of superior varieties and

improved biological technologies, the principal method of increasing output and farm income was through an expansion in area cultivated. Expansion along the extensive margin occurred, and when the supply of the most desirable land became more inelastic, the profitability of wheat was capitalized in increasing rental values. The farmers that expanded most quickly were those with the largest initial resource endowments, and those that could most effectively release their resource and financial constraints through better access to factor markets for buying, renting and borrowing. Small farmers that were more effectively bound by these constraints resorted to renting and selling their land and labor resources. Thus those farmers with the largest initial resource endowment had first access to the benefits of the incentives, and the growth of these benefits further exacerbated the inequitable intraregional distribution of resources and incomes.

- 6) Yield increasing technologies were relatively less available because they could not be directly imported.

Mechanization was easily accomplished by first importing tractors, tillage implements and harvesters, and later domestically producing essentially the same equipment with only minor local adaption. Imported biological technologies and particularly high yielding wheat varieties required considerable adaptation, however, and a comprehensive local research program was developed only in recent years. New improved varieties were quickly adopted by wheat producers as they were developed by research institutions.

- 7) Low and negative real interest rates, designed as a specific instrument to encourage capital use, have had a broad and

pervasive effect.

Interest rate reductions may in fact increase capital use if that capital is essentially productive, but subequilibrium interest rates force lending institutions to use nonprice rationing when faced with excess demand. In addition to influencing on-farm investment, interest rates can be expected to affect several other firm-household decisions regarding consumption, savings, and off-farm investments as well as resource transfers among sectors. Furthermore, the effect of tying formal credit to specific outputs and inputs to accelerate enterprise and technological changes may be partially offset by the release of internal resources used to finance alternative firm-household decisions. These impacts do not appear to have been adequately anticipated by policy makers.

8) Private marketing firms quickly responded to farmers' demands for products and services.

The private sector and individual entrepreneurs were able to satisfy most of farmers' demands for marketing services when that demand was stimulated by government policies. Little government intervention was required except for expensive investments in transportation, communications, and some storage capacity which frequently have a high social value not easily captured by private investors. Increases in number and size of firms, however, do not appear to have led to major efficiency gains in the private marketing sector.

9) An alternative development strategy based on pricing commodities closer to international levels and higher nominal interest rates for formal credit would have likely produced farm level impacts

quite different from those actually realized under the wheat self-sufficiency strategy.

Compared to the impact of high wheat prices and subsidized interest rates, such a strategy would have likely generated a higher value in total output with higher land and labor productivities, and produced higher average net farm income, while requiring less scarce capital and credit. The direct costs of the wheat price supports would have been saved. On the negative side, the probable costs of such a strategy would have been a slower growth in employment, greater income inequality among farmers, and higher domestic prices for beef which would have required subsidization in order to maintain low consumer prices. Less demand for domestic machinery manufacturers would have also occurred. Two major assumptions are required for this alternative strategy to actually produce these outcomes: the expanded supply of beef would have had to be absorbed either domestically or in the foreign market at the international price, and a rapid shift from traditional to improved beef production techniques would have had to occur. Both assumptions are open to question. On the one hand, substantial improvements in production and processing would have been required to meet sanitary and grading standards of major beef importing countries. On the other hand, a shift from beef to wheat often involved the entry of entrepreneurs who were less tradition bound than typical "Gaucho ranchers". Intensive beef production might not have attracted these ~~new~~ modernizing entrepreneurial types so the shift to improved beef operations might not have been as rapid as implied by the simulation results.

AGRICULTURAL DUALISM AND BRAZILIAN DEVELOPMENT

This research clearly demonstrated the disparities in agricultural growth between groups of farmers in Brazil, especially in the wheat region, and noted the broader interregional disparities which historically existed and appear to be even more accentuated in recent years. This process of growth has contributed to increased dualism in Brazilian agriculture: highly capitalized mechanized farms with low labor/land ratios, and under capitalized traditional small farms using large amounts of labor and little new technology. The dilemma appears to be the classic one of growth versus distributive equity, a theme of increasing importance in developing countries.

As noted above, the policies affecting Brazilian agriculture to the greatest extent in the post World War II period are associated with two major sub-periods of development strategies in the country: the first characterized by general neglect and occasional discrimination against agriculture, especially in the 1947-61 period of intense import substitution industrialization, resulted in agricultural growth largely along the extensive margin; the second, beginning in the mid-1960's and continuing to the present, represents a period in which policies have been aimed at agricultural modernization and expanded traditional and nontraditional exports. In the first period, the objectives for agriculture were limited primarily to producing an adequate supply of reasonably priced food for urban wage earners and secondarily, generate foreign exchange to finance the importation of the industrial raw materials and capital goods. The assistance granted to agriculture consisted largely of improving extension and marketing services. Since the mid-

1960's much greater emphasis has been given to modernization, and accelerating the growth of output and exportation. Emphasis on research increased in the early 1970's.

Generally Brazil has been quite successful in meeting its economic objectives. In fact, the high growth rates since 1968 have caused people to speak of the "economic miracle" and make comparisons with countries like Japan. This euphoria may be a bit premature, particularly in view of current energy problems, but clearly the performance has been exceptional in the past few years, in large part due to expert decision making. The emphasis, at least in agriculture, however, has been largely on growth rather than growth with equity. Given the state of the economy when the military took power in 1964, it is easy to understand this orientation. But it is also necessary to call attention to the potential structural problems arising from this approach which may hamper future economic growth and development. The experience of other countries has demonstrated the difficulty in achieving equity, in spite of good intentions, once great inequities have arisen. Perhaps some loss in growth rate occurs when increased equity is pursued, but the results of this and other research, which suggest relatively constant returns to scale in agriculture over a wide range of output levels, imply that the losses might not be that great.

If more broadly based growth is desired, the challenge to policy makers is clear and complex. It requires a fundamental rethinking of how millions of Brazilian farmers respond to policies. The tendency has been to view policy making as essentially a "top-down" activity with relatively little feedback about the dynamics of policy impacts. The

observed inequalities in resource use, income, and growth logically result. A growth-with-equity strategy would have to take into account the heterogeneity of farms and farmer response. Policy making would then involve identifying groups of farmers that are relatively more homogeneous and developing a specific set of policy incentives for each group. The recent efforts of the quasi-public national agricultural research institute (EMBRAPA) to develop region and crop specific technological packages is a promising attempt clearly in the right direction. The scientists and technicians of this institution are to be commended for this initiative and their appreciation of the complexities of the agricultural development process.

Another clear implication of this research is the crucial role which product and factor pricing has on the pattern of farm growth. Brazilian policy makers have consistently espoused the role of the market in allocating resources, yet continuously intervene in the market process in order to influence prices for some specific objective. Generally such intervention has been directed towards increasing the use of certain inputs, expanding output of selected products, or reducing consumer prices. The resulting distortions have helped meet the objectives, at least in the short-run, but have also contributed to resource misallocation and an unequal pattern of participation in the growth process by various groups of farmers. These inefficiencies and inequities could well frustrate future broad based rapid growth. Furthermore, the slow growth in effective demand of the marginalized segment of the rural population may frustrate the continued growth of the industrial sector.

Solely removing pricing distortions, as important as that may be, may

not constitute, however, the necessary and sufficient conditions for broader based agricultural development. Structural change needs to be attacked simultaneously. This research has shown how differential resource endowments and access to resources and policy incentives contribute to uneven farm growth. Land reform, credit for land purchases, effective land taxation, and improvements in the land market may be necessary to form the basis for more equitable growth where agricultural production is still largely a function of combining land with labor. More yield increasing technologies are also required so that increases in income are not restricted just to enterprise changes or mechanization. Rural education, now lamentably inadequate, must be improved and universalized so that farmers are better prepared to seek out and understand new information as well as provide a more productive source of labor when they choose urban employment. Extension workers must be provided with a larger stock of technological alternatives and must be freed of a myraid of administrative functions and a bias to concentrate their efforts on large farms.

Lastly, signs are beginning to appear in Brazil that the past emphasis on the macro approach to the study of agricultural problems is waning and a new interest is emerging in the study of the microeconomics of the agricultural sector. The research reported in this volume has made a small dent in this vast uncharted field. Hopefully it will encourage some of the extremely talented young Brazilian men and women now studying at home and abroad to delve into the problems faced by farms and rural markets which have only been touched upon here. Studies related to such problems as the determinants of consumption and savings, creation

of employment, returns from new technology, bottlenecks in input and product markets, impact of inflation and income distribution, exchange rate and other trade policy influences on agricultural trade, and financial market contributions to capital allocation and savings accumulation represent a few of the most crucial items in a long list of research priorities . Of immediate importance is the initiation of a nationwide system for the collection of farm level time series data absolutely essential to effective economic research.

This research and the rapidly growing literature on economic and agricultural growth and development in Brazil show that the sleeping giant of the southern hemisphere awoke with a start in the latter half of the twentieth century and shows great potential for becoming a commanding influence in the economy and politics of Latin America. It holds untapped and underutilized agricultural resources that could become one of the important breadbaskets to help feed the hungry world. By achieving high growth rates for several years, it has demonstrated a capability to effectively draw some of these resources into production. But if it is to realize its true economic potential and maintain long term high growth rates, it must begin to more effectively harness its most valuable resource, a resource largely overlooked in recent years - the growing quantity and quality of its peoples. When that occurs, we can justifiably refer to the "Brazilian Economic Miracle".

PUBLICATIONS LIST

The list of publications which begins on the next page contains most of the items which have been produced in one form or another as part of the project. Many of the items are out of print, some are available through AID, and others such as the Brazilian theses and publications are available only through the respective Brazilian institutions.

PUBLICATIONS

I. Economic and Sociology Reprints

- ESR # 1 Adams, Dale W and Walter Coward, Small-Farmer Development Strategies: A Seminar Report, The Agricultural Development Council, Inc., 1972.
- ESR # 2 Adams, Dale W, Harlan Davis and Lee Bettis, "Is Inexpensive Credit a Bargain for Small Farmers? The Recent Brazilian Experience," Inter-American Economic Affairs, 1972.
- ESR # 7 Rask, Norman, "The Impact of Selective Credit and Price Policies on the Use of New Inputs," Development Digest, Vol. IX, No. 2, April 1971, pp. 49-54.
- ESR # 8 Adams, Dale W, "Agricultural Credit in Latin America: A Critical Review of External Funding Policy," American Journal of Agricultural Economics, Vol. 53, No. 2, May 1971, p. 163.
- ESR #10 Adams, Dale W, "What Can Under-Developed Countries Expect From Foreign Aid to Agriculture? Case Study: Brazil 1950-1970," Inter-American Economic Affairs, Summer 1971, pp. 47-63.
- ESR #15 Adams, Dale W, "External Credit Policy for Latin America: Reply," American Journal of Agricultural Economics, Vol. 54, No. 2, May 1972, pp. 365-366.
- ESR #16 Adams, Dale W and A. E. Havens, "The Use of Socio-Economic Research in Developing A Strategy for Rural Communities: A Colombian Example," in Social Interventions, edited by Harvey Hornstein (Glencoe, Illinois: The Free Press, 1971).
- ESR #17 Adams, Dale W and others, "Rural Capital Markets and Small Farmers in Taiwan 1952-1972," Small Farmer Credit in East Asia, Vol. XI, (Washington, D.C.: Agency for International Development, 1973).
- ESR #18 Meyer, Richard L., Dale W Adams, Norman Rask and Paulo Araujo, "Rural Capital Markets and Small Farmers in Brazil, 1960-1972," Small Farmer Credit in South America, Vol. III, (Washington, D.C.: Agency for International Development, 1973).
- ESR #23 Adams, Dale W, "The Economics of Land Reform," Food Research Institute Studies in Agricultural Economics, Trade and Development, Vol. XII, No. 2, 1973, pp. 133-138.

- ESR #35 Adams, Dale W, "The Case for Voluntary Savings Mobilization: Why Rural Capital Markets Flounder," A.I.D. Spring Review of Small Farmer Credit, Vol. XIX, No. SR 119, June 1973, pp. 311-333.
- ESR #36 Engler, Joaquim J. de Camargo, and Richard L. Meyer, "Trigo: Producao, Precos e Produtividade," (Wheat: Production, Prices and Productivity), Pesquisa e Planejamento Economico, Vol. 3, No. 2, June 1973, pp. 341-369.
- ESR #46 Singh, Inderjit, "The Transformation of Traditional Agriculture: A Case Study of the Punjab, India," American Journal of Agricultural Economics, Vol. 58, No. 2, May 1971.
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