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FEASIBILITY OF SMALL FARM DEVELOPMENT STRATEGIES

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EXECUTIVE SUMMARY

There are two main objectives of this paper: (1) to identify the circumstances in which small farm development strategies are feasible and represent an economically efficient approach to achieving the increases in food production, consumption, and employment that are necessary conditions for economic and social progress in developing countries and (2) to examine the prospects and the means for overcoming the formidable obstacles to the design and implementation of dispersal strategies leading to widespread increases in productivity and output among a large and growing percentage of the small farm units that inevitably predominate in most low-income and many middle-income countries.

Recent but realistic extensions of neoclassical economics to take account of transaction and information costs together with abundant empirical evidence make it clear that diseconomies of scale (and farm size) outweigh scale economies in countries where the opportunity cost of farm labor is very low. The high percentage of agricultural labor in their total labor force and the rapid growth of the population of working age means that the size of the farm workforce will continue to increase for decades and alternative employment opportunities will continue to be extremely limited. This explains the well-known "inverse relationship" between farm size and output, i.e., the fact that production per hectare tends to decline on large farms as compared with small. Because of the structural and demographic characteristics just mentioned, most LDCs confront a choice

between dispersal strategies leading to a broadly based unimodal pattern of agricultural development and focus strategies in which resources are concentrated in a subsector of atypically large and capital-intensive farm units, giving rise to a dualistic or bimodal pattern of agricultural development.

Historical evidence, including particularly the agricultural development experience of Japan, Taiwan, and Korea, and theoretical analysis both demonstrate the economic and social advantages of dispersal strategies and a unimodal pattern of agricultural development in attaining the multiple objectives of development. Because of the nature of the problems they face, the contemporary LDCs need to be concerned with accelerating growth of output, expanding opportunities for productive employment (farm and nonfarm), raising food consumption levels and improving nutrition, maximizing the positive interactions between agricultural and industrial development, and slowing the growth of population.

There are formidable obstacles to successful implementation of dispersal strategies, but achieving the required rates of increase in agricultural output by any strategy is difficult because of the high rates of growth of output that are needed and the acute scarcities of resources--of human capital and institutions, as well as physical capital. The two principal obstacles are (1) macroeconomic policies that have adverse effects on agriculture in general but which are especially damaging to small farmers and (2) factors that have adversely affected the rate and bias of technical change, i.e., whether technical innovations are

biased appropriately in a labor-using and capital- and land-saving direction or inappropriately toward labor-saving, capital-using innovations.

The policies that adversely affect broad-based agricultural development are adopted and maintained in part because of the pressure of powerful group interests that benefit from preferential treatment of a subsector of large farms. But to view political leaders and policymakers simply as a self-serving group is as misleading as to view them only as disinterested servants of society. Policies and interventions that provide opportunities for discretionary and arbitrary exercise of power, e.g., in allocating foreign exchange when a currency is overvalued or rationing artificially cheap credit, encourage rent-seeking behavior rather than an emphasis on income-generating activities. However, giving priority to government's facilitating role and to strengthening public goods such as education, agricultural research, and roads and other infrastructure encourage an emphasis on the role of a political system in furthering the wider goals of development. Strengthening the capacity of national research systems to generate technical innovations that are feasible and profitable for small farmers is critical and especially difficult in heterogeneous rainfed environments. Farming Systems Research is no panacea, but on-farm research with a farming systems perspective can exploit the potential complementarities between formal research and the local knowledge of farmers and their capacity for adaptive management. Remarkable progress is possible when government policies and programs

enhance the quality of human resources and support the efforts of farmers and other producers to invest, to increase their technical and managerial skills, and to utilize labor and other indigenous resources more fully and more efficiently.

I. INTRODUCTION

A consensus has emerged concerning the desirability of pursuing agricultural strategies oriented toward the small farm units that comprise the great majority of the farm population in developing countries (AID, 1982). Doubts persist, however, concerning the feasibility of achieving the increases in agricultural productivity that are needed by means of a broad-based agricultural strategy rather than by concentrating resources within a subsector of relatively large and highly commercialized farm enterprises.

Given the limited success of contemporary developing countries in achieving widespread increases in agricultural productivity and output among small-scale farm units, it is important to determine whether small farm development strategies fall in the category of policies that are eminently desirable but infeasible. It should be noted, however, that development strategies for large farms have had an equally poor record in many countries despite preferential treatment for the large-scale subsector in government policies and resource allocation.

It would be meaningless to seek a simple "yes" or "no" answer to the question: Are small farm development strategies feasible? The historical experience of Japan, Taiwan, and Korea establish beyond any reasonable doubt that under certain circumstances small farm development strategies are not only feasible but economically efficient as well.

What are the circumstances in which small farm development strategies are feasible and represent an economically efficient

approach to achieving increases in food production and consumption and expanding opportunities for productive employment that are necessary for economic and social progress in today's developing countries? Section II addresses that question by stressing that the structural and demographic features that characterize virtually all low-income developing countries, and many middle-income countries, make it essential for an agricultural development strategy to be effective in simultaneously achieving those multiple objectives of increasing agricultural production, food consumption, and employment (farm and nonfarm). Prior attention is given, however, to the meaning of economic efficiency, its relationship to technical and allocative (price) efficiency, and to the fundamental importance of technical change and the choice of technology in determining the growth of agricultural production and the distribution of economic gains from increases in productivity and output. Section II also stresses that economic rationality is independent of farm size, however, access to resources affects the range of choices available to an individual or household and the ability of small farm units, landless laborers, and other groups to overcome the poverty that is now prevalent.

The discussion of alternative patterns of agricultural development in Section III emphasizes a fundamental choice that confronts contemporary LDCs between giving priority to dispersal strategies that lead to a unimodal pattern of agricultural development as compared to promoting focus strategies leading to a bimodal (dualistic) pattern of development. Dispersal strategies

lead to the gradual and progressive modernization of a large and growing fraction of the small farms that inevitably predominate in countries when some 50 to 80 percent of the total population and labor force are still dependent on agriculture for employment and livelihood. In contrast, focus strategies generally emphasize the crash modernization of a subsector of atypically large farm units that are highly commercialized and able to use relatively capital-intensive technologies because the large-scale subsector satisfies such a large share of the commercial demand for farm products. It is also noted, however, that focus strategies may be directed at groups of small farmers, but their coverage of the agricultural sector is very limited because the strategies are so management- and resource-intensive.

Any strategy for agricultural development will embrace some combination of (1) programs of institution building related to activities such as agricultural research and extension; (2) programs of investment in roads, irrigation, and other types of rural infrastructure; (3) policies related to prices, taxation, and land tenure; and (4) programs to improve product marketing and the distribution of farm inputs. All of these elements are of critical importance, but issues related to product marketing and input distribution receive little attention in this paper because the emphasis is on the actual and potential production performance of small farm units. Although any strategy for agricultural development must embrace those four elements, the nature of the specific policies and programs that are pursued

will determine their differential impact on small and large farm units.

Because the average size of farm units in a country is determined by its economic structure and demographic characteristics, this average size will change slowly. And, unfortunately, for the next two or three decades the trend will be toward smaller farm units in many of the contemporary LDCs as the farm population and number of farm families continues to increase whereas the scope for expanding the land area under cultivation is increasingly limited. The size distribution or pattern of land holdings can, however, be changed substantially by the differential effects of a country's agricultural policies and programs. Thus focus strategies promote the polarization of farms leading to a bimodal pattern. Anthony Tang (1984, p. 46) tersely summarized the matter in a report on agricultural poverty in Panama: "The skewed size distribution made extreme technological dualism (the digging stick vs. North American-style mechanization) possible in Panama; government price distortions made it profitable."

On the other hand, dispersal strategies offer the possibility of economic forces promoting a unimodal pattern of farm operating units. There has been a tendency to assume that the size distribution of farm units can be changed only by a redistributive land reform that changes the pattern of land ownership. But it is the size distribution of operational units that is most crucial in determining the choice of technology and the extent to which increases in agricultural production are coupled with

expansion of employment opportunities. In the land reforms carried out in Japan, Taiwan, and Korea following World War II, it is often overlooked that their unimodal patterns of agricultural development were well established when the size distribution of ownership units was still highly skewed.

Much of Section III is devoted to an analysis of the characteristics of the agricultural production process that give rise to both economies and diseconomies of scale and of farm size. The issues are complex, but they must be confronted. Dispersal strategies that lead to a unimodal pattern of agricultural development have obvious social advantages in making possible broader participation in the gains from increased agricultural productivity and output. Nevertheless, it is commonly assumed that focus strategies and a bimodal pattern of development is to be preferred because, it is claimed, large farms are bound to be more efficient because of the importance of economies of scale and of farm size. In fact, analysis of the features of the agricultural production process that give rise to economies and diseconomies of farm size and the empirical evidence available both confirm the advantages for most developing countries of a unimodal pattern of agricultural development. Thus, a major conclusion of the paper is that small farm development strategies are feasible and offer important economic as well as social advantages to developing countries that are still predominantly agricultural and where the total population and labor force are still growing rapidly.

In Section IV the principal obstacles to successful implementation of small farm development strategies are examined. It is argued that two sets of obstacles have been important. First, various macroeconomic policies have been responsible for inadequate resource allocation for agriculture and have resulted in price distortions that discriminate against the agricultural sector. Those policies have had generally adverse effects on agriculture, but those effects have been especially detrimental to small farmers. Moreover, the measures that are commonly adopted to offset the adverse effects of those macroeconomic policies generally benefit only a subsector of large farms and tend to exacerbate the difficulty of fostering widespread increases in productivity and output among small farmers. The second set comprises the various factors that have affected adversely both the rate and the "bias" of technological change--that is, whether or not the sequences of technical innovations that are made available are appropriate for small farmers with limited cash income.

In Section V attention is given to the prospects for overcoming the obstacles to effective implementation of small farm development strategies. In accordance with the preceding section, the emphasis is on the prospects for (1) improving macroeconomic management and (2) accelerating technological progress, the growth of farm output, and the expansion of employment opportunities.

A summary and conclusions are presented in Section VI. Owing to the great importance of variations in historical and

cultural antecedents, socioeconomic conditions, government policies and ideologies, and the physical environment for agriculture, it is extremely difficult to generalize about priorities for agricultural development. An effort is made, however, to identify some of the distinctive characteristics of agricultural development problems in Asia, Latin America, and Africa and the issues and programs that merit particular attention in those regions.

II. STRUCTURAL AND DEMOGRAPHIC CHARACTERISTICS OF LOW- AND MIDDLE-INCOME COUNTRIES

Section II.1

Food Production and Employment: An Overview

Food consumption growth rates, spurred by population growth and reinforced by income growth, have exceeded food productivity gains in the Middle East, Africa, and Latin America. (See Box II.1.) Past and prospective food production shortfalls and persistent undernutrition prompt concern with the supply side of food problems in poor countries. In "typical" circumstances, expansion of supplies of arable land is costly and time consuming. Consequently, prescriptions to boost aggregate agricultural output--and food supply in particular--commonly stress strategies to increase yield per unit area. Even in land abundant countries such as much of sub-Saharan Africa, continuing growth of the farm population is leading to unfavorable ratios of land per capita (Eicher, 1984, p. 6).

Concern with widening disparity between domestic supply and demand for food--and prospects of acute shortages--must be coupled with attention to the underlying source of production shortfalls and, equally important, the growth of demand. Population growth has a direct impact on labor supply as well as demand for food. Most of the poor majority in developing countries live and work in rural areas. The chronic problems of malnutrition and other consequences of underdevelopment rest with lack of opportunities for productive employment within this growing segment of the poor population. Hunger is a manifestation of

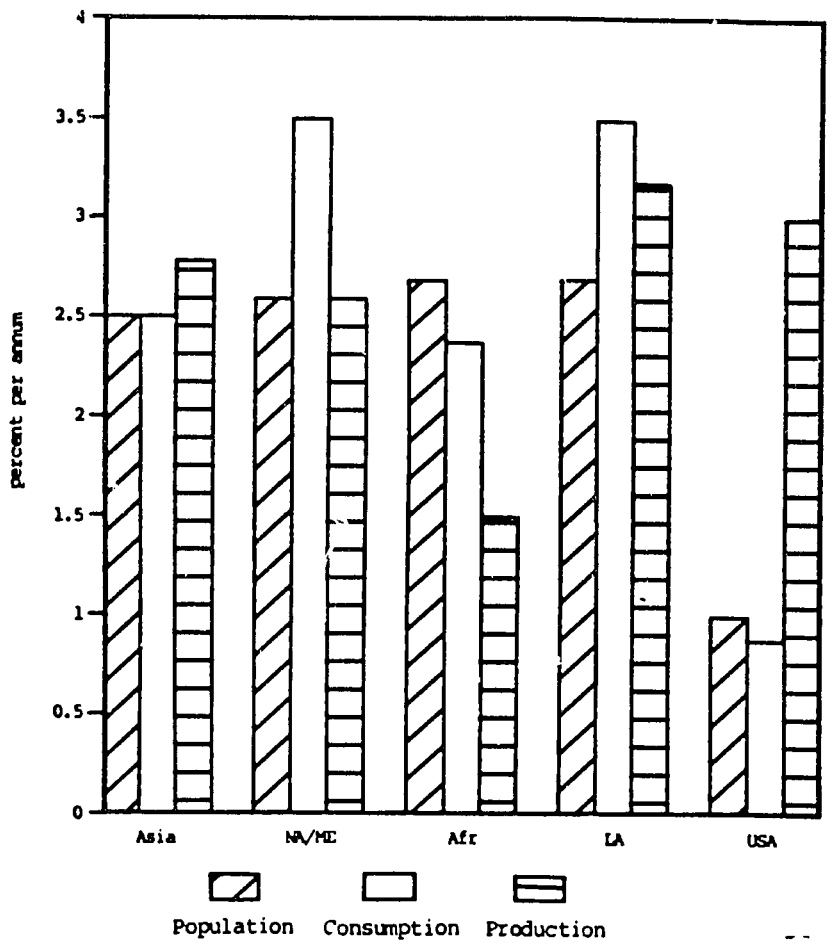
BOX II.1

Comparison of Rates of Growth of Population,
Food Consumption, and Agricultural Production

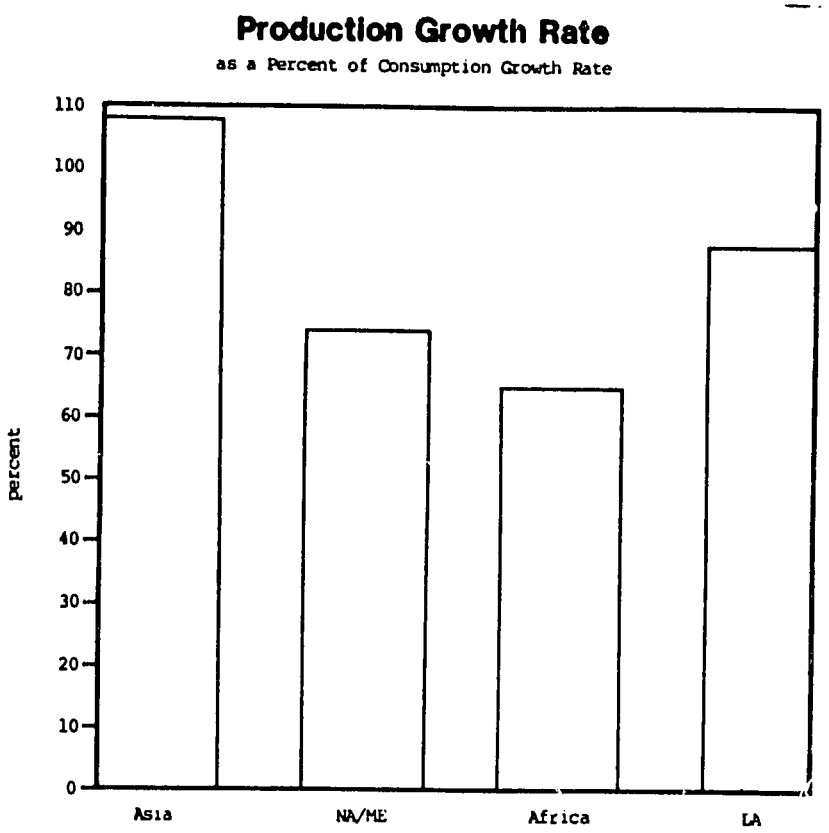
The following figures compare rates of growth in population, food consumption, and agricultural production for developing areas and the United States from 1961 to 1977. Interactions among population growth, aggregate income levels, and distribution of income levels are as important as productivity growth in determining the balance between food supply and demand.

The regional data in Figure A show that with population growth rates in developing countries at or above 2.5 percent per year, the effects of income growth (as for the North Africa/Middle East region) or stagnation in agricultural productivity growth (as in Africa) translate into ongoing prospects for shortfalls in domestic production and increasing reliance on food imports. The rate of increase in agricultural productivity for Asia, North Africa/Middle East, Latin America, and the USA fall within the range 2.6 to 3.2 percent per year. The distinguishing feature of the United States data is associated with high levels of per capita income: relatively low rates of growth of population and food demand.

Regional Comparisons of Growth Rates



The net effects of trends in growth rates are depicted in Figure B for Asia, North Africa/Middle East, Africa, and Latin America. Among these four regions, the rate of increase in agricultural production exceeds the rate of increase in demand for food in Asia alone.



Source: J.W. Mellor and B.F. Johnston, "The World Food Equation," American Economic Review (June 1984), Chart One.

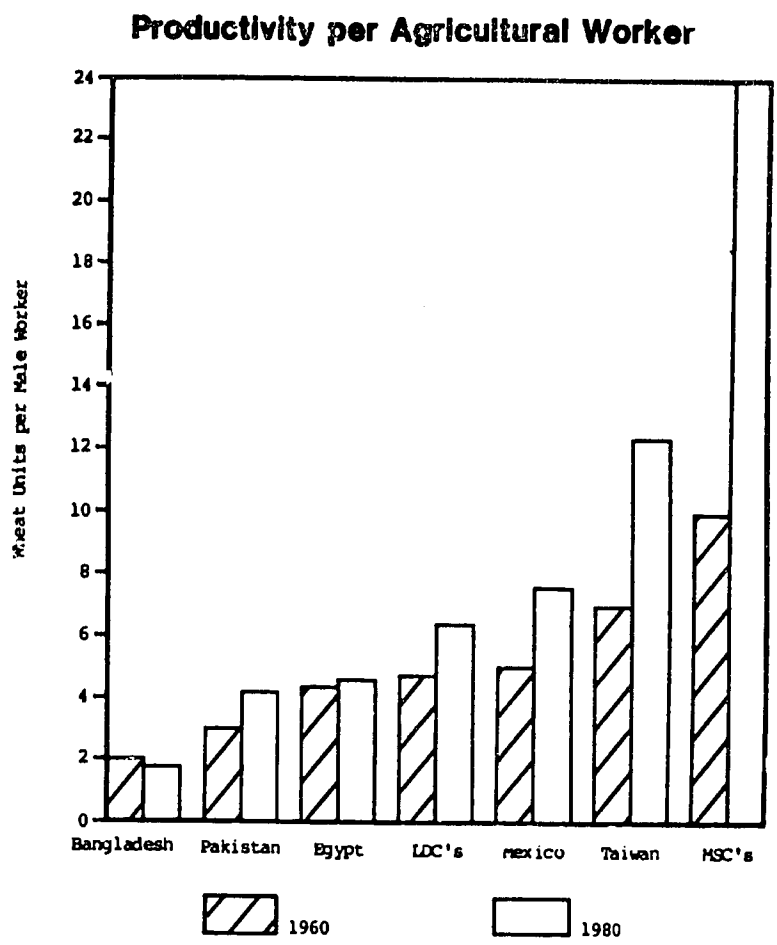
poverty; its alleviation rests with strategies to increase effective demand for food among the poor.

Output and, consequently, income per agricultural worker in developing countries is low. The absolute size and the prospective growth of the farm workforce underlie the problems of food production, poverty, and employment. Growth in aggregate agricultural output is a necessary condition for alleviation of income and consumption deficiences among the poor; it is not a sufficient condition. Improvement in living conditions for the rural poor depends on growth in aggregate output with widespread increases in labor productivity and expansion of demand for labor.

Dramatic labor productivity differences emerge from international comparisons of output per agricultural worker (as shown in Box II.2). Paradoxically, discrepancies among rich and poor populations also promise significant potential for productivity increases for agricultural workers in developing countries. Productivity differences do not result from behavioral deficiencies among disadvantaged farmers and agricultural workers. In a recently updated version of their authoritative work on agricultural development, Hayami and Ruttan (1984) attribute the widening gap between agricultural labor productivity in developed and developing economies to three sources of roughly equal importance: differences in internal resources, differential availability of modern technical inputs, and differences in levels of general and technical education.

BOX II.2

Comparison of Productivity per Agricultural Worker



This figure uses wheat units co compare agricultural labor productivity in 1960 and 1980 for individual countries and averages for twelve less developed countries (including Bangladesh, Pakistan, and Egypt) and for fifteen middle stage countries (including Mexico and Taiwan). Labor productivity in agriculture varies significantly among countries. Existing gaps between rich and poor countries are widening. The average for seventeen rich countries increased from 41.0 wheat units per male worker in 1960 to 116.1 in 1980. For the United States, productivity per male worker rose from 93.8 wheat units in 1960 to 285.1 in 1980--more than ten times the average for the middle stage countries and almost 45 times the level of the less developed group.

Source: Hiyami and Ruttan, 1984, Tables 5-1 and 5-2.

Differences in absolute and relative factor endowments--between rich and poor countries and among low-income countries--have long been recognized as an important part of the explanation of productivity differences. These factors, the productive attributes associated with land, labor, and capital, are relatively fixed in quantity at any moment in time but the rate and pattern of capital formation, both physical and human capital, and the evolution over time of the quality of those resources are affected by policy decisions. The proximate causes of low productivity of labor in agriculture include restricted access to productive resources, disincentives to production and investment, inadequate input supplies, and insufficient marketing opportunities.

Section II.2

Growth, Technical Change, and Economic Efficiency

For a given resource base, the choice of technology is a crucial determinant of the level of output and the efficiency of production. (As used here, technology refers to any process employed in production activities. Technology can be indigenous or imported; technical change can result from practical experience or scientific inquiry.) The relative economic efficiency of alternative technologies must be assessed in terms of two necessary components: technical efficiency and allocative (or price) efficiency.

Technical change, not expanding use of resource inputs, was the predominant source of growth in output during economic development of contemporary industrial countries. The historical

record demonstrates that it is possible to enhance the productivity of land, labor, and capital to achieve increases in production at rates substantially faster than the growth in supply of these production factors. In brief, increases in total factor productivity due to technical change can be a powerful source of production increases.

The essence of technical efficiency is captured in the phrase "more is better." Clearly, technology that produces more goods or services from a fixed set of inputs is preferable to another method that produces less output from the same inputs. Technical efficiency is a necessary component of economic efficiency. However, because technical efficiency is not a sufficient condition for economic efficiency, it is of limited usefulness in considering broader issues of resource allocation. (Annex 1 contains further explanation of economic efficiency and graphic representation of its components, technical efficiency and price efficiency.)

Production processes, especially in agriculture, are characterized by opportunities for substitution over wide ranges of possible input combinations. Consequently, the "more is better" principle of technical efficiency is confounded by economic questions: "Which inputs and at what cost?" The concept of technical efficiency cannot discriminate among methods that produce a given output from much land, little labor, and little capital; from little land, much labor, and little capital; or from little land, little labor, and much capital. Judgment of the economic efficiency of each technique depends on resource availability,

the relative endowment of land and labor, for example, and the type of resources available, such as the relative supply of Ph.Ds and peasants.

The extent of complementarity, compatibility, or conflict between output and employment objectives cannot be resolved meaningfully as long as partial measures--yield per unit area, on one hand, or output per worker, on the other--are the sole tools of analysis. Thus, in addition to technical efficiency, price or allocative efficiency is a necessary component of efficient economic choice. Price efficiency is characterized by choice of input combinations among technically-efficient alternatives to achieve least cost production of a given output. The range of resource allocation options reflects opportunities for reallocation of inputs--the efficient choice can only be made through consideration of the range of input productivities and input prices. These characteristics distinguish economically efficient choices among techniques with differing input proportions.

Ideally, prices reflect which goods and services to conserve in the choice among different technically-efficient methods. If factor prices reflect factor scarcity, differing factor endowments--by country or by household--dictate differing choice of technique on efficiency grounds. The net result is to economize on use of scarce resources and intensify use of abundant resources. In short, consideration of factor productivity and factor endowments means getting the most out of domestic resources, including fuller and more efficient utilization of the farm workforce.

It is not sufficient to assert that price efficiency guarantees socially-efficient resource allocation. The relative efficiency of allocation in a market-oriented economy depends on the price formation process. If markets for certain goods and services do not exist, or if market prices fail to reflect underlying scarcity relationships, prices will communicate the wrong signals regarding relative scarcities. There is nothing sacrosanct about market prices under real conditions; potential market imperfections--lack of competition, lack of information, and many other real problems--carry potential for systematic bias in prices. To the extent that government policies counteract market failures, these policies enhance efficient allocation. In practice, government actions have more often distorted price signals as discussed in Section IV.[1]

It is well known that price efficiency depends on competition. Fundamentally, this means that people take prices as given; they have no power as individuals to influence prices. The economical way in which a price and market system generates and transmits information derives from competition: people base their decisions on prices they find in markets without having to determine underlying scarcity relationships themselves.

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1 The terms efficiency prices, social prices, shadow prices, and accounting prices all have essentially the same meaning and can be used interchangeably to indicate price levels based on relative scarcity. The terms market prices, private prices, and financial prices are synonymous and indicate market price levels. Market distortions cause private prices to diverge from efficiency prices.

Individuals taking prices as fixed information cannot distinguish efficient prices from distorted prices. The independent behavior of individuals does not guarantee optimal allocation of resources in the aggregate, even if each can respond with perfect price efficiency. Although profit maximization depicts an important feature of economic behavior in capitalist societies (it seems to hold across countries and income levels), the prospect of distortion in private incentives means that the aggregate effect of private behavior does not ensure a socially optimal allocation of resources. On a case-by-case basis, price distortions shift income among different groups in the economy (producers and consumers, rural and urban, rich and poor). In the aggregate, inefficient resource allocation resulting from distortions means that total output falls short of potential. The implication of the possibility--indeed, the likelihood--of divergences between market prices and efficiency prices is that choices about economic strategy must consider efficiency prices. Nevertheless, the impact of policy decisions based on efficiency prices must be assessed in terms of existing private price incentives.

The crucial issues for agricultural development policy are not prevailing average levels of productivity or employment. Instead, the primary concern should be potential for increases in output and employment. Necessary growth in output based on technical change complicates assessment of economic efficiency. Under conditions of technical change, factor productivity and input demand change. This also means relative factor prices will

change. Consequently, the benchmarks for efficiency of production techniques are, themselves, determined during the process of change. Rather than a distinct efficient point determined by prices and endowments in a static economy, a changing economy can follow alternative paths. Moreover, even the stringent assumptions of perfect competition never fully met in reality do not ensure efficiency under change. Rather than a single efficiency-equity tradeoff, policy decisions are more appropriately viewed as choices among economically efficient outcomes that differ regarding equity. This does not mean that every desirable outcome is feasible; it does mean that choices matter.

Policy decisions regarding technology have a strong influence on productivity and efficient use of resources. Hayami and Ruttan (1984, pp. 7-39) emphasize the importance of the "capacity to develop agricultural technology to facilitate the substitution of relatively abundant factors for scarce factors in accordance with market price signals." Price distortions have special implications for distortions in research and development efforts and for adoption of new technology by farmers operating in a distorted price environment.

Technical change rarely is neutral in its effect on factors of production or in the distribution of the benefits of growth in output. Biased technical change refers to the differential effect of growth on demand for factors. While economic efficiency can be the outcome of different technical paths, the bias of technical change can be either positive or negative in

its effect on equity of income distribution and broad participation in the process of economic development.

Change means not only change in technology--it also involves relative change, or bias, in productivity of factors. Since the control of factors of production--landlords over land, workers over labor, and creditors over capital--represents a claim on the income they generate, the bias in technical change is translated into the distribution of income. Obviously, the gains and losses are not partitioned as neatly as a three-way categorization might imply; the complexity of control and access to factors of production is examined in more detail below. It is the nature of new technology which determines the optimum production environment as well as the relative demand for other factor inputs to be employed. Pinstrup-Andersen (1982, p. 124) enumerates five factors of major importance to the distribution of economic gains from technical change: (1) the nature of the new technology, (2) the structure of the agricultural sector, (3) the structure of markets for the factors of agricultural production and the possibilities of changing factor combinations, (4) the market for agricultural products, and (5) agricultural policy. The following sections will examine interaction among these forces in the process of technical change.

Section II.3

Significance of Structural and Demographic Characteristics of Low- and Middle-Income Countries

When agriculture weighs heavily in the total labor force and rates of growth of the total population and population of working age are rapid--as in most developing countries--the farm labor force will continue to grow. Even if other productive sectors can expand rapidly, their small size relative to the total economy limits labor force absorption outside agriculture. Consequently, current structural-demographic features will continue to characterize most developing countries for several decades. (See Box II.3.)

The "arithmetic of population growth," depicted in Box II.4, is fundamentally different for the contemporary developing countries as compared to today's industrialized countries. In the earlier period, the onset of economic growth and modernization was followed almost immediately by a decline in the absolute as well as the relative size of the farm work force.[1] In most of today's developing countries, the absolute size of the rural labor force will continue to increase well into the 21st century.

It is noteworthy that a diverse, yet representative, group of developing countries, including Brazil, Colombia, Egypt, India, Pakistan, and the Philippines, experienced a slight decline in population growth (from 2.6 percent to 2.4 percent per

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1 In the U.S., the farm labor force grew substantially in the 19th century; but this was a special case related to the large influx of European immigrants and the enormous scope that existed for expanding the cultivated area.

BOX II.3

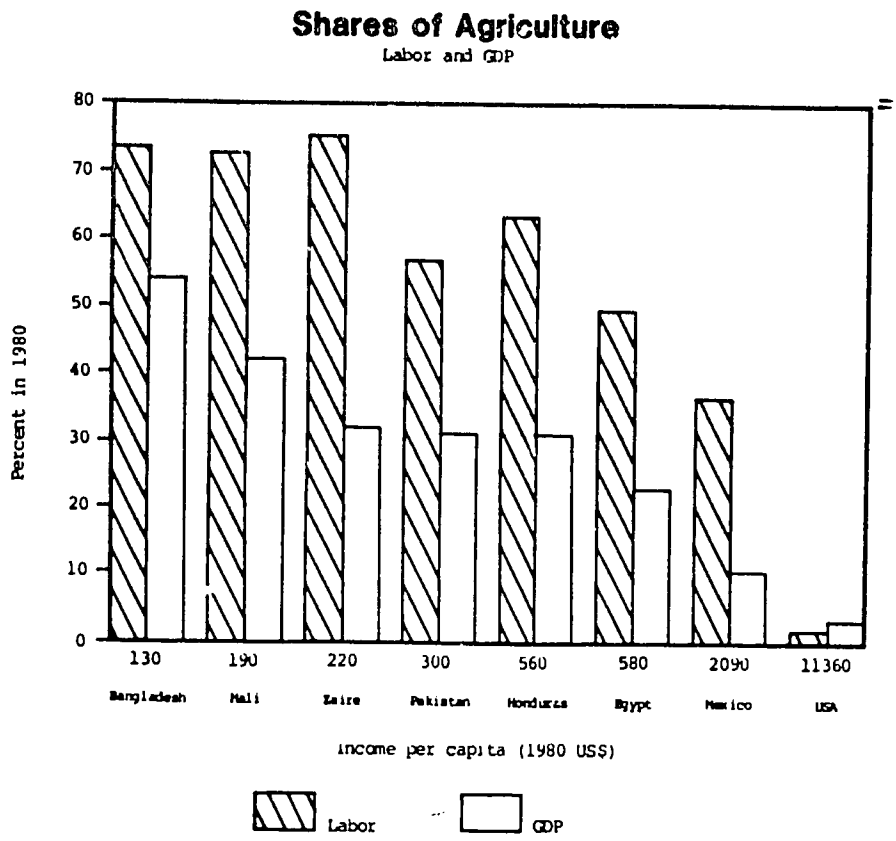


Figure A

Source: World Bank, World Development Report, 1982.

year) between the 1960s and 1970s; but this was accompanied by a sharp increase in the average rate of growth of their agricultural labor force (from 0.6 percent in the 1960s to 1.9 percent per year in the 1970s). The paradox of declining-population growth with accelerating labor force growth results from the lagged effects of demographic changes on the age structure of the population. The abrupt rise in infant and child survival in the 1940s and 1950s was not reflected in the growth of the labor force until those people reached working age.

Persistent population growth, age structures portending many new entrants to the labor force, and relatively fixed supplies of agricultural land mean that the aggregate ratio of arable land to population and labor force is shrinking in many poor countries. In the 1960s, land area under cultivation for the countries mentioned above increased at an annual rate of 0.5 percent, which nearly matched the rate of growth in their farm labor force. In the 1970s, the 0.4 percent rate of growth in agricultural area was much less than the rate of growth in the farm labor force. On average, the agricultural land area per farm worker was declining at an annual rate of 1.5 percent per year. Clearly, family planning programs are important to alleviating future burdens on resources. However, existing populations are heavily weighted toward youth. Even if fertility falls precipitously, growth in population and labor force will persist. (See Box II.4.)

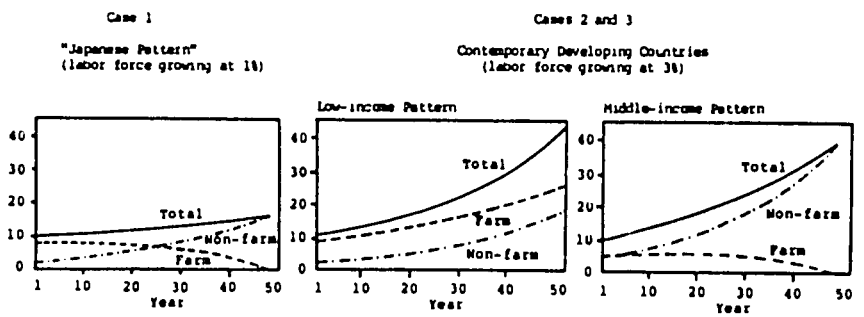
Despite the diversity in relative endowments of labor and land among countries, the general implications of population

BOX 11.4

The Arithmetic of Population Growth and Structural Change

Large and persistent increases in the absolute size of the farm workforce in most of today's developing countries contrasts sharply with the earlier experience of Western Europe and Japan where rates of population growth of 1.0 to 1.5% characterized the "rapid growth" phase of their demographic transition. In Japan, for example, growth of job opportunities in the nonfarm sectors was sufficient to absorb the annual additions to the labor force plus a small net transfer of workers from agriculture. In the contemporary developing countries, especially the low-income countries, the combination of agriculture's large share in the total labor force and the persistence of rapid rates of growth of the population of working age makes it certain that for many of these countries the farm workforce will continue to increase until well into the twenty-first century. The projected labor force growth rate for the low-income countries, excluding China and India, is 3.0% for 1980-2000, and in most of those countries some 70 to 80% of the total labor force still depends on agriculture for employment and income. The projected labor force growth rate for the middle-income countries for that period is also high--2.7%. But in Mexico, Egypt, Brazil, and many other middle-income countries, the share of agriculture in the labor force has been reduced to some 50% or less. That means that even with rapid growth of their total labor force there will be more limited growth or even a decline in the size of the farm labor force, provided that nonfarm employment is increasing rapidly.

The "stylized facts" about the prospective growth of the total, farm, and nonfarm labor force over a 50-year period are depicted for three situations: "the Japanese pattern," a contemporary low-income country with 80% of its labor force initially dependent on agriculture, and a middle income country with 50% of its labor force in agriculture in "year 1." The diagrams illustrate the powerful effects of differences in (1) the rate of growth of the total labor force and (2) agriculture's initial share in the total labor force. In all three cases the projected growth paths are calculated on the optimistic assumption that nonfarm employment is increasing at a 4.5% annual rate, a rate that is very high indeed in relation to historical experience. The initial labor force is 10 million with 8 million in agriculture in cases 1 and 2 and 5 million in agriculture in case 3.



Because of the assumption of a 4.5% rate of growth of nonfarm employment, the diagrams understate the probable increase in the farm workforce. In Japan the actual decline in the labor force from the 1880s to 1930 was only 15.5 to 14.1 million because the average rate of growth of nonfarm employment was only about 2.5%.

growth imply that typical farms in poor countries--already small--will become smaller. Fixed supply of land and population growth mean land use intensity and returns to land will increase. Some areas, notably in Africa, are exceptions; but as noted earlier, even in those areas rapid growth of the rural population and labor force is reducing the per capita availability of arable land. Productivity expansion through more intensive land use can be furthered by public investments in infrastructure to enhance the quality of the existing land base. These investments in land quality, such as construction of irrigation and transportation systems, can be complemented by land-saving technical change at the farm level, such as improved varieties, increased and more efficient use of fertilizers, and improved techniques for water and soil management. Growth in land productivity in developing countries has kept pace with the gains experienced in the developed countries during the past two decades. There was a slight rise in the rate of increase in yield per acre from an annual rate of 2.4 percent in the 1960s to 2.5 percent in the 1970s for the countries mentioned above.

Unfortunately, the rate of increase in farm labor productivity declined sharply from 2.3 percent per year in the 1960s to only 1 percent per year in the 1970s. The widening gap in labor productivity, according to Hayami and Ruttan (1984, pp. 5-10), is explained by the decline in the land-labor ratio. This meant a substantial widening of the already enormous gap in labor productivity between this group of developing countries, on one hand, and industrialized countries, such as the U.S.A. and the

countries of Western Europe, and middle-stage countries, such as Argentina, Brazil, Israel, Mexico, Portugal, and Taiwan, on the other hand. (These comparisons are depicted above in Box II.2.)

An analysis by V.S. Vyas (1979) of data for India on the effects of rural population growth illustrate the effects of rapid population growth coupled with limited agricultural land. Between 1953-54 and 1971-72, there was a 66 percent increase in the number of farm households in India, but cultivated area increased by only 2 percent--from 305 to 311 million acres. This led to a reduction in the average size of farm holdings from 6.3 acres to 3.8 acres and an increase in the number of marginal holdings (of less than one acre) from 15.4 million to 35.6 million. The economic effects of a similar pattern of marginalization in Kenya, described in Box II.5, is being reinforced by forced expansion onto inferior quality land.

The formidable challenge is to increase productivity of agricultural labor while, at the same time, increasing the demand for labor. For a particular capital cost, trends in relative factor endowments mean that economically efficient expansion paths for poor countries would be built on technology that is land saving and labor using. Even in middle-stage countries such as Mexico average farm size is declining in spite of a considerable reduction in the percentage of the labor force dependent on agriculture. (Agriculture's share in Mexico's total labor force declined from 55 percent in 1960 to 36 percent in 1980.) Consequently, for a wide range of developing countries, there is a need for increasing the productivity and incomes of small farms

BOX II.5

Kenya: Implications of Rapid Growth of a Country's Labor

Kenya's total land area is large relative to its population, but much of the land is marginal or totally unsuited to crop production because of inadequate rainfall. Moreover, the rapid population growth of recent decades has already led to substantial outmigration from high-potential but congested areas to semi-arid lands prone to drought, famine, and severe soil erosion. In the high potential agricultural areas of Kenya's Machakos District population growth had reached 2.8% as early as 1932-1948; but the rate in those areas declined to 1.6% in the 1960s, not because of a decline in birth rates but as a result of outmigration to marginal areas where the population grew at nearly 14% per year.

The implications of continued rapid growth of a country's labor force become awesome as the time horizon is extended. This is especially true, of course, where the growth rates are very high. It is estimated that Kenya's total labor force increased at an average annual rate of 3.3% between 1970 and 1982 and that the average rate for the period 1980-2000 will reach 4.2%. Projections by Shah and Willekens (1978, pp. 29, 38) trace the probable growth of population and labor force between 1969 and 2024 on the basis of six scenarios of possible changes in fertility and mortality between 1969 and 1999; reductions in fertility occurring after 1999 will have relatively little effect on the size of the country's population of working age in 2024. Their "most likely" scenario suggests a nearly sixfold increase in Kenya's population, from 11 million in 1969 to 64 million in 2024. On the basis of fairly optimistic assumptions about the growth of nonfarm employment, they project that the rural labor force would decline from 87% of the total labor force in 1969 to 65% in 2024. But those projections imply a fourfold increase in the rural labor force in spite of a sixteenfold increase in the population of active age in urban areas.

by labor-using, capital-saving technologies. But, for reasons examined in Section III, policies that promote expansion of a subsector of large farm units in these countries will tend to preclude the possibility of successful implementation of small farm development strategies.

Declining ratios of land to labor also mean that a growing portion of rural populations have no access to land, whether access is considered as ownership, tenancy, or reliable employment opportunities in agriculture. The effects of rural population growth often involve two important phenomena: (1) growth in the number of rural households causes a decrease in average farm size, but (2) the decrease is less than proportional to the increase in the number of rural households. The second effect reflects the increasing numbers of rural households without access to land.

Section II.4

Poverty and Access to Resources

Allocation of labor by members of rural families is determined through internal decision-making in rural households. Productive opportunities for labor depend on access to other resources. Access occurs through long-term property rights (ownership and usage regulated by custom) or short-term transactions (renting land or obtaining wage employment). The immediate outcomes and long-run economic implications of those market transactions depend on market structure and the initial distribution of wealth. Market channels also are sources of purchased inputs that can augment resource productivity.

Control of the factor services from land, labor, and capital means discretionary power over their productive use and entitlement to the income they generate. By definition, wealthy rural households control more resources; as a rule, they enjoy a relative abundance of land. Poor households have relatively abundant family labor and limited access to other productive resources.

Within a rural community, households have significantly different endowments of factors of production according to the size and age distribution of the household, their wealth and power, and their skill and luck. For a particular agricultural system, it will be mutually advantageous for households with diverse factor endowments to exchange services among themselves. If this process of exchange among households were flawless (from the standpoint of economic efficiency), income distribution would occur according to the pattern of control of factors but the organization of production would conform to the economic optimum. The shares of output would be set by institutions that determined who owned what, but the distribution of farm operating units would be independent of the distribution of land ownership. Landlords would be indifferent between hiring labor or renting land. Workers would receive the same income whether they were employed as wage laborers or cultivated land as tenant farmers. Clearly, this is not the case in reality. However, this simplistic example does enable clarification of two important points. First, while exchanges between households, the poor working for the rich, do provide employment opportunities, they do not compensate for preexisting disparities in distribution of

wealth, even under strict assumptions of perfect competition. Second, the bias of technical change will benefit those who own the right resources. For example, this means that a tenant farmer is likely to benefit from yield-increasing innovations only if the technical change increases the productivity of labor--the factor of production provided by the tenant. The benefit from access to land that the tenant gains is limited to the opportunity for productive employment of household labor.

In practice, both the distribution of land ownership and the size distribution of farm operating units (combinations of owned and rented land) matter in terms of choice of technology, employment, and returns to labor. To varying degrees in different developing countries, markets exist for trade in labor, land, and capital among rural households. Household cash constraints, however, mean that poor people have limited access to factor and product markets.

Diversity within the three broad categories--land, labor, and capital--also is important in relative access and returns. Land is not just two-dimensional space; the productive qualities of land are affected by soil characteristics, rainfall and other climatic characteristics, and relative location. These qualities can be enhanced (or denigrated): private investments (such as planting trees) or public works (road construction and irrigation projects) materially affect productivity. Aggregate labor productivity is determined not only by the quantity of labor, the number of workers, but by their individual characteristics: health, nutritional status, education, experience, and management

BOX II.6

Limited Access to Agricultural Land in Developing Countries: Evidence and Economic Implications

Percent Distributions of Farmed Area and Numbers of Holdings by Farm Size Categories for Selected Countries in Africa, Asia, and South America

FIGURE A

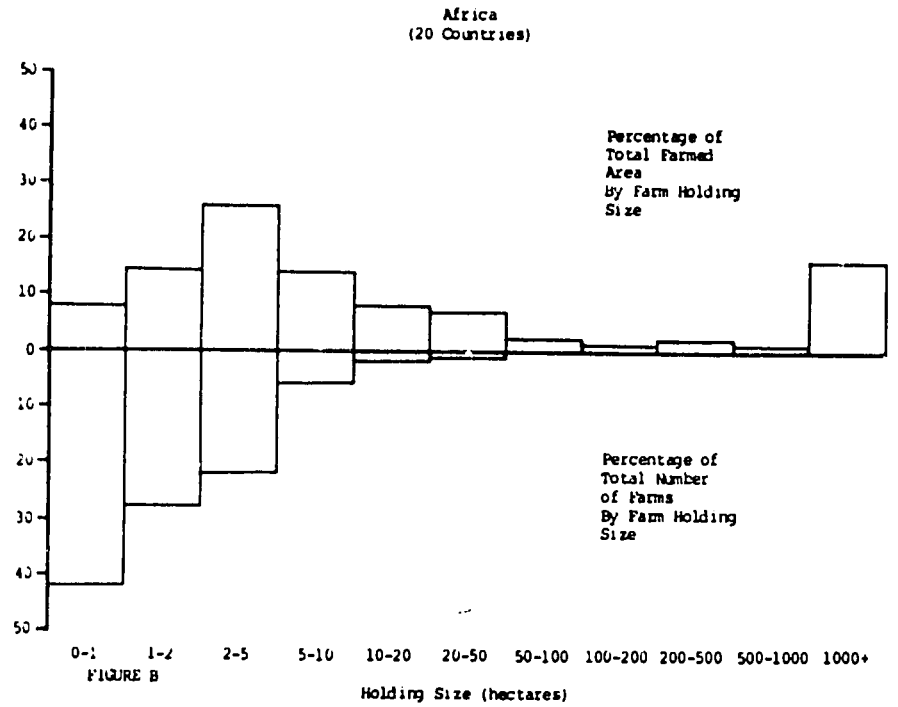


FIGURE B

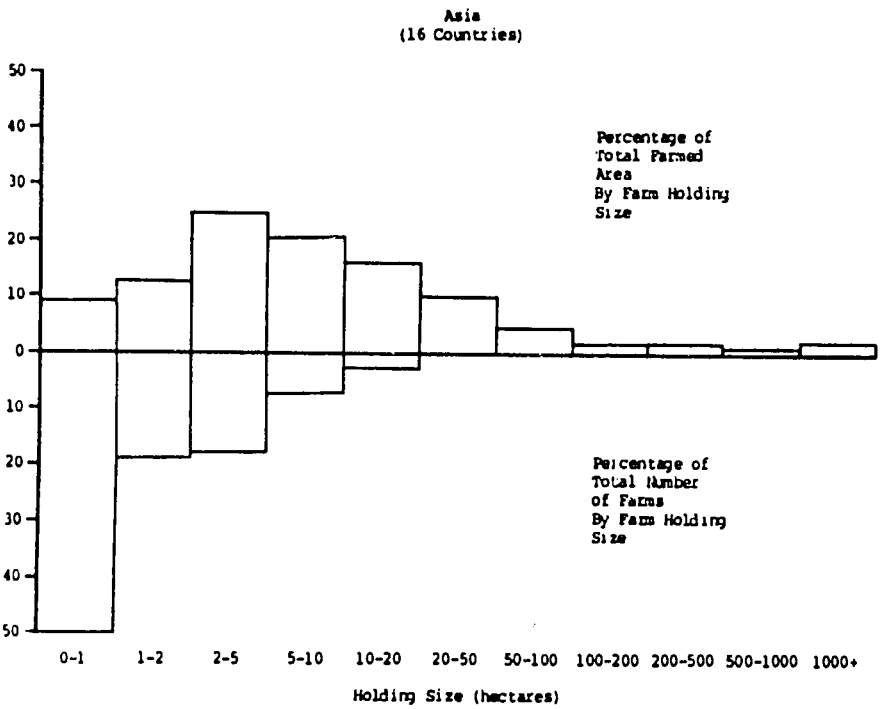
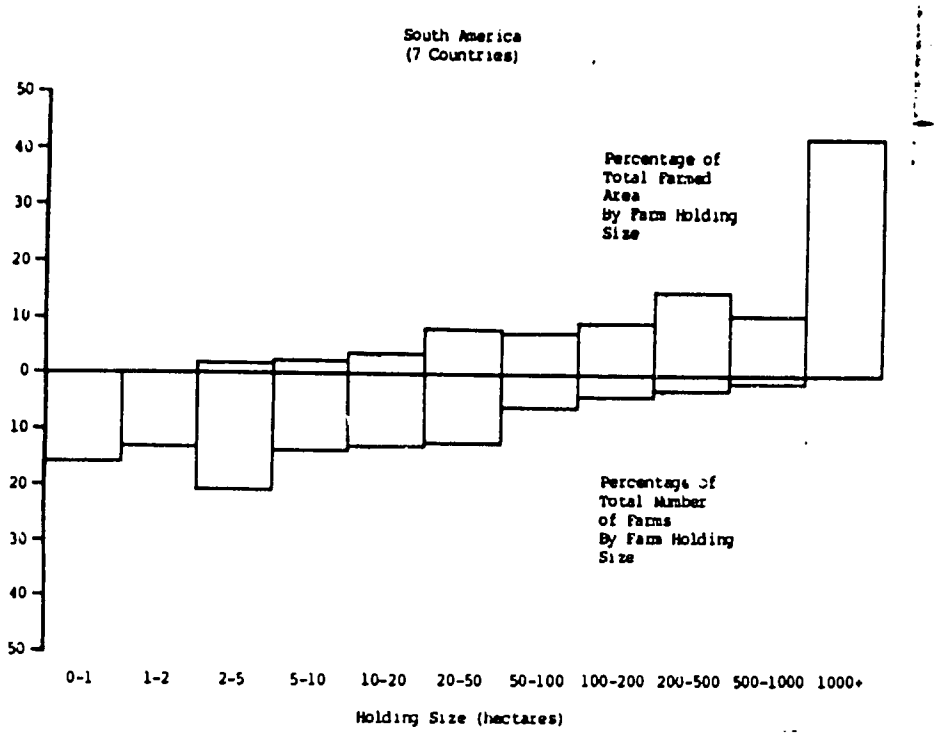


FIGURE C



Comparison of the distribution of agricultural area and number of agricultural holdings based on data for 20 countries in Africa, 16 countries in Asia, and 7 countries in South America reveals a strongly unequal distribution of land ownership. Although these figures obscure differences in size distribution and land quality across countries, they expose some important contrasts between continents. For Africa and Asia, the bulk of farms are under five hectares and almost half of agricultural land is held by farms in this category. The data from South America display a much stronger skew toward the largest size categories in the distribution of farmed area.

Members of the vast majority of rural families--those with little or no land--must diversify their economic activities in an effort to survive. The composition of household income sources depicted below for Indian and Peruvian households show the importance of wage labor, ancillary farm activities (such as intensive livestock raising), and other activities (such as trading and artisan production) in obtaining a meager income. In India, 47 percent of farms were one hectare or smaller in 1973. In Cajamarca, Peru, 60 to 70 percent of peasant families owned less than 11 hectares in 1973. In contrast to the common archetype of peasant agriculture consisting of land-based, crop activities dominated by adult male labor, more than half of the income in these poor households is generated by activities that are not based on control of land and are associated with work by women and children as well as men.

FIGURE D

Household Income Sources, 1970-71

for Indian farms (0.4-1 hectare)

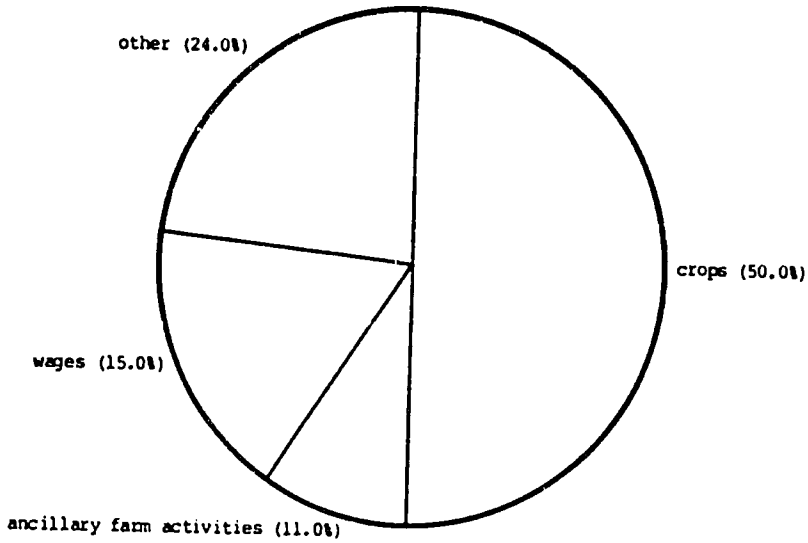
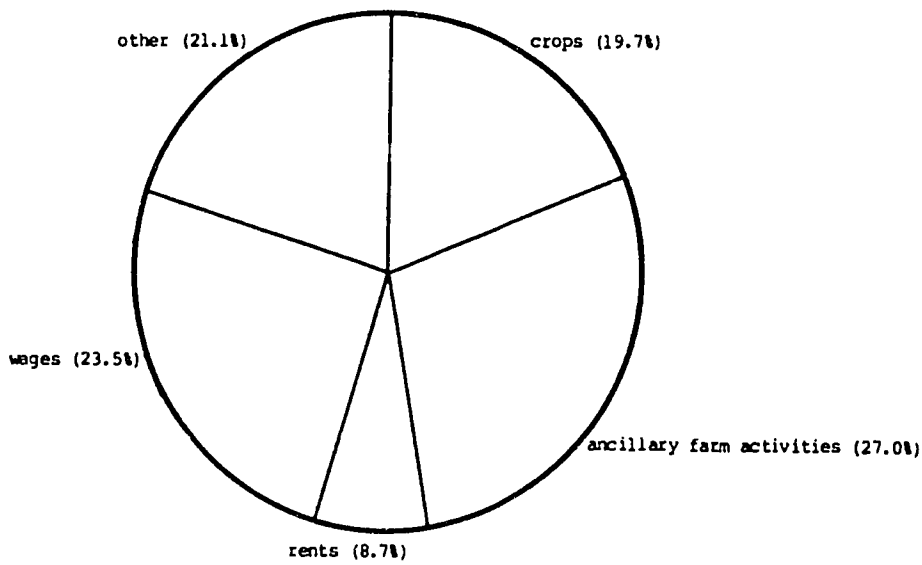


FIGURE E

Household Income Sources, 1973

Cajamarca, Peru: farms 3.5-11 hectares



Sources: FAO, World Census of Agriculture: Analysis and International Comparison of the Results, Rome: 1981.
World Bank, World Development Report, 1982, p. 79.
Alain de Janvry, 1982, pp. 115 and 245.

skills. Similarly, capital assets include cash and inventories, machinery, tools, and animals (which provide both power and production for sale) which differ greatly in terms of returns, relative liquidity, and ease of acquisition. Differences between similar factors and among classes of farms are not just details; they affect the economic transactions that can occur to ameliorate disparities among households. Differences in mobility, divisibility, gestation period from investment to returns, and value as collateral all contribute to and reinforce patterns of restricted access to resources.

Markets for commodities, land, labor, or capital and the relationships among people with different claims on factors--landlords and tenants, employers and employees, borrowers and lenders--need not follow the idealized model of allocation. Specific markets may be imperfect or fail to exist for a variety of reasons: incomplete information, high transactions costs, risky prospects, costly enforcement or difficulty in supervision of performance. The extent to which these imperfections have differential effects on farms of different sizes, including their access to technical information and commodity markets, is examined in Section III. Moreover, problems of unequal access to resources are determined by institutional patterns as well as market failures. Some rural institutions evolve to reduce costs of specific market failure. As discussed in Section IV, other policies and institutions exacerbate the effects of market imperfections.

The net effect of growth in rural labor force and existing economic and institutional relationships is that access, through ownership or rental, to productive land is severely restricted by technical and institutional barriers facing poor people in developing countries. In addition to growing numbers of households operating smaller plots, landless rural residents, whether they are involved directly in agricultural production as wage laborers or are engaged in other activity in the rural economy, constitute large segments of the rural population and labor force.

Skewed land ownership patterns often intensify the tendency toward small average size of farm holdings. While it is not assumed that technical change in agriculture and capitalist development exacerbate the concentration of land in large holdings, technical change with a capital-using, labor-saving bias raises the prospects for increasing concentration. Beyond this, the effects of a growing rural labor supply and a relatively fixed land base ensure that relative concentration of holdings will increase even if the current holding pattern does not change.[1]

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1 For a detailed investigation of the implications of population growth and technical change for the distribution of agricultural holdings and level of rural wage rates in Asia, see Y. Hiyami and M. Kikuchi, Asian Village Economy at the Crossroads, Baltimore: Johns Hopkins Univ. Press, 1982.

Section II.5

Efficiency of Production and Investment Decisions on Small Farm Units

Economic rationality is independent of farm size or access to other resources. Various circumstances can cause reasonable choices to diverge from pure profit maximization. Nonetheless, production and investment decisions on farms--whether small or large--are likely to represent rational resource allocation from the point of view of the individual decision maker. Increases in the size of the rural population with little or no land does not mean that production and investment activities will be inefficient. However, the pattern of production and investment is not independent of the structure of the rural economy. The range of choices that are possible and make sense differ greatly among people according to the resources they control.

It is important to distinguish the process of making choices from the range of choices available to various groups of people in low-income countries. Economic theory and empirical evidence support the view that people of different income strata make production choices in fundamentally the same way. Choices are affected by consideration of self-interest, availability of information, and risk associated with alternative prospects. Changes accompanying economic development accentuate the importance of behavioral responses to information costs and risky prospects.

Access to resources does affect the range of choices available to an individual. As described in preceding sections, access to resources is severely restricted for the vast majority

of rural people in developing countries. A growing portion of the rural population--those with little or no land--pursue a variety of options in their economic activities; few, if any, of these options are attractive. These people work for long hours for little pay, then experience unemployment during slack periods of the agricultural year. Almost all work some time during the agricultural year; yet, few have secure sources of income.

Households with small, marginal holdings are almost as dependent on labor markets for a source of income as households owning no land. The importance of family labor as the dominant factor of production under their control unites households with little land and households with no land; together, they face a similar set of problems and a limited set of alternatives. Their production and investment decisions are conditioned by their household resource endowments: to obtain income, they must seek opportunities for productive employment of family labor. The resources of these poor, but typical, households resemble the relative factor endowments of the rural economy. As they strive to subsist, these households' actions fit the objective of intensifying use of abundant family labor. Poor households will respond to incentives from well-conceived agricultural development policy designed to expand returns to labor.

Expanding employment opportunities can come from at least three sources: on-farm labor demand, ancillary activities (dairying, poultry, and fishing which are not as limited by land), and nonfarm employment (processing agricultural products, marketing, and work in the rural manufacturing and service

sector). Expansion of the latter two sets of activities--ancillary activities and nonfarm work--are correlated with rising output and income in agricultural production activities. Neglecting noncrop, nonfarm options overlooks many prospective sources of employment existing within the rural economy. In parallel, neglecting the need to promote effective demand in the rural sector can stifle opportunities for growth in these activities.

Profitable investment opportunities can fit the pattern of resource endowments in the rural economy. Saving and investment are necessary to further expansion of output and employment as incomes grow. Too often, however, misconceptions favoring show-piece projects have led to missed opportunities for desirable, but less apparent options. A major challenge for policy makers is to create an environment conducive to private saving and investment. Observations by Raup (1967, p. 273) put the image of potential investment patterns in proper perspective: "Capital formation in farming is rarely concentrated either in space or in time. It accumulates by an incremental process that is best described as accretionary." In poor households, investment decisions focus on the allocation of family labor between farm and household activities and use of resulting income for investment in productive assets or in consumption. Often, investments are manifested as subtle quality shifts in the factors of production: acquiring better livestock, planting trees, or adopting new methods of production. These decisions can have a significant impact in the aggregate, even if they are barely perceptible to

the outside observer. Insecure land tenure relationships create circumstances that are not conducive to saving. It is understandable that poor households, already operating at extremely low levels of consumption, might have low savings rates when every act of investment represents a decision not to consume--and when the fruits of investment can be denied arbitrarily. On the other hand, assurance of claims on returns to investment combined with accessible investment opportunities can induce very high rates of saving and investment among rural households.

Farm cash expenditures for current inputs such as chemical fertilizers, for capital equipment, and for consumer goods and services are constrained by the level of cash receipts from marketing crops. Farm units that do not market anything, so-called subsistence farms, are symptomatic of extremely low levels of production and consumption, inadequate marketing opportunities, or both. As nutritional needs are met and if market outlets exist, growth in farm output translates into growth in the marketed surplus. The degree of commercialization of farm operations is a continuum ranging from subsistence through increasing degrees of market participation. Marketing bottlenecks may arise because of poorly developed or inefficient marketing channels or deficiencies in infrastructure such as farm-to-market roads. It is essential to recognize, however, that to a considerable extent the availability of market outlets will be constrained by the structural features emphasized in this section. The enormous differences between Ethiopia, Taiwan, and the U.S. in the level of cash outlays for production inputs and other

types of expenditure in the 1960s, as summarized in Box II.7, were, above all, a reflection that some 85 percent of the Ethiopian labor force was in agriculture as compared to just over 50 percent in Taiwan and 7 percent in the U.S. at that time.

BOX II.7

Structural Transformation and Market Participation

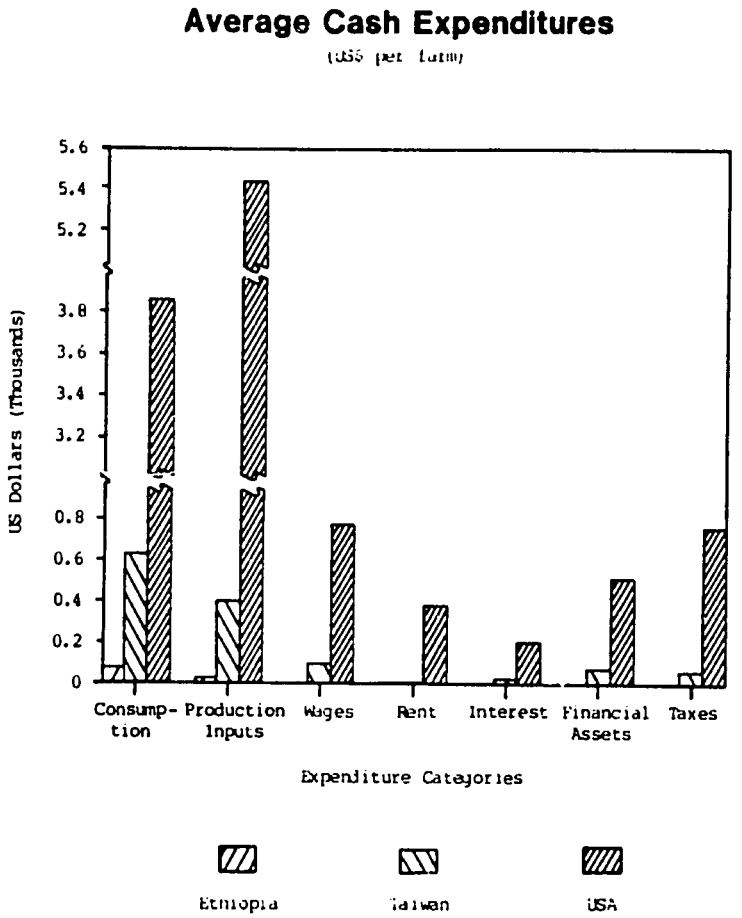


Figure A

Average Expenditure Shares

Per Farm in the Ethiopia, 1967

Total Expenditure = US $129.74

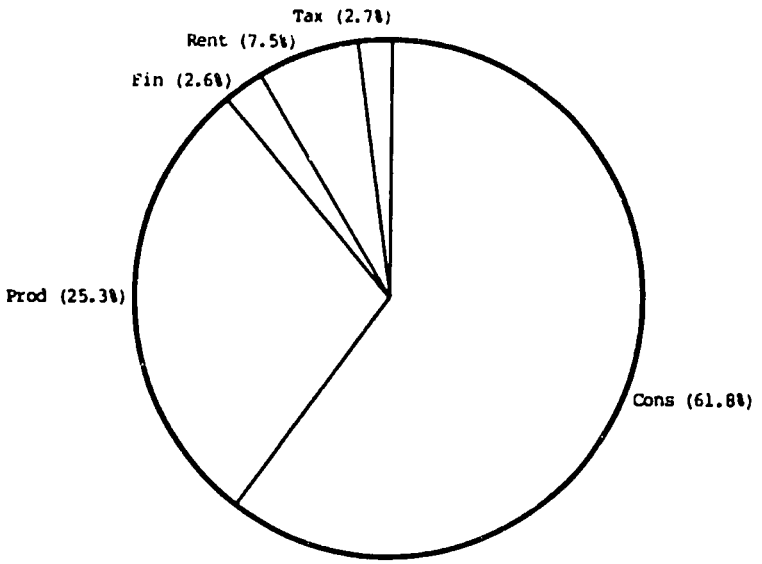


Figure B

Average Expenditure Shares

Per Farm in Taiwan, 1967

Total Expenditure = US $1329.98

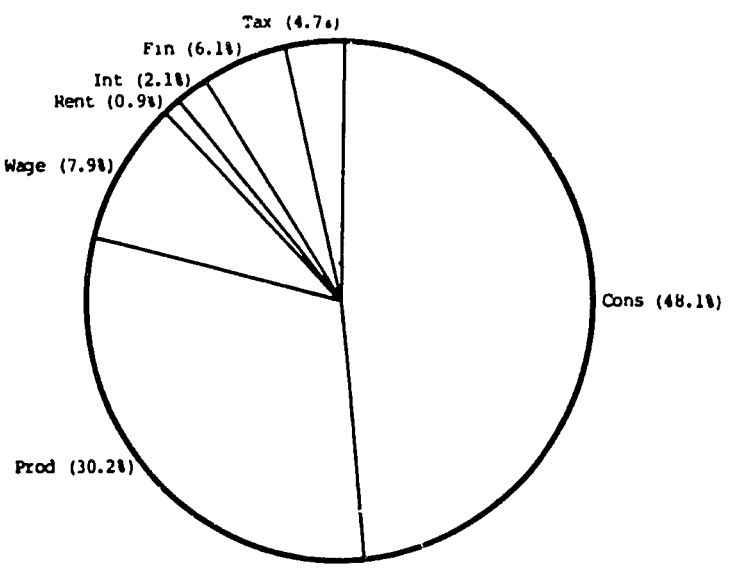


Figure C

Average Expenditure Shares

Per Farm in the United States, 1961

Total Expenditure = US $11939.00

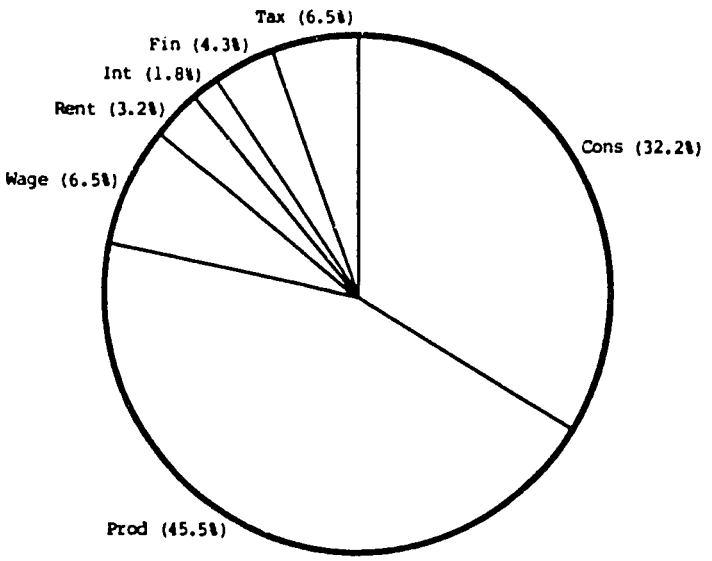


Figure D

Absolute and relative shares of average cash expenditures for consumption, production inputs, wages, rent, interest, acquisition of financial assets, and taxes in Ethiopia and Taiwan in 1967 and in the United States in 1961. Absolute sizes of production expenditures indicate agriculture's economic linkages. Specialization and increased market dependence occur in conjunction with increases in productivity of all factors, which, in turn, leads to higher income. Commodity flows--purchases of production inputs and consumer goods—constitute more than three-quarters of expenditures for each case. However, as income rises, expenditures on production inputs rise faster than expenditures on consumption.

Source: B.F. Johnston and P. Kilby, Agriculture and Structural Transformation, New York: Oxford University Press, 1979, pp. 70-74.

III. PATTERNS OF AGRICULTURAL DEVELOPMENT: ALTERNATIVE STRATEGIES

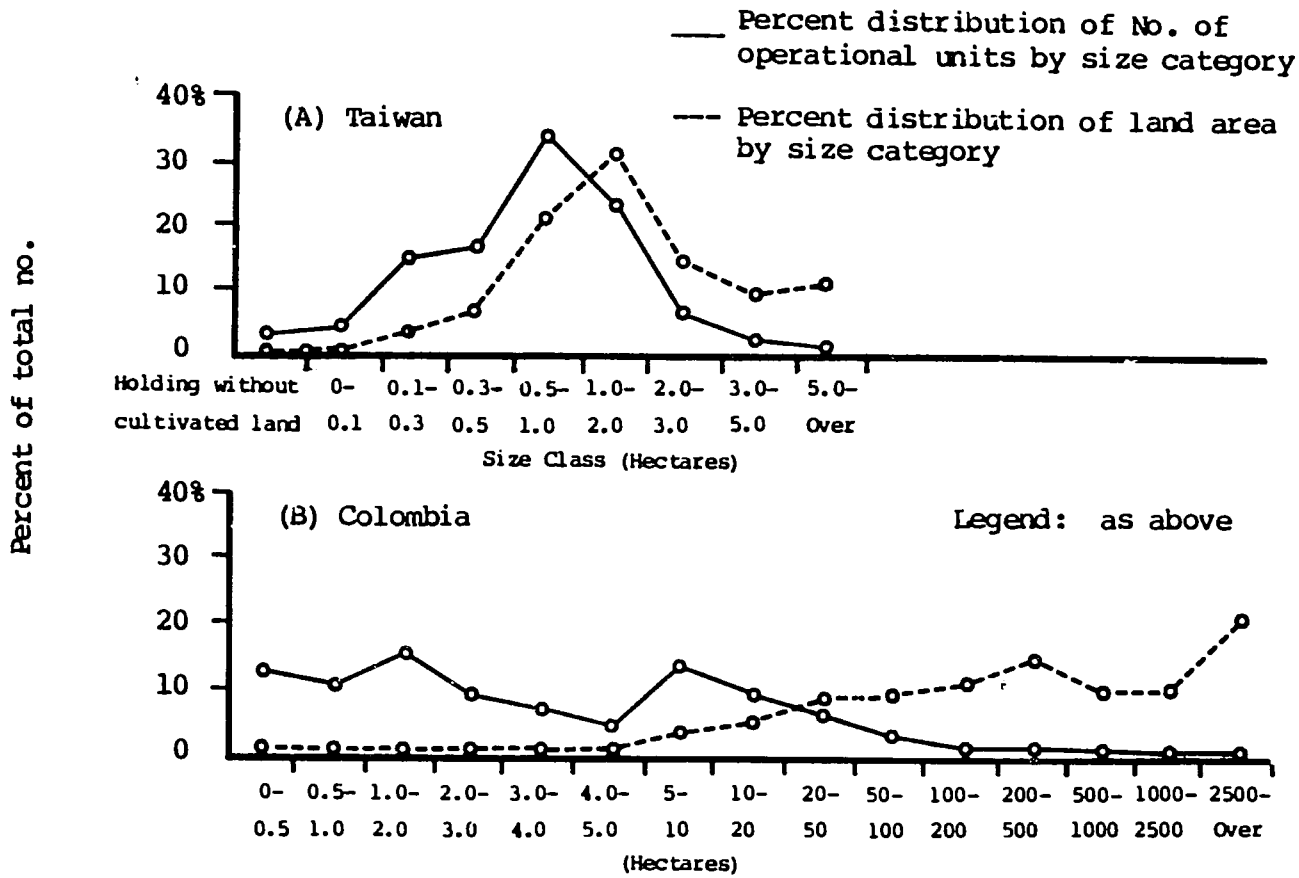
Section III.1

Structural and Demographic Characteristics and the Choice of an Agricultural Strategy

To declare that "small is beautiful" is a rhetorical indulgence. To emphasize that, for the great majority of farm units in developing countries, "small is inevitable" is to recognize a fact that derives from the structural and demographic characteristics examined in the preceding section.

Even though the average farm unit in LDCs is inevitably small, the pattern of agricultural development may be characterized by a subsector of large and highly commercialized farm units using technologies drastically different than those employed by the great majority of small, semisubsistence cultivators. The contrasting patterns of agricultural development that are possible are illustrated by the two panels in Box III.1. The unimodal pattern in Taiwan is compared to the bimodal pattern in Colombia. The broken line showing the distribution of agricultural land by size category in Taiwan lies to the right of the solid line showing the percentage of farm households in each size category. Although farm units in Taiwan vary in size, the great majority are more or less equally small: four-fifths of them are within one acre of the average size of 3.2 acres (1.2 hectares). But in Colombia the distribution of agricultural land by size category is totally different than the size distribution of farm operational units. Virtually all of the country's farm households are in the size categories of 5-10 hectares or less, whereas nearly all of the agricultural land is occupied by the very

Box III.1.



Box III.1.—Farm size distribution by number of operational units and by area cultivated, Taiwan and Colombia.

Source: Bruce F. Johnston and Peter Kilby, Agriculture and Structural Transformation. New York: Oxford University Press, 1975, p. 15

small number of operational units in the size categories ranging from 50 to 2500 hectares or more. Only 10 percent of the farm units have holdings within 5 acres of the average farm size of 56 acres (22.6 hectares) and the top 1 percent of farm units are 46 times as large as that average size. It is the contrast in the size distribution or pattern of land holdings in the two countries that is significant. An acre of agricultural land in Taiwan is the equivalent of several acres in Colombia because it is irrigated and intensively cultivated, whereas most of the agricultural land in Colombia is rainfed and much of it is devoted to extensive grazing of livestock.

Is a bimodal or unimodal pattern of agricultural development to be preferred? A widespread belief that economies of scale are important in agriculture underlies the common view that, in terms of efficiency, a bimodal pattern is superior. We turn shortly to an examination of the characteristics of the agricultural production process that give rise to economies and diseconomies of farm size to evaluate the validity of that view.

There is, however, a prior question that needs to be confronted: why do LDCs face a choice between a unimodal or a bimodal pattern of agricultural development? It is tempting to assume that governments can simultaneously pursue a small farm development strategy and policies and programs that favor a dominant role for the large-scale subsector that characterizes a bimodal pattern. However, because of the demographic and structural characteristics of LDCs, especially the low-income developing countries, the two alternatives tend to be mutually

exclusive. Achieving a successful unimodal pattern of agricultural development requires dispersal strategies leading to gradual and progressive modernization of a large and growing fraction of a country's small farms. If, instead, priority is given to focus strategies that stress the "crash modernization" of a subsector of large-scale farm enterprises, this will, to a considerable extent, preempt the possibility of achieving significant and widespread increases among the great majority of small farm units.1

In a land-scarce country, preemption of a large percentage of the agricultural land by a subsector of large farm units means average farm size for the great majority of farm households will be much smaller than the small average size that already is inevitable because of the limited area of agricultural land. The farm units in the large-scale subsector will also tend to produce a large marketable surplus over family needs and to account for most of the commercial output. Since the domestic commercial market is limited, the cash income or purchasing power constraint will be intensified for the overwhelming majority of farm households. The possibility of domestic production substituting for food imports or of producing export crops qualifies this cash

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1 Colin Barlow introduced the dichotomy between focus and dispersal strategies to characterize rubber development programs in Malaysia and Indonesia. The crucial distinction is that dispersal strategies offer potential for participation by the majority of farms, while effects of focus strategies are restricted to a narrow subset of farms. See Barlow and Jayasuriya, 1984.

income constraint, especially for a relatively small country such as Malaysia that exports products for which world demand is relatively elastic.

Malaysia appears to be unique in having been successful in simultaneously implementing dispersal strategies among smallholders and a focus strategy of production of rubber and palm oil on large estates. Because of an abundance of agricultural land, the expansion of the estate sector did not preclude the expansion by smallholders. Moreover, the trade-offs in the allocation of scarce resources of capital, government funds, and trained manpower have not been serious, in part because the estate sector has been able to obtain most of its capital from overseas investors and, especially in the earlier stages of development of the rubber and oil palm industries, much of the managerial and technical expertise was also recruited abroad. The initial expansion of rubber production by smallholders was largely a spontaneous response to the opportunities demonstrated by the estate sector. In the period since independence in 1957, dispersal strategies have been effective in promoting expanded smallholder production of rubber, rice, and palm oil. The area planted to rubber increased from 3.5 million acres in 1956 to 4.3 million acres in 1968, when smallholders accounted for 60 percent of the total compared to 43 percent in 1956. Important elements of the dispersal strategies have included research on production and processing, replanting schemes that enabled a large percentage of smallholders to replant their old stands of rubber with higher yielding materials, schemes to promote more rapid opening up and

settlement of land, mainly for rubber or oil palm, and major investments in irrigation to permit double-cropping of rice.

In Indonesia, however, a focus strategy for rubber improvement has been followed which appears to be incompatible with widespread increases in productivity and output even though smallholders are the target group and the availability of land is not a serious constraint in Indonesia's Outer Islands. The Smallholders' Rubber Development Project (SRDP) and similar schemes are so management- and capital-intensive that only a small percentage of the smallholder rubber producers are covered. It is estimated that it would take over 60 years to expand those resource-intensive schemes to cover even the present population of rubber producers; and because of the concentration of scarce development resources there has been a complete withdrawal of advisory services from ordinary smallholders (Barlow and Jayasuriya, 1984, p. 90). An alternative dispersal strategy based on selected seedlings, which are much more robust than the management- and resource-intensive budgrafts developed for estate production that are being introduced to a limited number of smallholders in intensive schemes such as the SRDP, would permit much broader coverage. Although the yield potential of the selected seedlings is not as high as with budgrafts, they give a significant yield increase even with traditional practices and they also have the capacity to respond to better management. Thus, there is scope for a sequential learning process as farmers acquire the knowledge, skills, and cash income to apply fertilizers and other inputs to gradually raise their yields and in-

comes. Eventually, many smallholders would undoubtedly move on to the more cash- and skill-intensive budgraft technology to further increase their yields and profits; a transition that has already been made by many smallholders in Malaysia. In the Indonesian rubber example, the trade-off is mainly a consequence of limited administrative capacity to implement focus and dispersal strategies simultaneously because of budget and especially manpower constraints.

Much more common are the situations in which focus strategies concentrated on a subsector of atypically large and capital-intensive farm units exacerbate the problems of implementing dispersal strategies by intensifying the land and purchasing-power constraints that usually confront small farmers. Concentrating a large percentage of the agricultural land in a subsector of large farms reduces the average farm size for the great majority of cultivators. Similarly, the sectorwide cash income or purchasing power constraint that characterizes countries where the nonfarm sector dependent on purchased food is still small is intensified for the great majority of farmers when a subsector of large farms accounts for the lion's share of commercial sales.

Given the structural and demographic characteristics that underlie these land and purchasing-power constraints, achieving broad participation of a country's small farmers in increases in productivity, output, and commercial sales requires dispersal strategies based on gradual expansion in the use of external, purchased inputs associated with divisible innovations such as

improved seed-fertilizer combinations which complement rather than displace the relatively abundant internal resource represented by a large and growing farm labor force. But can small farm development strategies of that nature achieve the efficient expansion of agricultural output required to meet the food needs of a growing population? To respond to that crucial question it is necessary to examine the characteristics of agricultural production processes and to review the empirical evidence on the relationship between farm size and output.

Section III.2

The Economics of Farm Size: Clarifying the Issues

The economics of farm size have received considerable attention in the context of redistributive land reform. Because the bulk of production effects due to economics of farm size apply to operating units rather than ownership holdings, these issues are important even if political barriers foreclose the option of changing the pattern of ownership of farms through direct government intervention. The choice of strategy will have an indirect, but powerful, impact on the number and sizes of farms. To the extent that markets for land operate--either through land sales or land rentals--policy-induced shifts in relative productivity of farms by size can affect the distribution of farms by size.

Focus strategies are likely to promote polarization of farms into a bimodal structure, either by encouraging concentration of land ownership through concentration of the distribution of income gains from growth or by encouraging concentration of operating units by making operation of large units relatively more

attractive than renting parcels to tenants. Conversely, dispersal strategies hold the prospect of setting economic forces to work, through conscious policy decisions, to promote a unimodal structure of farm operating units. Realization of this prospect depends, however, on the operation of markets for land, labor, and capital, and relative efficiency, not only by farm size, but by tenure arrangement. A dispersal strategy aimed not only at the current majority of small farms but also at increasing the number of farm operating units through land market transactions must weigh the relative efficiency of alternative tenancy arrangements.

Some crucial conceptual clarifications are necessary before proceeding to substantive issues. "Economics of farm size" has, so far, been used as an inclusive term for relative "economic efficiency," "economies and diseconomies of scale," and "economies and diseconomies of farm size." These concepts must be treated separately. Private economic efficiency can differ systematically by farm size if scale economies exist, if technology differs by farm size, or if technical or price efficiency differs by farm size.

Economies and diseconomies of farm size, as emphasized by Bachman and Christensen (1967), refer to the effect of farm size on changes in input and output relationships. In contrast, economies and diseconomies of scale (alternately called increasing or decreasing returns to scale) apply only to the specific relationship between proportional changes in all inputs and the resulting effect on output. In other words, scale refers to the

output effects of multiplication of production activities without changing relative input proportions. Differential intensities of labor, land, or capital use by farm size are due to economies and diseconomies of farm size; they are not scale effects. Economies or diseconomies of farm size can and do exist even in the absence of pure scale effects. (Scale effects are illustrated in Box III.2. Impact of farm size effects is depicted graphically in Annex 2.)

At the extremes of the size distributions of farm holdings, economies and diseconomies of scale probably exist in agriculture. Very large and very small farms both tend to rent out land in many countries. The crucial question, however, is whether scale matters significantly over the range of sizes that includes most farm operating units. Put differently, one might wonder what size exhausts significant scale economies and what size marks the onset of diseconomies, recognizing that this will vary according to location-specific differences in production conditions.

Scale economies in agriculture are associated with two sources: integration of agricultural production with other economic activities that embody significant scale economies, and agricultural activities involving indivisible (or "lumpy") inputs. Certain crops, notably sugar cane and bananas grown for export, require close coordination between production and processing or packaging and shipping, and the latter activities are characterized by economies of scale. For most crops, however, requirements for this degree of coordination do not exist.

BOX III.2

Decreasing, Constant, and Increasing
Returns to Scale

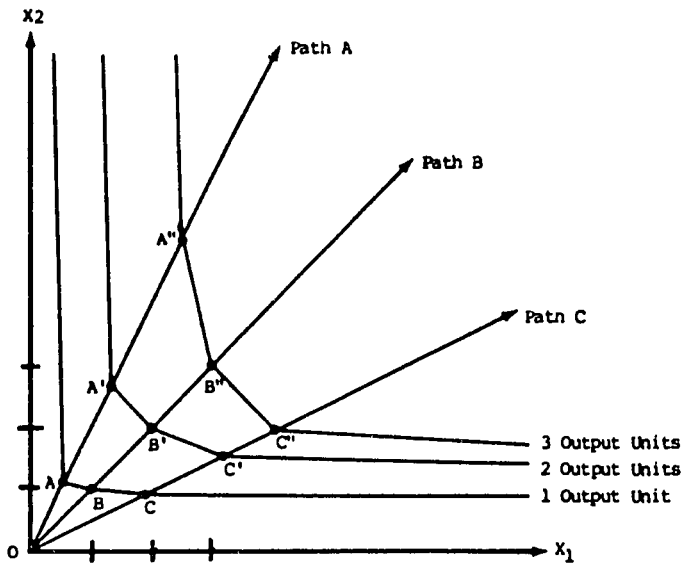

Figure A

Portions of a two-input, single-output production function depict different scale effects to isolate the technical nature of scale economies. Each kinked curve links the combinations of inputs X1 to X2 yielding a specific level of output. Increasing either input increases total output. Scale effects with only two inputs are defined as the effect on the level of output of proportional changes in both inputs. Graphically, this corresponds to tracing a straight-line path away from the origin and observing the relationship between quantities of inputs and output. Ratios of input X1 to X2 are 1:2, 1:1, and 2:1 for Path A, Path B, and Path C, respectively. This (unusual) production function was drawn to depict decreasing, constant, and increasing returns to scale in a single graph. These effects can be seen by considering the length of segments connecting different output levels.

For Path A: $OA < AA' < A'A''$

For Path B: $OB = BB' = B'B''$

For Path C: $OC > CC' > C'C''$

Because it is necessary to more than double inputs on Path A to increase output from 1 to 2 units, Path A exhibits diminishing returns to scale. By similar reasoning, Path B exhibits constant returns to scale (doubling both inputs doubles output) and Path C represents increasing returns to scale. These effects are purely technical. However, manifestation of the technical effects depends on economic decisions regarding price efficient input combinations (see Box II.3 above).

Moreover, while production activities may be well-suited to the scale of a typical small farm, other associated activities (e.g., marketing) may be profitably organized through group arrangements (e.g., agricultural marketing cooperatives).

Tractors and related items of modern farm equipment are typical examples of lumpy inputs. Tractor hire services can be a substitute for ownership; but because of critical timing requirements and scheduling difficulties, they are far from being a perfect substitute. Moreover, small farmers that depend on a tractor hire service almost always use the service only for primary tillage. It seems likely that in many situations use of a wider range of inexpensive, animal-powered implements, including interrow cultivators and seeders or planters, would be more profitable, at least from a societal viewpoint, than a subsidized tractor hire service, even if the subsidy is limited to the underpricing of equipment and fuel because of an overvalued exchange rate. The economies of scale in tractor ownership result from fuller use of the tractor when the size of the farm unit approximates maximum tractor capacity. The policy issue here is not as simple as "tractors, yes or no?" As emphasized in other sections, the main issue in mechanization relates to a spectrum of options that range from explicit and implicit subsidies that promote tractor mechanization to taxes that reduce the private profitability of tractors. A tax of this type is justified when private profitability of tractor use exceeds social profitability, as when the social opportunity cost of labor is low due to lack of alternative employment opportunities.

To what extent is superior managerial capability--enhanced through experience and education--a lumpy input because it is embodied in an individual? Clearly, a superior manager can have a greater impact on output when managing a relatively large farm. This, however, must be balanced against potential diseconomies in the scale of management. Moreover, the average level of management for the agricultural sector is likely to be superior when decision-making is decentralized and management decisions are made by a great many owner-cultivators or tenants operating numerous small farms. This is because of the great importance of on-the-spot supervisory decisions and because farmers with small holdings have more intimate knowledge of their land and other resources. Furthermore, supervision of hired labor and problems of ineffective incentives result from the biological nature of agricultural production processes: monitoring costs to control shirking and poor performance increase as farm size increases.

Significant economies of scale can exist in gaining market access to primary factors of production (credit, hired labor, equipment services, and land), access to markets for intermediate inputs, such as fertilizer, and access to technical knowledge. These represent the general phenomenon of economies of scale in transactions--exemplified by unit discounts for quantity purchases--and tend to be reinforced by political power, which

leads, in turn, to preferential treatment in government policy making.[1]

On balance, economies and diseconomies of scale turn out to be relatively unimportant. Although much of the literature is inconclusive, in general, the evidence supports constant returns to scale or slightly decreasing returns to scale for agriculture in developing countries. In the recent book by Hayami and Ruttan (1984), analysis based on cross-sectional data for agriculture in developed and developing countries suggests that scale economies exist in developed countries, but that agricultural production in developing countries is neutral with respect to scale of farm operation. For Indian agriculture, the most studied of all developing countries regarding economies of scale, evidence favors constant returns to scale, with some results suggesting decreasing returns to scale. In general, the crucial aspect of economies and diseconomies of scale is that they do not seem to be important in agriculture. Most of the empirical evidence for India and other developing countries seems consistent with a study by P.K. Bardhan (1973) of about 1,000 farms in India which suggests that returns are constant or decreasing with respect to farm size in most districts but generally reveal no advantage for large farms regarding efficiency or output. Bardhan (p. 1370) concludes that "the negative relation between output per acre and

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1 Taken together, transactions costs and the managerial issues raised in the previous paragraph also have important impacts on the relative intensity of inputs used in production. Consequently, they will be examined further in the following section on economies and diseconomies of farm size.

farm size" is mainly the result of the inverse relation between farm size and inputs of labor and other nonland inputs. Having discounted scale as a factor in the economics of farm size, we now turn to variation in input intensities by farm size, what we have called the economies and diseconomies of farm size.

Section III.3

Economies and Diseconomies of Farm Size

Even in the absence of scale effects and efficiency differentials, production decisions can vary systematically if economic considerations work to differentiate opportunities and rational strategies by farm size. Choices can vary by farm size if economic conditions lead to behavioral differences, if farms of different sizes have access to different technologies, or if farms of different sizes experience different costs. Technologies can differ either through differential access or barriers to adoption, or simply because technologies differ in their economic attractiveness due to cost differences across farm sizes. Similarly, costs can differ, even if markets are competitive, if cost components such as transaction costs and risk premiums differ by farm size.

The importance of economies of farm size will depend to a large extent on three things: (1) fundamental relationships among output and input intensities determined by behavioral and material (physical) constraints; (2) whether the relative availability and prices of capital and labor warrant a shift from labor-using, capital-saving technologies to labor-saving, capital-using technologies; and (3) policy makers' assessment of

development opportunities relative to resource endowments and subsequent impact of their decisions on applied research and the network of services supporting agriculture. Misplaced hope for realization of economies of scale can be translated into policy-induced, and inappropriate, economies of farm size.

Consideration of potential economies and diseconomies of farm size requires extension of the structural characteristics reviewed in Section II to incorporate farm-level aspects of what Binswanger and Rosenzweig (1983) refer to as "behavioral and material determinants of production relations in agriculture." Their recent contributions to synthesis of qualitative aspects of production relations provide the basis for this discussion of fundamental aspects of agricultural prcduction relations and consequences in terms of output and factor intensity. While this general treatment of complex issues cannot substitute for empirical work in specific circumstances, it does provide a useful point of departure in considering agricultural development options under conditions of abundant labor, scarce land, and limited capital.[1]

Meaningful analysis of farm size production effects requires relaxation of standard economic assumptions, particularly regarding the existence of information costs and the impact of risk. Basic features of agricultural production mean that information costs and risk can be important in understanding economic

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1 A complementary paper by Binswanger and McIntire (1984) addresses similar issues under the different resource constraints of "Land Abundant Tropical Agriculture."

behavior. Because much of agriculture is land-based, many production activities are dispersed. Spatial dispersion and biological variation accentuate information costs. The seasonality of agriculture means that timing of inputs is crucial and that activities tend to be concentrated in time.

Binswanger and Rosenzweig develop their analysis of consequences of risk and information costs by introducing six generalizations: (1) individuals face risk from production, market, and health factors; (2) information is costly: the least costly means of acquiring information often is through direct involvement in production activities; (3) individual behavior serves primarily self-interest; (4) individuals value consumption; (5) individuals dislike effort--which is a consequence of valuing leisure; and (6) individuals are risk averse when stakes are not trivial but the degree of risk aversion may vary among individuals. The universality of these observations is unproven, but they are accepted widely as simplified descriptions of economic behavior.

While sterile in themselves, these six generalizations lead to four consequences that are the foundations of farm size effects. First, self-interest and costliness of information lead to asymmetries in access to information. Simple examples make a convincing case for existence of this phenomenon. Workers know more about their skills and diligence than potential employers. Sellers of land, livestock, or used equipment know more about its qualities than potential buyers. Borrowers know more about their ability to repay than their creditors. Second, when information

is costly and distributed asymmetrically, incentives problems and transactions costs are part of economic relationships. This consequence is particularly important in labor market transactions. The costs of supervision and monitoring make it difficult to provide sufficient incentives to reward hard work and to control shirking in performance of various service contracts. Third, under these conditions, property rights cannot be enforced perfectly. Finally, risk (and risk aversion) make insurance contracts or insurance substitutes attractive. However, insurance markets rarely exist in poor rural areas and substitutes often are imperfect or entail other costs. As a general consequence, legal and cultural constraints may emerge as adaptations to risk and information costs. Either these imperfections, or the institutions they spawn, have material effects on production relations. Most important for present purposes, these effects tend to differ by farm size.

It is difficult to assess the direct impact of risk aversion on production decisions. It is plausible that poor farmers with small plots will be conservative in making production decisions when the prospect of failing to achieve expected profits translates directly into a threat to household subsistence. Certainly, meeting minimum consumption requirements for the family is an important consideration for impoverished, but rational, household decision-makers. Risk aversion can affect decisions regarding production inputs, allocation of land, and adoption of innovations. It has often been argued that this translates into an economy of farm size, with large farms being

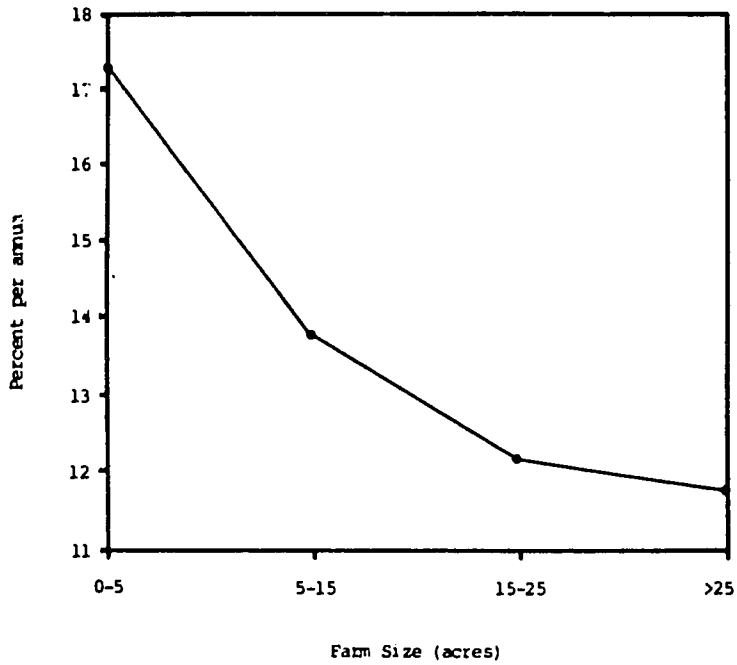
more productive because they are wealthier, they can be less concerned with risk. Nevertheless, the plausibility of responses to risk does not, by itself, establish the existence of inefficiency or economies of farm size. Moreover, as Roumasset (1979, p. 14) has observed: "It is often tempting to use risk aversion as a kind of deus ex machina to explain observations that appear inconsistent with profit maximization." The importance of farm size effects related to risk on farm-level behavior and adaptation requires further study. It seems clear, however, that efforts to reduce the objective risk facing farmers by investments in irrigation and by measures such as increasing the drought-tolerance of improved varieties will often merit a high priority. On the other hand, crop insurance schemes appear to offer little promise because of the problems of adverse selection and moral hazard which make it very difficult and costly to administer such schemes. In practice, crop insurance schemes seem to confer a differential advantage on large farmers who are better able to pay insurance premiums and also to manipulate the administration of the scheme to their advantage. This is an important example of the policy-induced effects on the economies of farm size that are examined in Section IV.

Information costs and risk manifested through rural credit markets can also have significant farm size effects on production decisions. Economies of farm size in borrowing reflect economies of scale experienced by lenders in information and enforcement costs. Average costs to lenders are inversely related to size of loans and credit limits are directly related to land owned (due

BOX III.3

Cost of Capital

By Farm Size in India



The negative relationship between farm size and cost of capital in India reflects differing interest charges by source of capital as well as the effects of fixed costs of institutional lending activities.

Source: S. Bhalla in R.A. Berry and W.R. Cline, 1979, pp. 159-161.

to collateral requirements). Consequently, farm households with little collateral will experience higher finance costs even if credit markets are competitive. (See Box III.3.)

Collateral has three roles in rural credit markets: it increases expected returns to lenders and decreases returns to borrowers, it shifts risk of loss from lender to borrower, and it provides incentives for borrowers to repay. (Note that these patterns reflect interaction of risk aversion by lenders and asymmetric information between lenders and borrowers.) Consequently, collateral-poor groups will have limited access to credit and will pay higher rates of interest. The physical characteristics of land make it a particularly suitable and important form of collateral when property rights are well defined. As a result, land owners enjoy special advantages that extend beyond (and derive from) their relative wealth under conditions commonly encountered in credit transactions.

These capital market imperfections also induce imperfections in land markets. The collateral value of land relative to other assets becomes embodied in land market prices (but not in rents). This means that land prices will be higher than the present discounted value of land productivity, making land purchases even more difficult for people without land, who also need land to get credit.

Given the skewed pattern of land ownership holdings in most developing countries, land and labor can be combined in proportions more appropriate to relative factor endowments through three separate classes of factor market transactions: land sales,

wage labor hiring, or various land tenancy arrangements. In general, land sales do not contribute significantly to the equalization of factor intensities with aggregate endowments. For reasons discussed above regarding capital market imperfections, most land-poor people do not have the means to acquire land. At the same time, capital market imperfections mean that landowners have little incentive to sell land when things are going well: land is the primary stock of wealth in agrarian economies and there are few alternative investments. Of course, a primary motivation for liquidation of land assets is to maintain consumption levels when times are bad. Bad times--brought on by crop failure, disease, or myriad other factors--tend to strike the regional rural economy as a whole. Consequently, beneficiaries of distress sales are likely to be those who already are well off. Those who own land tend to retain possession if they can. If they own a lot of land relative to their household size, they can augment family labor by hiring workers or they can rent land to tenants.

Labor hiring involves significant diseconomies of farm size due to asymmetic information between prospective employees and employers--hiring costs--and due to incentive problems subsequent to hiring--costs of supervision and monitoring. The special advantages of family labor in small-scale agriculture have long been cited as sources of productivity and input intensity differentials by farm size. Because family members have a claim on the residual production of the farm, rather than claiming a fixed wage, their self-interest is served through maximizing farm

profits by hard work and the exercise of initiative and judgment. In contrast, laborers hired on a daily wage basis have little incentive to exert themselves beyond a level necessary to avoid being dismissed. Consequently, to achieve efficient levels of production, the employer must incur the costs of control and supervision of laborers. Hence, labor management costs increase rapidly and labor management effectiveness is likely to decrease.

The original concept of a dual labor market as an explanation of diseconomies of farm size based on an extreme distinction between farms relying exclusively on family labor and farms relying on hired workers does not fit the information presented in Section II. Wage labor constitutes an important part of household income for families with small land holdings. These same small holdings also hire labor. The assumption that family labor is isolated from labor market forces does not fit the general picture of rural economic activity and is not consistent with rational behavior.

Explicit recognition of transaction costs in labor markets is the key to reconciling increasing costs of labor hiring with labor market participation by members of small-farm households. Relative to the money wage rate, two sets of forces drive up costs incurred by employers and drive down remuneration realized by wage laborers. On the one hand, workers incur search costs of finding a job and costs of foregone production on the family farm and within the household. On the other hand, employers incur hiring and screening costs as well as supervisory costs that increase directly with the number of hired workers.

Consequently, a consistent explanation for the often observed inverse relationship between size of farm operating unit and intensity of labor use can be based on diseconomies of farm size due to transactions costs in labor hiring. (See Annex 2.)

Economies of scale in the decision-making component of management skills eventually are balanced by diseconomies of farm size in supervision of workers by management. In addition, because the number of distinct decisions to be made rises with farm size, decision-making skills are subject to diseconomies of farm size as a direct result of the heterogeneity of natural resources and the diversity of the resource management tasks inherent in agricultural production processes. These managerial diseconomies of farm size lead to incentives to replace management-intensive production activities (e.g., intercropping) with extensive production activities and to substitute capital equipment for labor supervision.

Tenure arrangements, such as share cropping, allow institutions to combine land and labor and also permit the decentralization of management decisions. Although owners of large farms will enjoy economies of farm size in access to credit, diseconomies of farm size in labor hiring and management affect input and output decisions to such an extent that land owners can gain by renting their land in smaller plots.

The existence of specific tenancy institutions is determined by imperfections in markets for land, labor, and capital. Transactions costs mean that landless individuals with some management skill can do as well as tenants as they can through wage

labor. At the same time, owners of relatively large farms can do better by renting land to tenants than by hiring labor themselves. These arrangements can take on a variety of forms: rent paid as labor, rent paid as a share of production (i.e., sharecropping or share tenancy), fixed rents in kind, and fixed rents in cash. Share tenancy has received special attention. Until the period of intensive analysis of tenure arrangements following the publication of Steven Cheung's seminal article in 1968, sharecropping was generally viewed as inefficient as well as unjust: inefficient because it was assumed that it would discourage tenants from applying an optimal level of inputs and unjust because of the large rental share typically received by landlords. There is now considerable recognition that share tenancy offers important advantages as an incentive system, a credit system, a method of risk sharing, a means of minimizing transactions costs in labor hiring and supervision, and a means of decentralizing production management decisions. Although the risk sharing role of sharecropping has received much attention, the existence of transactions and information costs is the primary factor behind the willingness of landlords and tenants to accept share rent arrangements (Roumasset, 1976, pp. 78-79). Fundamentally, the landlord-tenant relationship combines landlords' land with tenants' labor. Share tenancy also permits a combination of landowners' advantages regarding economies of farm size in credit markets with small-scale tenants' advantages due to diseconomies of farm size in labor hiring and management activities.

The relative efficiency of land tenure arrangements is an important issue if a unimodal distribution of farm units is pursued through promotion of short-term tenure contracts in the absence of opportunities to restructure land ownership patterns. In a "third best" world of economic and political imperfections, sharecropping arrangements seem to be relatively efficient institutions for combining land and labor in agricultural production.[1] On the other hand, incentives for investment of family labor effort in improvement of productive capacity of land are lacking when tenancy contracts are not accompanied by security of tenure. Thus, while short run efficiency may result, long-run productivity potential may not be realized. Nonetheless, Berry and Cline (1979, p. 30) conclude: "The possible distortions of sharecropping have received a great deal of theoretical attention. However, both the ambiguous theoretical conclusions and the inconclusive empirical evidence on the subject suggest that it is of considerably less importance for policy purposes than the issue of productivity in relation to farm size."

In summary, this section establishes the conceptual basis for economies and diseconomies of farm size. These farm size

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1 Arguments regarding the productive efficiency of share tenancy do not establish the equity of these arrangements. Given the greater economic and social power of landowners relative to landless members of rural society, it is not likely that tenants will be able to extract much beyond the returns to their direct labor and management skills. Nevertheless, tenancy may be mutually advantageous if measures to redress inequitable distribution of assets are politically infeasible.

effects arise from factor market imperfections and lead to systematic differences in inputs and outputs across farm units of different sizes. The tendencies for smaller operating units to adopt capital-saving, labor-using technologies is illustrated in Annex 2. The labor market imperfections also explain the effectiveness of management on small farms and the special productivity advantages of employing family labor. The general pattern of farm size effects on production decisions seem to hold for land tenure contracts as well as owner-operated farm units.

Section III.4

Evidence on the Inverse Relationship Between Farm Size and Output

In the final analysis the effect of farm size on land productivity--value added in crop and livestock products per unit of land--is empirical. An impressive body of evidence has accumulated that points to declining output per unit area as total area operated by an individual farm increases--the famous "inverse relationship" between farm size and output.

In their 1979 book, Albert Berry and William Cline summarized data from the 1960s and 1970s for a number of developing countries that indicated that the land productivity of smaller farms was higher than on larger farms.[1] Berry and Cline specify

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1 They use data for 20 or more countries for cross-country tests and test their hypotheses on the relationship of farm size to productivity and technical change more intensively for 6 countries: Brazil, Colombia, the Philippines, Pakistan, India, and Malaysia (the Muda River rice area).

three possible sources of this inverse relationship between farm size and productivity: (1) higher yields on smaller farms, (2) more intensive use of limited land available on smaller farms, and (3) higher cropping intensity and more intercropping on small farms. Although each of these effects does not necessarily apply in all circumstances, these generalizations are consistent with the farm size effects on management and labor use outlined in the preceding section. Subsequent studies have confirmed the inverse relationship between farm size and productivity for India, Brazil, and some other countries examined by Berry and Cline. Evidence now available for Bangladesh, Indonesia, and Kenya also show the usual negative relationship between farm size and land productivity (Hossain, 1977 for Bangladesh; Booth, 1979 for Indonesia; and Senga, 1976, pp. 94-95 for Kenya).

Two qualifications to the inverse relationship need to be noted. First, there is evidence for India and the Philippines which suggests that the inverse relationship between farm size and productivity is due to an inverse relationship between farm size and land quality (Bhalla and Roy, 1983 on India; Roumasset, 1976, chapter 4 on the Philippines). However, the attempts to control for land quality simply attenuate or eliminate the relationship; they do not reverse it. Furthermore, Kutcher and Scandizzo (1981, pp. 47-53) concluded that in all but one region of northeast Brazil small farms had no advantage regarding land quality, but nonetheless their data provide strong evidence for an inverse relationship between farm size and productivity.

The other qualification relates to the influence of technological change on the relationship between farm size and land productivity. Bhalla's analysis of farm survey data for India over the period 1968-69 and 1970-71 (in Berry and Cline, 1979) indicated a weakening of the relationship as a result of the Green Revolution. Deolalikar (1981, p. 275) even asserts that "the inverse relation is true only of a traditional agriculture...." However, studies of the high-yield wheat varieties in the Indian Punjab by Sidhu (1974) and of modern techniques among rice farmers in the Philippines by Herdt and Mandac (1981, p. 398) suggest that the inverse relation is maintained.

Adoption of new technologies is never instantaneous, and the rate and time pattern of adoption does appear to be related to farm size. Frequently there is a time lag in the rate of adoption of technology on small farms relative to large farms. Risk aversion, combined with imperfections in credit markets and in access to information, are obvious explanations for such a lag. Nevertheless, small farmers can gain experience through tentative and limited on-farm experiments before moving to a whole-hearted commitment to new technology. The great advantage of a sequence of divisible innovations as epitomized by improved seed-fertilizer combinations is precisely that such an incremental adoption process is facilitated. Moreover, there appears to be no intrinsic long-run productivity disadvantage for small farms. Lack of formal education, which is of course common among small farmers, may slow adoption. Because technical change is an adaptive learning process, comprising adaptation of technology to

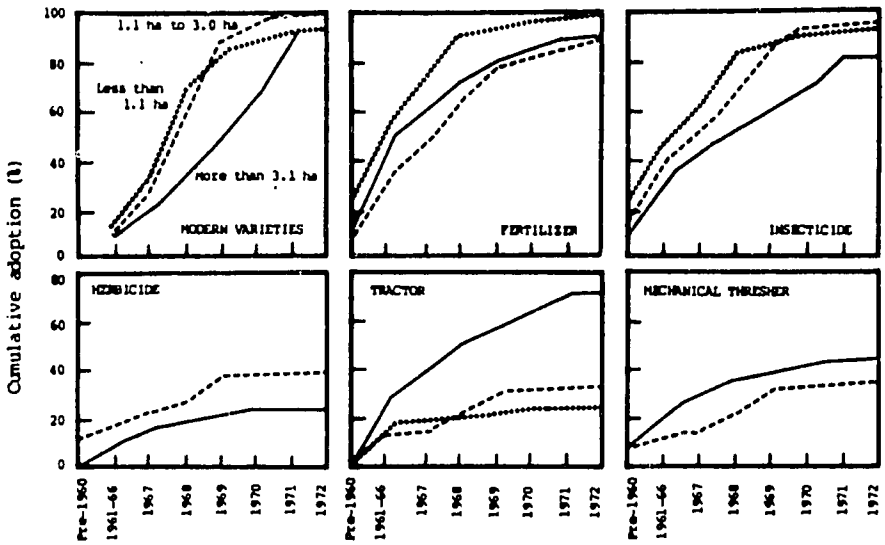
individual circumstances as well as adaptation of individuals to new technology, education has a positive effect on an individual's ability to select and adapt technologies. (See, for example, Jamison and Lau, 1982.) However, the complementary roles of relevant skills and experience are too often overlooked as sources of adaptive capacity. Individuals involved directly in agricultural activities have a distinct advantage in terms of knowledge of site-specific factors crucial to decision-making in agriculture--regardless of their formal education. Finally, it is important to note that agricultural extension can substitute for formal education in facilitating the diffusion of technical knowledge.

Numerous studies are now available that document the willingness and ability of small farmers to adopt innovations that are profitable and feasible. The spread of the high-yield varieties of rice from 2.6 million hectares in 1967-68 to 21.3 million hectares in 1974-75 was possible because of widespread adoption by small as well as large farmers. The same observation applies to the spread of the new varieties of wheat; in the Indian Punjab they expanded from 3.6 percent of the total wheat area in 1966-67 to 65.6 percent by 1970. The adoption pattern for specific innovations summarized in Box III.4 is especially interesting in showing that only in the case of lumpy inputs has adoption by large farmers been significantly greater than by small farmers.

Although the bulk of the evidence available pertains to Asia, studies that have been carried out in Latin America and in

BOX III.4

Relative Adoption Behavior
by Farm Size and Type of Technology



Cumulative percentage of farms in three sizes clases adopting specific innovations. Farms in 30 selected villages in Asia (IRRI, 1987b).

Source: P. Pinstrup-Andersen, Agricultural Research and Technology in Economic Development, New York: Longman, 1982: Figure 6.2, p. 130.

Africa report similar findings. Thus Luning (1982, p. 25) reports on a study of rice farmers in Surinam which indicates that between 1967-68 and 1974-75 the differential between small and large farms in the adoption of new varieties disappeared. A study of the adoption of hybrid maize in Kenya by Gerhardt (1975) found that small farmers in Kenya adopted hybrid maize more rapidly than their predecessors in Iowa, and a study in El Salvador by Walker (1980) reports a similar outcome. Gerhardt and Walker emphasize, however, that the pattern of adoption was uneven, not because of differences in the attitudes or characteristics of the farmers concerned but because of differences in environmental conditions that affected the yield advantage of the new varieties. In their analysis of "Impediments to Technical Progress on Small Versus Large Farms," Perrin and Winkelmann (1976, p. 893) emphasized that "the most pervasive explanation of why some farmers do not adopt new varieties and fertilizer while others do is that the expected increase in yield for some farmers is small or nil, while for others it is significant due to differences (sometimes subtle) in soils, climate, water availability, and other biological factors." This influence of the heterogeneity of physical environments, which is especially characteristic of rainfed farming, is of great importance in many of today's developing countries and receives further attention in Sections IV and V.

Principal attention has been given in empirical studies to the relationship between land productivity and farm size. This emphasis is understandable given the great importance of increas-

ing output per hectare because of the growing scarcity of agricultural land in most LDCs. The largest differences in land productivity per hectare are found in areas where land is relatively abundant, large farms are extremely large, and a substantial percentage of the agricultural land is used for extensive grazing of livestock rather than cultivation of crops. It is not uncommon in Latin America, however, to have extensive ranching on large farms with good arable land coexisting with cultivation of crops on very small farms with poor land. Berry and Cline (1979, p. 132) estimated that a redistributive land reform that equalized the size of holdings would lead to the largest increases of output in the three areas of Latin America that they studied intensively--an increase of nearly 80 percent in northeast Brazil, a 25 percent overall increase for Brazil, and a 28 percent increase for Colombia. For three Asian countries--the Philippines, India, and Pakistan--they estimate that the increase in agricultural production from a redistributive land reform that equalized the size of holdings would be 23, 19, and 10 percent respectively.[1] In those countries, however, the inverse relationship between the extent of multiple cropping and farm size would probably be of major importance.

It is also important to consider the evidence that relates to the relationships between farm size and the intensive use of

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1 To realize these output increases, redistributive land reform would have to be accompanied by programs to assure access to agricultural services and inputs for the recipients of land.

labor and other inputs. Some studies in India and other Asian countries carried out during the early years of the Green Revolution confirmed the usual finding of higher labor use on small farms but indicated that large farms were using more purchased inputs per hectare. Data for Japan and Taiwan are of interest because they pertain to situations in which the learning process that characterizes agricultural development had influenced farm units of all sizes. The inverse relationship has been reversed in Japan in recent years as the economy-wide expansion of employment opportunities has increased the opportunity cost of farm labor, but as late as 1964 there was still a strong and steady reduction in use of both labor and purchased inputs as farm size increased. In Taiwan, the use per hectare of labor and purchased inputs also has been inversely related to farm size. No data are available comparing total factor productivity for different size categories in Japan or Taiwan. However, given the unimodal pattern of agricultural development in the two countries, it is significant that increases in factor productivity were a major source of increase in agricultural production in both countries. In Taiwan, increases in factor productivity appear to have accounted for a remarkable 70 percent of the increases in agricultural production in both the prewar period (1911-15 and 1936-40) and the postwar years of 1951-55 and 1961-64 (Johnston and Kilby, 1975, p. 242). Rough estimates of total factor productivity by farm size for Brazil, Colombia, and India seem to indicate an inverse relationship especially when a zero social cost is imputed to labor (Berry and Cline, 1979, pp.

127, 172-74). In Colombia, however, when an intermediate social price of labor is assumed, the very smallest farm sizes were found to be less efficient in terms of factor productivity than the moderate-size groups, and in India when nonzero labor costs are used (ranging from one-half the market wage to the full market wage), factor productivity is approximately constant for the size groups up to 15 acres.

The inverse relationship between farm size and employment opportunities in agriculture has significant implications for the returns to labor and income distribution. Differences in labor use are substantial among farms of different sizes. Data for northeast Brazil for six size groups in seven different zones all show an extremely sharp and consistent decline in labor inputs per hectare from the smallest to the largest farms; a typical zone shows a reduction from .26 man-years per hectare in the smallest size group (averaging 3.7 hectares) to .003 man-years per hectare for the largest farms (averaging 1,178 hectares). The data for Japan in 1964 show declines ranging from 679 to 495 hours per 0.1 hectare for the under 0.5 and 0.5 to 1.0 hectare categories to 217 and 163 hours per 0.1 hectare for farms of 2.5 to 3.0 hectares and over 3.0 hectares.

In both Japan and Taiwan agricultural labor was almost entirely family labor, although prior to the post-World War II land reforms much of that was the labor of members of tenant households. It was noted earlier that in today's LDCs there has been a large increase in the number of landless or virtually landless farm households dependent on wage labor. (The reasons

for that important contrast do not seem to be well understood, although the heavy land tax levied on landowners in Japan and Taiwan was no doubt an important factor inducing them to rent their land in small parcels to be cultivated intensively by tenants.)

The relationship between farm size and the use of hired labor is not as well established as the inverse relationship between farm size and total labor inputs. There is considerable evidence, however, that even small farm units hire labor. For India, Bhalla (in Berry and Cline, 1979, p. 165) shows that hired labor per acre actually decreases a little with farm size. Data for settlement schemes in Kenya reported by Senga (1976, pp. 94-95) indicate no systematic change in the use of hired labor per hectare as farm size increases. However, total labor inputs decline dramatically with farm size: labor inputs per hectare on farms of less than 10 acres are twice as high as for farms in the 10-20 acre category, more than 7 times as large as for farms in the 60-70 acre category, and more than 11 times as large as on farms of more than 70 acres.

In a study of rice production in the Philippines, Roumasset and Smith (1981) find that the introduction of high-yield varieties was associated with a considerable reduction in the use of family labor and, initially, a more than equivalent increase in the use of hired labor. But in a second phase the adoption of labor-saving innovations for land preparation (power tillers) and for weeding reversed the increase in labor hiring. They report that this was induced "by the falling cost of mechanical power

and herbicides relative to animal power and labor" (p. 416). An important goal of development is to raise returns to labor by tightening labor supply-demand conditions so that the land- and capital-saving phase of agricultural development may give way to a land- and labor-saving and capital-using phase. However, the rise in labor demand in rural areas is often cut short by the premature onset of capital-labor substitution induced by price distortions. (See Section IV.)

In our review of the voluminous literature on the relationship between farm size and productivity we noticed the absence of any studies on the positive relationship between farm size and land productivity. It seems particularly surprising that economists such as Wyn Own (1971), who have advocated a bimodal strategy, have not offered any supporting evidence even though their viewpoint has been challenged. It is true, of course, that there are subsectors of large farms in LDCs that achieve crop yields that are well above the national average. The large farms of northern Mexico are an important example; but the explanation lies not in economies of scale or farm size but in their preferential access to resources--ample credit, technologies relevant to their large-scale operations, and, above all, controlled irrigation. The large European farms in Zimbabwe are another example. In this case part of the explanation is related to a proposition mentioned earlier: technological progress in agriculture is an adaptive learning process. Zimbabwe's European farmers have been accumulating the technical knowledge and

managerial skills important for the transition from resource-based to science-based agriculture over many decades.[1]

Section III.5

The Advantages of a Unimodal Pattern of Agricultural Development

In as much as the focus of this paper is on the feasibility of small farm development strategies, only a brief summary of the advantages of pursuing dispersal strategies that lead to a unimodal pattern of agricultural development will be given. The social advantages of broadly based agricultural development have received so much attention that this may have contributed to the common assumption that small farm development strategies must involve a sacrifice of efficiency for equity. It deserves emphasis that in countries with the structural and demographic features analyzed in Section II, there are significant economic as well as social advantages associated with dispersal strategies and unimodal pattern of agricultural development.

To be sure, if an emphasis on equity is pushed too far, efficiency and growth objectives are sacrificed. The rhetoric of recent years that has called for giving priority to "the poorest of the poor" can lead to that outcome. The very low productivity that characterizes agriculture in most LDCs means that there is

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1 This situation poses a dilemma for Prime Minister Mugabe's postindependence government. The highly productive European agricultural sector is a valuable economic resource for the country; but the growing pressure of population on the land means that this concentration of a substantial percentage of the country's arable land in the hands of a few thousand European farmers represents a difficult political issue.

almost always a substantial potential for increasing agricultural productivity, output, and commercial sales. In some areas, however, it may be exceptionally difficult to realize that potential, e.g., because the deficiencies in supporting services of agricultural research, extension, marketing, and input distribution are so great. Conversely, small farms in other areas may have exceptional opportunities to expand output rapidly and at relatively low cost in terms of private and government expenditure because of past investments in roads, irrigation, and other infrastructure and because profitable technologies adapted to the area are available. An advantage of viewing the development process as one of evolving and implementing dispersal strategies adapted to specific areas and leading over time to a unimodal pattern of development is that it avoids any implication that small farms should be uniformly small and that different farms and different areas should be expected to progress at the same rate. Indeed, it will sometimes be essential to face up to the reality that the environment for agriculture in certain localities is so hostile that agricultural research cannot be expected to generate feasible and profitable innovations and that the only realistic opportunities for the inhabitants of such localities to improve their economic well-being lie in migration or the development of nonfarm income-earning opportunities.

Emphasizing dispersal strategies leading to a unimodal pattern of agricultural development has significant economic advantages because of the fit between the resource requirements for such a strategy and the resource endowments and relative

prices that characterize--or should characterize--late-developing countries where the bulk of the population still depends on agriculture for employment and income. Because of its structural and demographic characteristics, the agricultural sector of developing countries is subject to a cash income or purchasing power constraint that limits the extent to which expansion of agricultural output can be based on increased use of purchased inputs. This consideration underscores the importance of the forces that determine the rate and nature of technical change. Generating and diffusing a sequence of divisible innovations that are complementary to the existing on-farm resources of labor and land is decisive in minimizing the cost of the sector-wide expansion of farm output and also in determining the pattern of development. The economic advantages of dispersal strategies that achieve widespread increases in the productivity of a large and growing fraction of a country's small farm units derive from the fact that it is the most feasible and cost-effective approach to attaining the multiple objectives of development, notably the growth of output, expansion of employment, narrowing of income differentials, and reduction of malnutrition. Given the economic constraints that condition the means for promoting development, dispersal strategies leading to a unimodal pattern of agricultural development are, in general, the most efficient means of attaining these multiple objectives.

Perhaps the principal trade-off that arises in pursuing a small farm development strategy is the possibility that the growth of marketed output will not be as rapid as with a bimodal

pattern of agricultural development. Although the rate of increase in total farm output is likely to equal or exceed the rate of growth that would be attained with a bimodal pattern, the growth of a marketable surplus is likely to be less because of the greater increase in food consumption by small farmers and their families. However, improving food consumption levels and nutritional status among low-income farm families is in itself an important development objective, whereas increasing the marketable surplus by perpetuating substandard consumption of such households is hardly a satisfactory solution.

The key to the effectiveness of small farm development strategies in attaining both economic and social objectives of development lies in its potential contribution to expansion of employment opportunities, within and outside agriculture, such that increasing demand for labor exceeds the rate of growth of the population of working age. The principal explanation for the employment-generating potential of small farm development strategies is, of course, the labor-using and capital- and land-saving technologies fostered by dispersal strategies that lead to a unimodal pattern of agricultural development. The fact that such technologies make it possible to increase farm output by fuller as well as more efficient utilization of a developing country's large and growing farm labor force is also the key to minimizing the agricultural sector's requirements for the particularly scarce resources of capital and foreign exchange.

Achieving a successful unimodal pattern of agricultural development also helps to encourage more rapid expansion of

nonfarm employment opportunities than can be realized in a bimodal pattern of development. Broadly-based agricultural development fosters positive interactions between agricultural and industrial development that stimulate growth of nonfarm output and employment. This occurs because the pattern of rural demand for inputs and consumer goods and services associated with widespread increases in farm productivity and incomes foster the decentralized growth of small- and medium-scale manufacturing units using relatively labor-intensive technologies and which have a relatively low content of imported inputs. In contrast, a bimodal pattern of agricultural development is associated with growth in demand for more sophisticated consumer goods and farm inputs; concentration of income gains induces demand for automobiles and tractors instead of bicyles and improved animal-drawn implements. Even if the more sophisticated items are manufactured domestically, they tend to be produced in large factories using relatively capital-intensive technologies, and relying on imported inputs. Therefore, the rate of expansion of firms responding to that pattern of demand is more constrained by the scarcity of capital and foreign exchange than is the output of smaller firms using more labor and other indigenous resources and with lower requirements for capital and foreign exchange per unit of output--and with an even greater advantage in relation to the job opportunities that are created.

Rapid expansion of employment opportunities in manufacturing and service activities using labor-intensive technologies is of critical importance in slowing the rate of growth of a country's

farm labor force. Creating off-farm employment opportunities is especially critical in land-scarce countries such as Bangladesh and India. Initially, it can reduce the adverse effects of diminishing returns in agriculture. Subsequently, more rapid growth of employment outside agriculture accelerates attainment of the structural transformation turning point when the absolute size of the farm workforce begins to decline.

The substantial increase in the number of landless and near-landless households in countries such as Bangladesh and India underscores the importance of expanding opportunities for nonfarm employment. Even labor-using agricultural technologies are limited in their capacity to absorb a growing farm labor force into productive employment when there is little or no possibility for expanding the area under cultivation. Furthermore, growth of the farm workforce at a rate that exceeds the rate of expansion of employment opportunities in agriculture is bound to depress wage rates as well as the availability of job opportunities. This has adverse effects on landless households dependent on wage employment in agriculture and tends to reduce the incomes of tenants: the same forces of supply and demand that reduce wage rates have the effect of enabling landlords to increase the already large crop share that tenants are required to pay. In the longer term, slowing the growth of a country's total population and labor force are vital to slowing the growth of the farm population and workforce.

There are many reasons why few contemporary developing countries employ dispersal strategies to promote a unimodal

pattern of agricultural development. Erroneous perceptions about the importance of economies of scale and misperceptions of economies of farm size have certainly contributed to that outcome. Bimodal patterns of agricultural development have also been related to failure to recognize that reliance on focus strategies tends to preclude the possibility of implementing dispersal strategies. More specific obstacles result from adverse effects of macroeconomic policies and deficiencies in government programs of research and other support services. These obstacles are examined in Section IV.

IV. OBSTACLES TO THE SUCCESSFUL IMPLEMENTATION OF SMALL FARM DEVELOPMENT STRATEGIES

Although the potential advantages of pursuing dispersal strategies for a unimodal pattern of agricultural development appear to be great, relatively few of today's LDCs have been successful in realizing that potential. In this section we consider first some general obstacles to achieving broad-based agricultural development that derive primarily from macroeconomic policies that have adverse effects on agricultural development in general but that are especially damaging to small farms. We then consider some of the key factors that have adversely affected the rate and the bias of technological change, i.e., whether technical innovations are biased appropriately in a labor-using and capital- and land-saving direction or biased inappropriately toward labor-saving, capital-using innovations. Given the scarcity of resources, successful implementation of dispersal strategies depends critically on accelerating the rate of technological progress and ensuring that the bias of technical innovations is consistent with fuller as well as more efficient utilization of an LDC's large and growing farm labor force.

Section IV.1

The Political Economy of Broad-Based Agricultural Development

Successful implementation of small farm development strategies is often compromised by the same government policies that have adverse effects on agriculture in general. The reasons are twofold.

First, macroeconomic policies that have given overriding priority to industrial development have often entailed both the neglect of agriculture in government resource allocation and price distortions that discriminate against the agricultural sector. Such policies have usually been associated with highly protectionist Import-Substituting Industrialization (ISI). Inadequate funding of research and other support services and policies that make capital and foreign exchange artificially cheap tend to have especially adverse effects on small farmers. Secondly, the policies adopted to attempt to overcome the agricultural stagnation that results from inadequate allocation of resources for physical and institutional infrastructure to support agricultural development and from the disincentive effects of price distortions commonly lead to corrective measures which benefit only the large-scale subsector. That preferential treatment of large farms further exacerbates the problem of fostering widespread increases in productivity and income among the great majority of small farmers.

In recent years there has been growing recognition of the ways in which economic policies aimed at ISI and shortcomings in macroeconomic management place a heavy burden on the agricultural sector. High tariffs and import quotas to protect a modern industrial enclave increase the price of most imports and locally manufactured products and turn the terms of trade against agriculture by raising the cost of farm inputs and consumer goods. At the same time, "cheap food policies" often depress the prices received by farmers. Furthermore, the large budget deficits in

LDCs caused by increases in government expenditures that are not matched by enlarged tax revenues are usually financed by expanding the money supply resulting in substantially higher rates of inflation in those countries than in the developed countries that are their major trading partners. Inasmuch as exchange rates are commonly fixed and governments tend to resist devaluations until the balance of payments situation becomes critical, the local currencies tend to be overvalued which further worsens agriculture's terms of trade for producers of export crops. Moreover, the foreign exchange rationing, import licensing, and other measures adopted to defend an overvalued currency usually have especially adverse effects on small farmers.

On the basis of his extensive study of the Japanese development experience and of agriculture in contemporary developing countries, Professor Kazushi Ohkawa has argued that small farms will tend to have an economic advantage over large farms as long as farm labor is relatively abundant so that its opportunity cost is low. He emphasizes, however, that this potential advantage may not be realized for two basic reasons. First, there may be limited possibilities for small farms to increase their productivity because of neglect of research. Consequently, divisible innovations such as locally adapted, high-yield, fertilizer-responsive crop varieties are not available. Secondly, the potential superiority of small farms in terms of economic efficiency may be offset by various differentiating factors that give large farms a differential advantage over small farms.

Many of the differentiating factors that are important in today's developing countries are related to the macroeconomic policies just discussed and to the measures that are commonly adopted to overcome their adverse effects. For example, development banks and other financial institutions are often directed to make credit available to farmers at artificially low interest rates as well as to firms in the modern manufacturing sector. The result, however, is to create an "excess demand" situation as the low-interest rates stimulate the demand for credit while ceilings on the interest paid on deposits discourage saving. The inevitable result is administrative rationing of the loanable funds available from institutional sources, and it is well documented that the larger and more influential farmers receive the lion's share of the institutional credit while the overwhelming majority of small farmers have to turn to very high-cost credit from village moneylenders and other traditional sources or do without credit altogether. The frequently lamented failure of rural credit and other institutions to serve the needs of small farms is often a consequence of such price distortions and the preferential rationing which they engender. Ensuring wider access by small farmers to credit at higher but market-clearing prices is usually a more realistic approach to minimizing discrimination. Another important example of a policy-induced differentiating factor is the common practice of subsidizing fertilizer prices, again giving rise to an excess demand situation and administrative rationing of the supply available with

the same tendency toward preferential treatment of the larger and more powerful farmers.

The effects of macroeconomic policies which enable large farmers to acquire tractors at artificially cheap prices have especially adverse consequences on the prospects for achieving a unimodal pattern of agricultural development. The high tariffs instituted to promote ISI are usually highly differentiated by product. In particular, imports of industrial machinery, tractors, and other capital goods are often permitted at low or zero tariffs because of the erroneous belief that this is a good way to promote capital formation. Faced with stagnating agricultural production, governments are especially prone to permit duty-free imports of tractors and tractor-drawn equipment. An overvalued exchange rate means that the price of this imported equipment is already artificially low. When large farmers also have access to subsidized credit, the incentive to invest in inappropriately capital-intensive, labor-displacing technologies is further strengthened.

Needless to say, historical, political, and cultural factors may be important in creating and perpetuating bimodal patterns of agricultural development. In many countries there is a legacy of economic and social inequality that creates obstacles to the implementation of a small farm development strategy.

Indeed it is commonly alleged that a redistributive land reform is a necessary condition for success in achieving a unimodal pattern of agricultural development. It is extremely difficult to generalize about land tenure issues because the

political feasibility and even the desirability of land reform depends on circumstances in individual countries. It will be recalled, however, that small farm development strategies were feasible in Japan, Taiwan, and Korea in spite of a highly unequal size distribution of land ownership prior to the redistributive land reforms carried out after World War II. This was because large landowners found it profitable to rent their land in small plots to tenants so that the size distribution of operational units was unimodal. This meant income distribution in rural areas was very unequal because such a large part of the economic rent to land accrued to landlords. However, both landowners and tenants had an interest in investments in research and in irrigation and other types of infrastructure that facilitated technological progress based on divisible, yield-increasing innovations that were labor-using and capital- and land-saving. The redistributive land reforms carried out in those East Asian countries following World War II resulted in a much more equal distribution of income in rural areas and reinforced their unimodal pattern of development, but they were not a necessary condition for that outcome.

The tendency for many large landowners in contemporary LDCs to choose direct cultivation of large operational units is probably influenced by the prevailing climate of opinion and legislation. Landlords are reluctant to rent land because of concern that by doing so they will increase the risk that their land will be taken over by the government for redistribution to their tenants. Land reform legislation that puts a ceiling on

rental payments or attempts to proscribe share tenancy may also encourage landowners to opt for direct cultivation so that economic rent on their land will accrue to them directly as part of their return to the management and ownership of land.

In Latin America the legacy of economic and social inequality poses special problems resulting from the huge land grants made during the period of colonial rule. The politically powerful landlord class has vested interests in policies that maintain the economic and political power that derives from their ownership of huge haciendas. Moreover, they are usually not willing to rent land to enable peasants to become small cultivators. Under such extreme conditions of agricultural dualism a redistributive land reform may well be a necessary condition for successful implementation of dispersal strategies leading to a unimodal pattern of agricultural development.

The de facto persistence of a caste system in India and some other Asian countries also poses special problems. Successful implementation of broadly based agricultural strategies that provide poor farm households with access to improved income-earning opportunities is difficult when those households have so little power to influence policies and their implementation. One of the most significant features of the original Anand dairy cooperative and India's National Dairy Development Board that was built on that experience is that poor farmers, including those from the lowest castes, acquired the organizational capacity to promote and defend their interests. (See Box V.1.)

In many countries a tradition of paternalism, prevailing bureaucratic practices, and disparaging attitudes toward the capacity of small farmers to innovate and be efficient managers represent major obstacles to achieving unimodal patterns of agricultural development. Such attitudes are prevalent in both socialist and mixed economies and are usually reinforced by the mistaken belief that economies of farm size are of major importance in agriculture.

To some considerable extent the tendency to extol the superior efficiency of large farm units is motivated by special interests of groups that stand to benefit from a dualistic pattern of development. The owners and managers of large private enterprises in the large-scale subsector in a mixed economy clearly have a vested interest in perpetuating policies that give them preferential treatment.

Leaders and policymakers in socialist economies usually stress the traditional Marxist view extolling the virtues of large-scale farm units, but they may well be motivated by other considerations. In Egypt, for example, it appears that an important motivation for the former officers who have continued to promote state farms as the preferred form of organization for land reclamation areas was their vested interest in the managerial positions associated with direct government involvement. Thus Robert Springborg (1979, p. 63), in an interesting analysis of policymaking under Presidents Nasser and Sadat in relation to tenure policy for reclaimed areas, states that their commitment to "the Russian model" was "not because of leftist ideological

commitments, but because on grounds of economic efficiency they believe reclamation and large-scale commercial agriculture to be desirable and because without such activity their respective state companies and organizations would be left with little or nothing to do." Another common motive seems to be related to the view that collective or state farms can be controlled, thereby becoming more reliable than small farms as a source of food supplies for urban areas. Because of the common failure to provide the support services and incentives required to enable small farmers to produce a marketable surplus, the lack of confidence in small farmers is often a self-fulfilling prophecy. Moreover, a situation in which a large percentage of the population consists of individual farm households is likely to be viewed as a threat to the maintenance of power by the ruling regime.

Some critics are prone to argue that the macroeconomic policies and related measures that have had adverse effects on agricultural development should not be viewed as "mistakes" but rather as the conscious result of the efforts of powerful groups to manipulate policies and programs so as to serve their group interests. Such a viewpoint usually has considerable validity. But it is suggested in Section V that that is an incomplete and excessively pessimistic view of the policy process.

Section IV.2

The Rate and Bias of Technological Change

Deficiencies in the level and orientation of investment in agricultural research have probably been the most serious consequence

of the neglect of agriculture in government resource allocations. A "satisfactory" rate of technological progress in the small-farm sector is not possible without publicly-supported biological research that generates a sequence of divisible innovations that are feasible and profitable for small farmers. If a country fails to achieve increases in agricultural production based on widespread adoption of yield-increasing innovations, the increases in productivity and output that large farms can realize by direct transfer of tractor-based techologies are likely to be regarded as crucially important.

Infrastructure investments in irrigation and drainage are often highly complementary to biological-chemical innovations because they expand the land area with environmental conditions favorable to realizing the yield potential of improved seed-fertilizer combinations and often permit increased multiple cropping. Because of the growing population pressure and deteriorating labor/land ratios that were emphasized in Section II, technological progress is needed to offset the effects of diminishing returns in raising costs of production and food prices. Moreover, in order for the demand for labor, including the opportunities for productive employment of family labor on small farms, to increase at least as rapidly as the increase in the supply of farm labor, it is essential for technological change to be labor-using and capital- and land-saving and neutral to scale.

In addition to the general neglect of agriculture, two major obstacles have adversely affected the rate and bias of tech-

nological change in many of today's developing countries. First, the price distortions discussed earlier have given large farms preferential access to cheap credit and imported tractors, thereby encouraging inappropriately capital-intensive technologies. Even more important in the long run, those distorted price signals bias the orientation of research. The interaction between the interests of large farmers and the decisions of agricultural administrators and research workers leads to a pattern of "induced innovation" that responds to the distortions in the price of capital caused by overvalued exchange rates and the preferential access of large farmers to cheap credit supplied by national governments and international aid programs.

The second major obstacle to successful implementation of small farm development strategies has been the general failure to develop strong national research systems capable of generating a sequence of innovations suited to the needs of small farm units. There is little hope that today's LDCs can achieve the increases in agricultural productivity and output required to satisfy the food needs resulting from rapid population growth and rising incomes without a transition from a resource-based to a science-based agriculture. Cumulative progress in agricultural science and technology provides the basis for substantial increases in productivity. This is illustrated by the experience of Japan, Taiwan, and Korea and more recently by the rapid diffusion of semidwarf varieties of rice and wheat in other Asian countries. The major role of IRRI and CIMMYT, the first of the International Agricultural Research Centers, in facilitating these recent

breakthroughs has reinforced exaggerated views of the potential for direct transfer of technology embodied in materials such as high-yield seeds. Because of the location-specific nature of agricultural production, the scope for direct transfer of technology is limited. As a result of the scientific breakthrough in identifying the genes that determine photoperiodism in rice and wheat, the varieties developed in the Philippines and in Mexico had an unusually broad impact, although largely limited to areas with well-controlled irrigation. Even so, local adaptive research was needed to determine appropriate agronomic practices for specific environments. Moreover, research has demonstrated that even under quite similar environments for irrigated rice production, local variations in soil structure and in soil organic matter can give rise to substantial variations in yields (Herdt and Mandac, 1981, p. 398). Furthermore, the countries that have been able to realize major benefits from high-yield varieties of rice and maize have had the ability to follow up on the initial direct or "material transfer" with the second and third phases of technology transfer--"design transfer" and "capacity transfer" (Hayami and Ruttan, 1984). As a country creates its indigenous capacity for scientific research and technology development, it is able to utilize imported prototypes of genetic material or equipment, scientific knowledge, effective methodologies and instrumentation for experimental work, and knowledge of efficient organizational designs and management procedures for research in order to develop plant and animal varieties adapted to local ecological and socioeconomic condi-

tions. The need for acquiring this capacity for location-specific research is especially important with respect to the biological and chemical innovations that are critically important for achieving widespread increases in productivity and output among a country's small farmers.

During the past 10-15 years there has been a growing consensus that the lack of success in creating effective national research systems in many of the contemporary LDCs is also to be attributed to a failure to devise research and extension methodologies well-adapted to fostering technological progress in the heterogeneous, rainfed environments that predominate in so many of these countries. Japan, Taiwan, and Korea enjoyed a significant advantage in generating and diffusing technologies adapted to the needs of their small farms because of the relatively homogeneous irrigated agriculture that is dominant in those countries. There was still a need for adaptive research, illustrated by the time required to evolve techniques for growing japonica varieties of rice under Taiwan's semitropical conditions and the even longer time required to develop high-yield, fertilizer-responsive indica varieties which are also important in Taiwan. But once appropriate techniques and varieties had been identified, diffusion was rapid because environmental and socioeconomic conditions were fairly homogeneous.

Most of the contemporary LDCs confront more difficult problems in generating and diffusing innovations in spite of the advantages associated with being able to draw upon a larger backlog of scientific knowledge and experimental methods. The

lack of relevance of research to small farmers has been partly a consequence of research being biased toward the needs of large farms. A more general problem, however, has been the limited relevance of experiment station research to the needs of small farmers because of the environmental heterogeneity that generally characterizes the rainfed farming that is nearly universal in sub-Saharan Africa and is predominant in much of Latin America. Even in South and Southeast Asia, rainfed and dryland rice cultivation covers a considerably larger area than irrigated rice although population is concentrated in the irrigated areas where yields are two or three times as high.1

Initial concentration on innovations suitable for the favorable and relatively homogeneous environment of controlled irrigation was rational. Such concentration of effort enabled plant breeders and other scientists to develop varieties capable of performing well under irrigated conditions in many countries. Since the potential yield increases were large and reliable and the diffusion of the new varieties was rapid, the returns to the initial investments in research were enormous--some 84 percent for IRRI and an estimated 74 in 1975 for national research programs in Asia (Evenson, 1978). It is suggested in our next section, however, that the prospects for overcoming the obstacles

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1 See Huke/IRRI, 1982, p. 7. R. W. Herdt and R. H. Bernsten have estimated that two out of three rice farmers in Asian LDCs have not adopted improved technologies because the modern varieties presently available require favorable environmental conditions--usually assured irrigation and water management facilities (Barlow and Jayasuriya, 1984, p. 85).

to successful implementation of small farm development strategies will depend to a large extent on evolving cost-effective methods of increasing the relevance of research to small farmers operating under heterogeneous conditions.

V. PROSPECTS FOR OVERCOMING OBSTACLES TO SMALL FARM DEVELOPMENT STRATEGIES

In this section attention is given to the prospects for overcoming the formidable obstacles to implementing small farm development strategies. It is clear from the preceding section that there is a well-nigh universal need to (1) move toward macroeconomic policies that are less damaging to agriculture and (2) to accelerate technological progress, the growth of farm output, and the expansion of employment opportunities. Political factors and a lack of consensus concerning the types of policies and programs that merit priority both represent serious constraints. There are, however, grounds for hope that those constraints can be modified and relaxed if future choices and actions can be guided by better understanding of the benefits and costs associated with alternative policies.

Section V.1

Prospects for Improving Macroeconomic Management

The neglect of agriculture in government resource allocations and price distortions that discriminate against agriculture have a generally discouraging effect on the agricultural sector. However, the polarization of agriculture leading to a bimodal pattern of development is influenced even more directly by the fact that the beneficial effects of government measures adopted to offset the adverse effects of those macropolicies are almost always concentrated on the large-scale subsector so that the prospects for increases in productivity and output by the great majority of small farmers are damaged even more.

What are the prospects for government decisions and actions to change those macroeconomic policies in ways that will create an environment more favorable to broadly based agricultural development involving a large and growing fraction of a country's farm households? One encouraging consideration is that changes in macropolicies, such as correcting an overvalued exchange rate, can rapidly improve the incentives for all producers and potential producers of export crops. A discouraging consideration is that to some considerable extent the macroeconomic policies that adversely affect broad-based agricultural development are not mistakes resulting from lack of information or faulty perceptions of the consequences of government policies. Rather such policies are adopted, or at least maintained, partly (mainly?) because they are beneficial to certain powerful group interests even though they are damaging to the broader national objectives of economic and social progress.

Clearly, it is important to recognize that the design and implementation of agricultural policies and programs are inevitably shaped by politics. Harold Lasswell's 1936 classic--Politics: Who Gets What, When, and How?--"focuses on how an elite uses its power to acquire the desirable things in a society..."[1] This "influence perspective" is unquestionably a very important dimension of politics and of the exercise of power in any society. However, to view the rulers that wield authority

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1 The quotation is from William A. Gamson, Power and Discontent, 1968, p. 9. We follow his analysis in emphasizing that there is a societal as well as a private influence perspective on the exercise of power.

authority as simply a self-serving subgroup may be as misleading as to view them simply as disinterested servants of society. That is, it is important to recognize that there is another and equally valid way of looking at power which William Gamson refers to as "the social control perspective." In this perspective the relevant question is not who gets what, when, and how but rather: "How does leadership operate to achieve societal goals most efficiently while at the same time avoiding costly side effects?" (Gamson, 1968, p. 11). In other words, the focus is not on the use of power for private purposes but on how the power of authority viewed as a system is utilized to mobilize and generate resources to attain societal goals. One implication is that a political system will be concerned with the regulation of conflict, e.g., by processing demands of various social groups and arriving at authoritative decisions that are, by and large, accepted as legitimate. This possibility derives from the fact that all systems are composed of elements with both conflicting interests and common interests, individual concerns with "how the pie is divided" and collective concerns with increasing the size of the pie.

Given our concern with issues of agricultural development, two important conclusions are suggested by those contrasting perspectives on the uses of power. On the one hand, it is apparent that policies that lead to administrative rationing of foreign exchange, subsidized credit, fertilizer or other resources will magnify the importance of the "influence perspective." In fact, the arbitrary and discretionary element in

administrative allocation of such resources or of import and other licenses encourages a concentration on "rent seeking" activity rather than on income-generating activities (Krueger, 1974). On the other hand, it seems clear that giving priority to government's catalytic or facilitating role and to improving access to public goods or quasi public goods such as education, agricultural research, and investments in infrastructure can encourage a focus on a political system's role in achieving collective goals. Development is not a zero sum game but rather a process whereby both material and human resources are enlarged, productive capacity is expanded, and per capita incomes and well-being are increased. Progress in those directions has been attained under a wide variety of political regimes when government policies and programs have enhanced the quality of human resources and supported the efforts of farmers and other producers to invest, to increase their technical and managerial skills, and to utilize their resources fully and efficiently to increase their productivity and output.

Is it realistic to expect that leaders in developing countries will give priority to policies and programs that are effective in achieving societal goals rather than respond to group interests with resulting inefficiencies? Robert Bates (1983, 1980) in particular has argued that governments prefer interventions that give officials arbitrary and discretionary power to grant or withhold subsidized credit and other scarce resources because they enhance a regime's capacity for political control. That is, the ability to grant preferential treatment

represents a valuable political resource that is used to secure the support of large and influential farmers who might otherwise provide leadership in championing rural interests against the government's support coalition comprised of the bureaucracy, industrialists, and urban workers. Clearly, a regime's leaders may well attach more importance to those political advantages associated with arbitary controls and interventions than to their adverse effects on efficiency, equity, and economic progress.

Nevertheless, there are grounds for a more optimistic view. Today as in the past there are "progress-oriented" governments in developing countries. In Meiji, Japan, a great many factors, including a broadly shared commitment to "a rich nation and a strong army," as it was expressed in a popular slogan of that era, led the country's leaders to adopt policies that were highly effective in leading to a unimodal pattern of development.

It is well to recall that when so many of the contemporary LDCs obtained their independence between 1945 and the early 1960s, a commitment to central planning and an activist role by government were generally seen as critical "for promoting economic development to eradicate poverty and for the general advancement of the popular welfare."[1] The highly protectionist

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1 The quoted phrase is from Ness and Ando (1983, p. 33). Their account of the emergence of government population policies and an "antinatalist revolution" in Asia is a useful reminder that the initial motivation for government initiatives and interventions stemmed much more from idealism and impatience for economic and social progress than from rent-seeking self-interest. Moreover, the success in reducing fertility in a number of Asian countries is only one of a number of positive results from the political commitment to national development and a growing administrative capacity to implement government programs.

Import Substitution Strategies that were widely adopted at that time were the conventional wisdom of the "development experts" of that day. It was not until the late 1950s that policymakers in Taiwan faced up to the inefficiencies resulting from excessive protection, an overvalued currency, and artificially low interest rates and shifted to policies that encouraged growth and efficiency rather than rent-seeking activities to take advantage of discretionary and arbitrary controls.

There are some indications that the very severity of the present food crisis in sub-Saharan Africa is encouraging a more realistic assessment of the feasibility as well as the desirability of alternative policies. The accumulating evidence on the poor performance of marketing boards and other parastatals appears to be leading to greater awareness of the serious problems caused by imbalance between public sector responsibilities and resources, including the critical resource of administrative capacity. Thus there is greater readiness to curtail government's direct role in agricultural production and marketing, activities that can be performed more efficiently by private firms whose actions are coordinated by price and market mechanisms and with competition providing a spur to efficiency and a curb on monopoly pricing. Fundamental to the success achieved in Japan and Taiwan was the concentration of government programs on the provision of public goods such as research, extension, and infrastructure investments. Direct government action in those areas is indispensable and powerful because it facilitates widespread increases in agricultural productivity and

output based on the decisions, knowledge, and efforts of millions of small farmers.

Section V.2

Accelerating Technological Progress, the Growth of Farm Output, and the Expansion of Employment Opportunities

Deficiencies in the level and orientation of national agricultural research programs rank among the most serious obstacles to success in achieving widespread increases in productivity among small farmers and a unimodal pattern of agricultural development capable of simultaneously increasing agricultural production and expanding opportunities for productive employment within and outside agriculture. Investments in infrastructure, especially irrigation and drainage, are also of critical importance in most LDCs for increasing farm output and expanding employment opportunities.

The prospects for creating effective national agricultural research systems depends first of all on sustained support for expanding the indigenous supply of well-trained agricultural scientists and allocating the manpower and financial resources for a critical mass of research effort directed at the major crop and livestock activities in a country's principal farming regions. Many factors will, of course, influence the ability and willingness of national governments to provide more adequate support for agricultural research. In most LDCs political leaders and policymakers have only limited appreciation of the potential returns from agricultural research. That situation has changed substantially in a number of Asian countries where the

Green Revolution resulting from the rapid spread of high-yield varieties of rice and wheat has undoubtedly been a major factor in generating greatly increased support for agricultural research. Successful research programs tend to be self-reinforcing as they build public awareness, especially among farmers, that productivity can be increased greatly by an appropriate sequence of innovations. Thus the perceptions and attitudes of political leaders and policymakers are influenced indirectly as well as by their recognition of the high returns being realized from investments in agricultural research. The changes in attitudes and performance that have occurred in India and Indonesia since the mid-1960s are striking examples.

In many other developing countries, however, the limited success of past research efforts has certainly contributed to the persisting lack of substantial and sustained support for agricultural research programs. Experience during the past two decades has led to increased recognition that the limited success of agricultural research programs has been influenced greatly by the special difficulties that arise in promoting technological progress in the heterogeneous, rainfed environments that predominate in so many of the contemporary LDCs. Farming Systems Research (FSR) has received a great deal of attention as a response to the problem of increasing the relevance of research to the needs of small farmers operating under heterogeneous conditions. Recent papers by Byerlee, Harrington, and Winkelmann (1982) and by "CIMMYT Economists" (1984) represent an important forward step in their emphasis on "on-farm research with a

farming systems perspective" rather than an attempt by formal research programs to develop and diffuse complete farming systems. The disadvantages of emphasizing rigidly defined technical packages are especially serious in heterogeneous environments. Even the effort to identify promising components for farmers to fit into their farming systems requires a focus on specific recommendation domains that are reasonably homogeneous in terms of their physical environment, major socioeconomic constraints, and the main features of the prevailing farming systems.

Given the acute scarcity of scientists with the training and capacity for the diagnostic analysis required for FSR, there appears to be an urgent need for better methods for exploiting the potential complementarities between formal experiment station research and the local knowledge of farmers and their capacity and opportunities for adaptive management. The sharpening of skills through learning by doing is part of this; but more important is the process of adaptation that occurs as farmers modify technologies as they apply them to their specific environment. A recent study by Tomich (1984) of private land reclamation in Egypt provides striking evidence of the capacity of local farmers to evolve farming systems adapted to difficult and extremely heterogeneous conditions. The relevance and economic value of formal research can be enhanced by efficient information flows that tap this on-farm experience, and the task of FSR becomes more feasible when it is recognized that many small

farmers have the capacity for the adaptive management required to modify their farming systems in response to new opportunities.

In rainfed farming there is often a need for simultaneous attention to biological and chemical innovations and appropriate mechanical innovations. Apart from areas where rainfall is very reliable and well distributed, the potential yield increases that are obtainable with the introduction of high-yield, fertilizer-responsive crop varieties is relatively limited. However, it is often feasible for small farmers in rainfed areas to increase their output by enlarging the area cultivated per worker as well as by increasing crop yields. Furthermore, it is frequently necessary in rainfed areas to supplement biological and chemical innovations with equipment and tillage innovations to improve soil and water management to realize the yield potential of improved varieties.

Tractor-based technologies are likely to appear to be especially attractive in rainfed areas because their speed and power makes them effective in achieving timeliness in carrying out farming operations. But inasmuch as those technologies represent a large and lumpy investment, they are not likely to be a feasible option for small farmers.

Historical experience and recent developments in a few LDCs suggest that wider and more efficient use of animal-powered equipment may offer a feasible option for enabling small farm units with limited cash income to augment their area under cultivation and also increase yields by improving the timeliness and precision with which plowing, harrowing, seeding, and other

operations are carried out. The price distortions which make tractors artificially cheap and the tendency to view tractors as a symbol of modernity have often diverted attention away from sustained efforts to identify and diffuse an improved and wider range of animal-drawn equipment capable of increasing the profitability of mixed farming systems combining crop cultivation with the rearing of livestock.[1] The tendency of agricultural engineers to work in isolation and to concentrate on design problems, rather than working with farmers and agronomists to identify implements that can enhance the profitability of a location-specific farming system, also appears to have contributed to the ineffectiveness of many farm equipment improvement programs.

Considerable attention has also been given to small (12-25 h.p.) tractors for small farmers. Despite the superficial attractiveness of that approach, it has not been successful. There are important economies of scale in the manufacture of internal combustion engines so the cost advantage of small tractors is not great except for power tillers (single-axle tractors). And light weight tractors encounter traction problems which limit their capacity and efficiency, although again power tillers used for puddling rice paddies are an exception. It is important to emphasize that engine-powered pumpsets for irrigation and small threshers are frequently both privately and socially profitable long before tractors. Electric motors or

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1 See McDowell and Hildebrand, 1980, for a report on a Rockefeller Foundation conference on the integration of crop and animal production on small farms.

diesel engines for pumps are especially likely to increase the opportunities for productive employment of labor by permitting increased cropping intensity. Their technical superiority over traditional technologies such as the Persian wheel is so great that they essentially represent a new technology rather than a substitute for a more labor-intensive alternative. It must be emphasized that in each case private and social profitability of these techniques depends on specific circumstances.

Emphasis has been given to the possibilities of increasing farm productivity under rainfed conditions because irrigation is of such limited importance in many of the contemporary LDCs. In some of the rainfed regions it will be technically feasible and socially profitable to create more favorable environmental conditions by major and minor irrigation projects, including gravity flow systems, tubewells, and low-lift pumps. Tillage innovations such as the ridge and furrow system and water harvesting for supplementary irrigation being studied by the Farming Systems Research Program at ICRISAT also merit attention. (See Ryan, et al., 1980.) Pakistan, India, and other countries with huge aquifers fed by melting snows in the Himalayas are exceptional, but many other areas have an unexploited potential for using groundwater resources profitably, perhaps only for supplementary irrigation. Furthermore, opportunities exist for more efficient use of water available in existing irrigation systems by reducing losses in handling water, improving the timeliness of delivery to farmers' fields, avoiding the allocation of too much water to fields near laterals and too little to

those farther away, improving on-farm management, and discouraging wasteful use of water. (See, for example, Takase and Wickham, 1978.) In many countries there is a great need for hydrological and economic research to evaluate the feasibility and social profitability of investments in irrigation.

More generally, there is an almost universal need to strengthen policy research and policy analysis to evaluate alternative options for increasing productivity and output and thereby provide a more solid basis for reaching a consensus on agricultural development priorities. An especially important and difficult challenge is to devise ways to institutionalize a capacity for economic and policy research. This is necessary to ensure that such research will receive sustained support and to enable it to have a significant impact on the policy process.

We have stressed the need to increase the effectiveness of research programs because well-adapted technical innovations can to a considerable extent be "self-spreading" as they diffuse among farmers. Nevertheless, it is essential for measures to strengthen research systems to be linked to action to increase the effectiveness of agricultural extension programs. A huge literature and a considerable body of experience have emerged in response to the ineffectiveness of those programs which, in the words of one extension specialist, "has meant that most extension field services have been a complete waste of time" (Roling, 1982, p. 106). Introduction of the Training and Visit (T and V) system promoted by Daniel Benor and the World Bank has been the most widely diffused approach to improving the effectiveness of

extension systems. Niels Roling affirms that the T and V system, by unity of command, avoidance of tasks other than extension, and systematic deployment and in-service training of field workers, "seems to go a long way to rationalize the use of existing extension resources" (p. 106). However, Roling and many others have questioned whether the "contact farmer" approach of that system is effective in achieving broad coverage of small farms and reports with approval on an attempt to use "contact groups" instead. Efforts by Roling and others to introduce a group approach for reaching small farmers in Kenya appear to have been effective.

Esman and Uphoff (1984) and many others have argued that a variety of participatory local organizations have a key role to play in "any strategy of rural development combining growth in productivity with broad distribution of benefits . . ." (p. 40). In the recent enthusiasm for participation there has been a tendency to ignore the fact that participation in local organizations represents an investment of time and effort on the part of the participants, and such investment can only be induced if the objectives, membership, and techniques for managing the organizations are such as to yield significant benefits not obtainable by less costly techniques. Because of the importance of economies of scale in constructing irrigation and drainage systems and the advantages of local participation in their design and management and in mobilizing local resources of money and labor, irrigation

associations are a type of local organization that has often been beneficial to its members.[1]

In contrast, local organizations carrying out group farming have rarely yielded net benefits. Whenever participants in an organization contribute their labor and other resources to a common productive activity, difficulties will arise in assigning, coordinating, monitoring, and legitimating individual responsibilities and rewards. Given the limited importance of economies of scale in carrying out farming operations, the costs of investing in organizations for group farming are likely to be regarded as exceeding the benefits to be derived from collective action. Cooperative organizations for agricultural processing or marketing, however, are much more likely to be perceived as worthwhile

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1 Recent experience in the Philippines is of interest in demonstrating that a government agency can promote the creation of effective local organizations to participate in the planning of small communal irrigation systems; in helping to check the quantity, quality, and prices of construction materials; and in managing the new facilities and allocating water to farmers. When the National Irrigation Administration (NIA) initiated this effort in 1976, the senior officials recognized the need to approach the new task as a learning process and established a high-level Community Irrigation Committee which worked closely with social scientists from several research institutions. A three-stage learning sequence began with an initial pilot project concentrated on a trial-and-error process of devising a workable approach that made sense to local villagers, "learning to be effective." In a second phase, "learning to be efficient," the research staff and community organizers worked with two additional pilot projects on finding ways to increase efficiency by reducing input requirements. In the third phase, "learning to expand," the new participatory approach was extended gradually throughout the country. See D. Korten, 1980; Bagadion and F. Korten, 1980; and World Bank, 1984, p. 93.

because economies of scale are important. In addition, management problems are not as difficult because, for example, payments to farmers for milk that they deliver to a cooperative creamery can be directly related to the quantity and quality of the milk delivered by each farmer. (See Box V.1 for a brief account of India's highly successful National Dairy Development Board.)

Successful implementation of programs to accelerate technological progress, the growth of farm output, and the expansion of farm and nonfarm employment opportunities will, of course, be influenced powerfully by the extent to which progress is made in improving macroeconomic management. This is most obvious in relation to the need to give a higher priority to agriculture in budget allocations for the training of high-level manpower, for agricultural research, and for investments in infrastructure and in modifying price policies that have serious disincentive effects on agricultural production. In addition, efficient management and implementation of agricultural programs are often impaired because of budget and foreign exchange crises which, for example, make it impossible for field staff to carry out their responsibilities because travel funds are suspended or vehicles are not useable owing to the unavailability of fuel and spare parts. Those problems have been especially severe in sub-Saharan Africa and receive further attention in Section VI.

It seems worthwhile to emphasize that there may be positive interactions between success in increasing the effectiveness of a country's agricultural research system and related support services and the extent to which its leaders give priority to

government's facilitating role in achieving societal goals rather than direct interventions that have adverse effects on agriculture. We have noted that governments may have a preference for interventions with a large discretionary and arbitrary element in determining directly "who gets what, when, and how" because such interventions enlarge the scope for rewarding special interest groups in exchange for their political support (or perhaps more immediate and tangible benefits for the politicians or administrators who grant the special favors). In a narrow and short-run political calculus, the tangible benefits from political patronage or rent-seeking may seem more attractive; but on occasion politicians and policymakers do play a more statesmanlike role and give greater weight to a strategic perspective that recognizes that the great majority of a country's producers and all consumers benefit from technological progress that permits widespread increases in farm productivity.

Furthermore, support for agricultural research represents a particularly appropriate form of economic and technical assistance. It has already been noted that the international network of agricultural research centers has yielded very high returns. Although they are not a substitute for national research systems, they can increase the payoff to parallel investments in strengthening national programs. The long-term nature and substantial foreign exchange costs of strengthening national research systems also underscore the important contribution of foreign aid. This applies both to the costs of overseas graduate training for agricultural scientists and the need in

many LDCs to utilize scientists from developed countries to augment the cadre of national scientists until the supply of the latter has been enlarged. Perhaps even more fundamental is the role of economic and technical assistance in strengthening the capacity of local institutions of higher learning to provide first-rate graduate degree training in the agricultural sciences and in agricultural economics and in other social science programs needed to staff research, extension, and other agricultural programs.

VI. SUMMARY AND CONCLUSIONS

The major conclusion of this paper is that small farm development strategies are feasible and have very important advantages for low-income countries where a large percentage of the population and labor force are still dependent on agriculture and the population of working age is increasing rapidly. To be sure, formidable obstacles need to be overcome to achieve success in the design and implementation of dispersal strategies capable of accelerating the growth of agricultural production and the expansion of opportunities for productive employment. However, the alternative of pursuing focus strategies leading to a bimodal (dualistic) pattern of agricultural development, also confronts serious obstacles. A subsector of large-scale farm units invariably relies on relatively capital-intensive technologies and therefore its expansion is more limited by the acute scarcity of capital and foreign exchange that characterizes a low-income developing country than the labor-using, capital-saving expansion path fostered by dispersal strategies. Thus the sectorwide expansion of agricultural production is likely to be less under a bimodal than a unimodal pattern of agricultural development; and the growth of opportunities for productive employment--farm and nonfarm--will certainly be less under a bimodal pattern of agricultural development.

The fact that there is no easy alternative to dispersal strategies leading to a unimodal pattern of agricultural does not alter the fact that it is a very difficult task for a developing country to design and implement effective dispersal strategies.

One danger, suggested by the word dispersal itself, is that resources may be spread too thinly to have a significant impact. This danger underscores the need to make hard choices about priorities and to recognize the need for time-phasing of efficient sequences of technological change. Indeed, at any point in time programs must be well focused in the sense of a realistic balance between objectives and means. The distinguishing feature of dispersal strategies is that, unlike a focus strategy, the nature of new technologies and the level of external support in money and manpower are such that they can be expanded progressively to reach a large and growing percentage of a country's small farm units, in spite of the purchasing power and other constraints which they face. In addition, it was emphasized that the pattern of rural demand for farm inputs and consumer goods associated with a unimodal pattern of agricultural development stimulates the growth of small- and medium-scale manufacturing firms using technologies that make effective use of labor and other domestic resources and minimize their use of capital and foreign exchange. And by maximizing the positive interactions between agricultural and industrial development, a unimodal pattern of agricultural development is capable of fostering more rapid growth of nonfarm output and employment as well as more widespread increases in productivity and incomes among farm households.

The experience of the three East Asian countries--Japan, Taiwan, and Korea--is especially encouraging in demonstrating the feasibility of broadly based agricultural development and the

importance of positive interactions between agricultural and rural development in fostering economic growth and rapid expansion of farm and nonfarm employment.

Experience in the People's Republic of China (PRC) differs drastically from the experience in those three East Asian countries, and it is still a low-income developing country. Nevertheless, remarkable progress has been made in eradicating acute poverty, improving the health and nutritional status of the mass of the population, including a notable reduction in infant and child mortality rates which has undoubtedly contributed to the success of more direct measures to reduce fertility and slow population growth to a rate that appears to be similar to the greatly reduced rates of natural increase in Taiwan and South Korea. In spite of the radically different ideology of China's political regime, the pattern of agricultural development appears to have been essentially unimodal in involving progessive modernization of small production units based on labor-using and capital- and land-saving technologies. A limited number of state farms and the aberration represented by the Great Leap and the attempt to make production brigades the unit of management represent qualifications to that generalization; but the adverse effects of making production brigades the accounting unit soon led to corrective action. The production teams of some 30-40 households that were the units of management until 1978 were small enough to permit reliance on labor-intensive technologies and also to curb the problems of labor-shirking and lack of initiative that characterize collective farming. However, the

recent reforms seem to be in the direction of further strengthening incentives, thus increasing the similarities between agricultural development in the PRC and the unimodal patterns of development in Japan, Taiwan, and South Korea.

Progress in most of Southeast and South Asia during the past two decades has been substantial in spite of continuing rapid growth of population and the limited scope for expanding the area under cultivation in many countries in those two subregions. South and Southeast Asia are, of course, the areas that have benefited most from the spread of the high-yield varieties of rice and wheat that have come to be known collectively as the Green Revolution. The spread of the semidwarf varieties of wheat has been largely limited to areas of controlled irrigation in northern India and Pakistan, although there has also been a rather surprising spread of the high-yield varieties in rainfed areas of northern Pakistan and Bangladesh. The impact of the high-yield varieties of rice has been wider but more uneven, reflecting the diversity of conditions under which rice is cultivated. Rainfed areas and areas of deep flooding (as in much of Bangladesh and Thailand) have benefited relatively little from the semidwarf varieties of rice, although some of the second and later generation varieties have somewhat extended the area in which modern varieties have had a significant impact.

Some of the Asian countries have also achieved considerable progress through implementing dispersal strategies related to crops other than rice or wheat. Reference was made in Section III to the impressive expansion of smallholder production of

rubber and oil palm in Malaysia. Thailand has also achieved some success with those two crops in high rainfall areas of southern Thailand while substantial production of maize and cassava for export has made a significant contribution to raising farm incomes in northern Thailand.

A highly significant positive factor in much of South and Southeast Asia has been the very considerable expansion in the supply of well-trained agricultural scientists, social scientists, and agricultural administrators and specialists. The rapid expansion of agricultural research programs since the mid-1960s would not have been possible without this augmented supply of well-trained and, increasingly, experienced scientists and administrators. The impressive development of India's agricultural universities during the 1950s and 1960s is the most notable example and one which benefited substantially from the sort of economic and technical assistance mentioned earlier, but parallel developments have occurred in many other countries in South and Southeast Asia. The role of AID in supporting much of this institution building was impressive. Programs of the Rockefeller and Ford Foundations and the more limited but strategic efforts of the Agricultural Development Council (ADC) to fund overseas training of promising agricultural economists and to provide in-country support for agricultural economics research and training also made notable contributions to this strengthening of indigenous capabilities.

Agricultural policies and programs in the countries of South and Southeast Asia have given considerable attention to small

farm development strategies, although there are significant exceptions. In India's Punjab and especially in Pakistan, the Green Revolution appears to have encouraged many large landowners to evict their tenants and to undertake direct cultivation on large operational units. This has been influenced strongly by price distortions that have artificially reduced the price of capital and foreign exchange. The inappropriately capital-intensive technologies adopted on these large farms have also been induced by the shirking and incentive problems and high costs of supervising hired labor emphasized in Section III.

In a number of countries redistributive land reform could make an important contribution to narrowing inequalities of income distribution and to facilitating a unimodal pattern of agricultural development. However, most informed observers question the political feasibility of effective implementation of land reform measures. In Asia many of the "big" landowners have holdings of 10 to 20 hectares or even much less in Bangladesh and Java. This means that the landowners opposed to redistributive land reform are numerous and politically powerful. But it also means that there are significant possibilities for increased renting of land in small parcels to be cultivated intensively by tenants. This option will become increasingly realistic as agricultural research programs continue to generate technologies based on divisible innovations that are feasible and profitable for small farm units. It would no doubt also be facilitated by government policies that recognized the practical advantages of tenancy arrangements, including share tenancy, and which focused

on realistic efforts to induce landlords to share in the cost of purchased inputs rather than a usually futile and counterproductive effort to enforce rental ceilings. Land taxes that reduced the economic rent retained by landowners could also be useful in augmenting government revenues for infrastructure investments and other development programs while reducing interfarm and interregional inequalities in income. There is considerable doubt, however, whether even a flat-rate land tax would be politically feasible, and an attempt to make the land tax progressive according to farm size would be even less feasible.

The countries of Latin America are even more diverse than the countries of South and Southeast Asia. It was emphasized in Section IV that the colonial legacy of enormous land grants and of economic and social inequality has given rise to special problems. The belief that economies of scale are important in agriculture appears to be especially pervasive in Latin America. Those with a vested interest in preferential treatment of a large-scale subsector are understandably disposed to extol the superior efficiency of large farm units. Furthermore, the most influential groups opposing the emphasis on large private farm enterprises tend to accept the Marxist view of the importance of economies of scale in agriculture and seek to promote large collective farms for that reason and because of their emphasis on the virtues of cooperativism and hostility to individualism.

These historical, attitudinal, and ideological factors have been major obstacles to land reform leading to effective implementation of small farm development strategies. The fact that

large farms in Latin America are often so very large means that landowners are few in number. Even so their economic power and links with other elite groups give them considerable political power. In addition to the general opposition and resistance of large landowners, effective implementation of land reform has also been compromised by the use in land reform legislation of the social function of landed property as a criterion for decisions about redistributing land. In general, this means that "owners who are making more productive uses of their land are less vulnerable to losing it to reform beneficiaries" (Eckstein, et al., 1978, p. 8). In practice, large farms are generally viewed as fulfilling their social function when they produce efficiently and invest in modern equipment while renting land to be cultivated intensively with labor-using, capital-saving technologies would probably be regarded as "antisocial" and increase the likelihood that an owner's land would be subject to redistribution. This is probably one of the reasons why peasants in Latin America have rarely been able to obtain access to land as tenants. In addition, the concentration of land is so great that large landowners have a great deal of monopsony power in the hiring of labor as well as monopoly power over the renting of land. It seems likely that this ability to control the market for labor as well for land may also help to explain why large landowners have been unwilling to offer peasants dependent upon them the option of becoming tenants.

It also needs to be emphasized that in a number of Latin American countries considerable structural transformation has

taken place. In Chile, Colombia, and southern Brazil only some 20 to 25 percent of the labor force is dependent on agriculture, and in Argentina and Uruguay agriculture's share is less than 15 percent. In Central America, only 29 and 33 percent of the labor force is dependent on agriculture in Costa Rica and Panama whereas agriculture's share in the total labor force in Guatemala and Honduras is 55 and 63 percent respectively. Furthermore, in countries such as Brazil and Mexico large urban populations are so dependent on the existing subsectors of large, capital-intensive, and highly commercialized farm units that a shift from bimodal to unimodal patterns of agricultural development is probably neither feasible nor desirable. In such countries the more realistic option appears to be increased emphasis on parallel strategies which give serious attention to fostering increases in productivity and incomes among the small farmers that still represent a significant fraction of their population and account for a large part of the poverty that persists in those countries. At least in Mexico, it is now recognized that increases in productivity and output among the small farmers that predominate in rainfed areas is also essential for achieving further increases in domestic production of basic grains.

In many countries of Latin America the special problems of rainfed farming and of tropical agriculture are important constraints on the implementation of small farm development strategies. Those problems are, however, even more pronounced in the countries of tropical Africa.

During the past two decades the countries of sub-Saharan Africa have emerged as being the region where the failure of food production to keep pace with the growth of population has been most conspicuous and disturbing. Although there is now understandable concern with Africa's food crisis, future prospects are even more disturbing. On the supply side, the countries of sub-Saharan Africa face a formidable and long-term problem in achieving a transition from the traditional resource-based agriculture, that has relied mainly on horizontal increases in agricultural production based on increases in the area under cultivation and in labor inputs, to a science-based agriculture in which increases in productivity and crop yields become major sources of expanded output. On the demand side, even maintaining present inadequate levels of food consumption will be difficult. Africa is the one major region in which high levels of fertility have remained virtually unchanged as mortality rates have declined. As a result, the rate of natural increase has risen steadily from an estimated 2.1 percent in 1950 to 2.7 percent in 1965 and 3.1 percent in 1980. Although death rates have declined from 29 to 18 per thousand between 1950 and 1980, the level of mortality remains well above the levels in other developing regions. This portends further increases in population growth rates unless more widespread and effective measures are undertaken to bring about a reduction in fertility. In any event, concentration of population in the age groups under 15 means that annual additions to the population and labor force in African countries will continue to increase for several decades even if early success is realized

in reducing age-specific fertility rates (World Bank, 1984, pp. 63-67).

The need to move toward macroeconomic policies that are less damaging to agriculture and to strengthen agricultural research systems applies with special force to sub-Saharan Africa. The common problem of imbalance between public sector responsibilities and the availability of resources has been compounded in the countries of sub-Saharan Africa because of the tendency for governments or parastatals to be given operational responsibility for marketing food crops, distributing inputs, and other essentially commercial activities that are especially difficult for bureaucratic organizations to manage effectively. On the other hand, administrative capacity seems to be less than in other developing regions because opportunities for formal education and for acquiring experience in administrative positions were exceptionally limited until the postindependence period which generally did not begin until the 1960s. Furthermore, the deficiencies in macroeconomic management have often given rise to budget and foreign exchange crises that paralyze effects on the implementation of agricultural development programs. Among the numerous problems that reduce administrative capacity and performance, the occurrence of severe revenue/expenditure crises (and the excessive politicization of technical functions which they induce), inability to adhere to schedules, failure to repair or maintain equipment, high rates of staff transfers and turnover, and low morale of field staff appear to have been especially damaging. (See Moris, 1983; Lele, 1975, 1979.)

Another common problem has been a tendency to respond to critical food problems by ill-advised and ill-prepared crash programs. But the establishment of state farms, for example in Nkrumah's Ghana, in Tanzania, and in Mozambique, has probably been motivated more by the Marxist faith in the importance of economies of scale in agriculture. And an expectation that it would be easier to purchase grain for urban areas from state farms than from small farmers also appears to have been a motivating factor. The resulting concentration of capital, foreign exchange, and trained manpower in subsectors of large state farms means that the great majority of the farm population is bound to be deprived of inputs and supporting services so that pessimistic views of the capacity of the small-farm sector to increase productivity, output, and sales are likely to be confirmed. The penchant for large-scale schemes has by no means been confined to countries with socialist regimes or to the post-independence period.

Agricultural development in sub-Saharan Africa is also exceptionally difficult because of the special problems of fostering increases in productivity and output under heterogeneous rainfed conditions. These include humid forest and transitional zones where soils are fragile and trypanosomiasis is a serious problem and extensive semiarid regions where rainfall is marginal and erratic. Those problems make it especially difficult to create effective national research systems. In addition, the African countries have not benefited nearly as much as Asian countries from long-term, sustained efforts by external

donors for institution building. In recent years the level of foreign aid per capita has been high in sub-Saharan Africa, but aid programs did not become substantial in the region until after donor countries, especially the U.S., had moved away from the earlier emphasis on long-range institution building efforts. An additional problem that complicates the task of creating effective national research programs derives from the small size of many of the countries of sub-Saharan Africa. This means that the tax base and supply of trained manpower for establishing effective national research systems tends to be grossly inadequate, especially in view of the wide variation in agroclimatic conditions and farming systems within countries that are very small in terms of population and GNP. These considerations point to the need for regional experiment stations serving a group of countries, particularly because similar agroclimatic conditions are often found in a number of countries whereas the diversity within individual countries is great. (These same considerations also apply to the countries of Central America.)

It is all too obvious that maintaining regional cooperation among independent countries in the support of agricultural research programs is extremely difficult. Experience with the International Agricultural Research Centers and earlier experience with regional agricultural research programs during the colonial period point to the strategic importance of foreign aid in overcoming the difficulties of negotiating cost-sharing and related arrangements.

The foregoing is just one example of the need to increase both the level and effectiveness of foreign aid programs in sub-Saharan Africa. Aid inflows increased at nearly 20 percent per year in current prices during the 1970s, but the rapid increase in the level and sources of aid has created many problems. In fact, ill-advised and poorly coordinated policies and programs of both bilateral and multilateral donor agencies appear to have contributed to the poor performance of African agriculture during the past 15-20 years (World Bank, 1981, p. 130, and 1984; Lele, 1983).

Given the magnitude of the task of expanding food production to keep pace with the growth of population and the complexity and inherent difficulty of the tasks of agricultural and rural development, it is not possible to be very optimistic about the short-run prospects for economic and social progress in today's low-income developing countries. And the immediate prospects appear to be especially bleak for the countries of tropical Africa. Although it is tempting to seek solutions through establishing large-scale modern farm enterprises or other new strategies, the nature of the problems and the lessons of past experience indicate that for the contemporary low-income countries there is no viable alternative to reliance on dispersal strategies leading to a unimodal pattern of agricultural development. In the future, as in the past, attempts to find easy and quick solutions will only result in frustration and waste of resources. Rather, there is a compelling need for persistent, sustained efforts to achieve progress in moving toward macro-

economic policies that are less damaging to the great majority of farmers and for patient but determined efforts to accelerate technological progress by strengthening national research systems. Emphasis on Farming Systems Research is certainly no panacea. Nevertheless, devising and institutionalizing techniques to exploit the potential complementarities between formal experiment station research and the local knowledge of farmers deserve special emphasis. Individual farmers' capacity for adaptive management in modifying their farming systems by incorporating innovations that are feasible and profitable given the constraints that they face appears to be the most promising option available for attaining the multiple objectives of agricultural and rural development.

Those efforts will not succeed, however, unless there is parallel attention to improvements in macroeconomic management. In addition to the need to move away from the price distortions that are so damaging to broad-based agricultural development, there is also a need to face up to the problems caused by the imbalance between public sector responsibilities and resources. This should not be viewed as a choice between competing ideologies of socialism and private enterprise but rather as a need to recognize that a society's goals can be attained by a variety of social techniques of "calculation and control." (See Johnston and Clark, 1982, chapter 5 for a fuller discussion of this viewpoint which derives from the work of R.A. Dahl and C.E. Lindblom.) Actions to make available public goods or quasi public goods such as education, agricultural research, roads and

other infrastructure, and rural health programs capable of improving the health and survival prospects for infants and small children and fostering the spread of family planning are critical to the success of agricultural and rural development programs. But successful implementation of those programs is not likely to be realized unless the scarce resource of administrative capacity is concentrated in areas in which government action is indispensable.

This means that greater reliance needs to be placed on the role of private firms and independent cooperatives or other local organizations in carrying out agricultural production and marketing. Those activities can be performed more efficiently by relying on price and market mechanisms rather than the hierarchical techniques of calculation and control on which government agencies must rely. In brief, the need is for a pragmatic, pluralistic approach. Kenya's Tea Development Authority, for example, has performed a valuable role in making investments in "tea roads" and in organizing the collection and processing of tea leaves which made it possible for some 140 thousand small-scale farmers to raise their incomes by undertaking tea production. This happened despite the long held belief that tea could only be produced efficiently by plantations. But the proliferation of crop authorities in Kenya and in many other countries performing essentially commercial functions has frequently been a costly source of inefficiency and has led to a diversion of scarce administrative capacity away from more essential tasks.

ANNEX 1

Distinguishing Between Components of Economic Efficiency: Technical Efficiency and Price Efficiency

Casual assertions about relative economic efficiency can lead to ambiguous--and incorrect--conclusions. Graphs of production processes employing two factor inputs to produce a single output are used here to clarify the separate aspects of technical efficiency and price efficiency which, together, are necessary components of economic efficiency. The distinctions that become apparent in this simple graphic analysis carry over to complex agricultural production processes.

Technical efficiency is an engineering concept. Valid comparison of technical efficiency of two producers requires that they have the same access to technical information and to input supplies. The following graphs plot technically-possible combinations of two inputs to produce a unit of output. Figures A, B, and C depict different technical relationships between inputs. In Figure A, inputs X1 and X2 can be substituted freely; consequently, only the cheaper of the two inputs will be used in this technology. The technology represented in Figure B represents the opposite extreme: substitution between X1 and X2 is impossible and the proportion of X1 and X2 employed will not be affected by price. The curves in Figure C represent two technologies with substitution possibilities characteristic of agricultural production. Smoothly-bending unit-output curves indicate diminishing marginal rates of substitution (more and more X1 must be substituted to replace X2, or vice versa). Nothing can be concluded about the technical or price efficiency of production at point 1 or 2 in Figure C because each curve represents a different technology (note: the two curves cross).

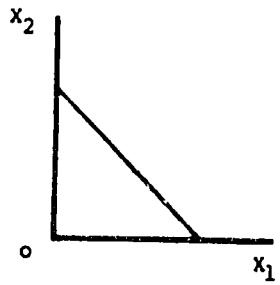


Figure A

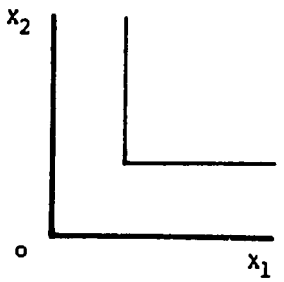


Figure B

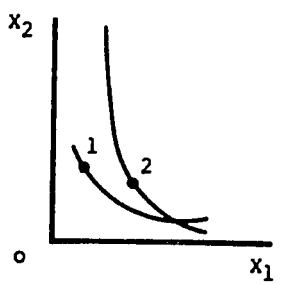


Figure C

Price efficiency refers to evaluation of economic allocation patterns. Appropriate use of this criterion depends on knowledge of the actual prices experienced by producers and on the validity of assuming all decision-makers seek to maximize profits and that they can do so instantaneously. Cost information for all inputs must be considered to assess price efficiency accurately.

Figure D contains sufficient information to establish the technical superiority of producers operating at point 3 or 4 relative to point 5. A producer at point 3 uses less of each input to produce a unit of output than a firm at point 5. A firm at point 4 uses the same amount of X1 as a firm at point 5, but less X2 is used. Points 3 and 4 are technically superior to point 5. Clearly, point 5 is technically inefficient. If no feasible points lie closer to the origin on Figure D, points 3 and 4 are both technically efficient. Figure D does not contain enough information to determine which of the two technically efficient points is economically efficient. Point 3 uses more X2 and less X1; point 4 uses more X1 and less X2.

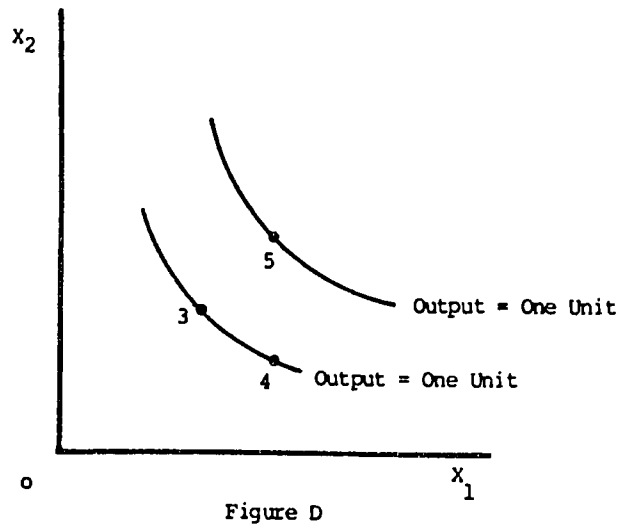


Figure D

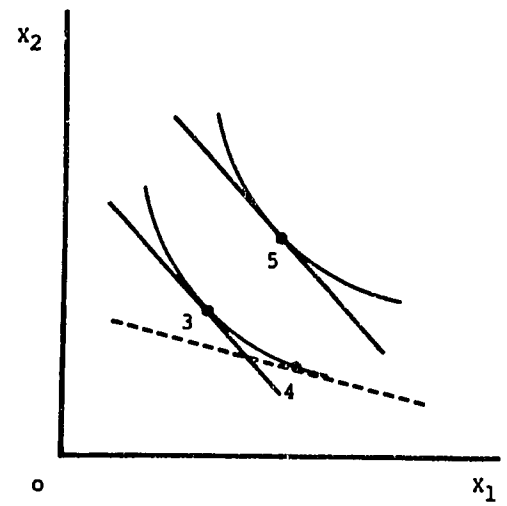


Figure E

Figure E incorporates input cost information into the technical relationships of Figure D. Assuming all producers face the prices of inputs XI and X2 indicated by the solid lines, the slope of the price lines determines price efficient input proportions in Figure E. Point 5 is price efficient, but not technically efficient. Point 4 is technically efficient, but not price efficient: it used too much XI at these prices. Only point 3 is economically efficient because it is both technically efficient and price efficient at these prices.

If prices change in Figure E such that XI becomes relatively cheaper and X2 relatively more expensive (as depicted by the broken price line), efficiency evaluations change. At these prices, point 5 is inefficient in technical and price terms, point 3 is no longer price efficient (meaning it is no longer economically efficient), and point 4 attains economic efficiency. In response to these price changes, an economically efficient producer initially operating at point 3 would shift to point 4. Ability to allocate—and reallocate—is the essence of price efficiency.

For further information, see: P.A. Yotopoulos, "Rationality Efficiency, and Organizational Behavior," Food Research Institute Studies XIII, no. 3 (1974): 263-74.

ANNEX 2

Impact of Farm Size Effects on Capital-Labor Ratios

Examination of the effect of farm size (measured in land area) on relative quantities of capital and labor inputs requires consideration of three inputs to the production process. Even a simple three-input, one-output graphic representation, such as Figure A, is difficult to interpret. In order to compare production possibilities for farms in two size categories (1 unit and 3 units of area), imagine the curves in Figure A are projected onto the plane formed by the labor-capital axes. Points A, B, C, D, E, and F are projected to points A', B', C', D', E', and F'. This "side view" representation corresponds to the two-dimensional graph in Figure B.

Figure A

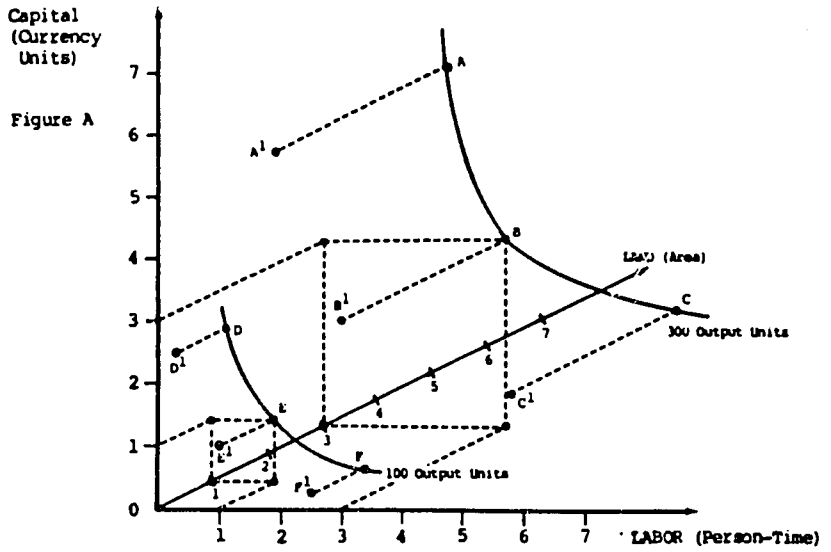
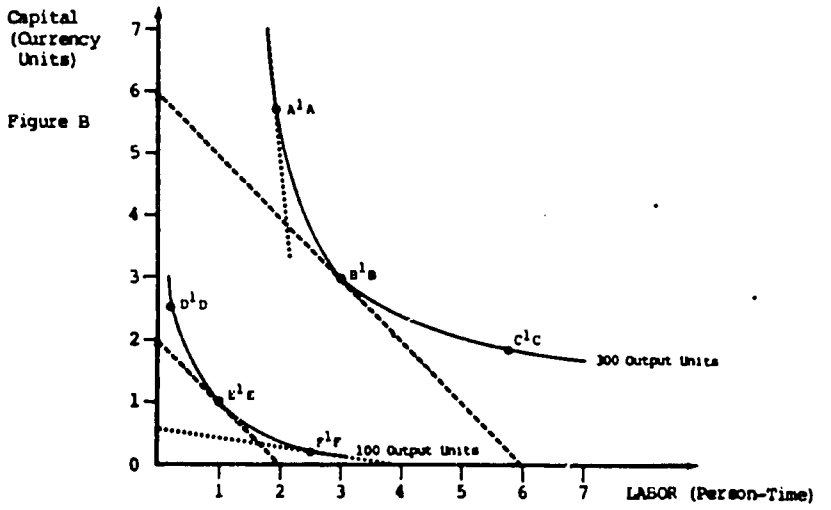


Figure B



Without farm size effects and under idealized economic conditions, prices of capital and labor are the same regardless of farm area. This situation is depicted by the two parallel price lines (with arbitrarily-chosen slope) indicated by the dashed red lines in Figure B. The economically efficient point for small farms, at E'E, and for large farms, at B'B, lead to an identical capital-labor ratio regardless of farm size.

Farm size effects mean that prices of capital and labor vary by farm size, as depicted by the solid red price lines in Figure B. Financial institutions' economies of scale in lending, the collateral value of land, and other imperfections in credit markets decrease capital costs for large farms relative to average levels. At the same, costs of transactions and monitoring increase effective cost of labor as hired labor increases relative to fixed management capacity. The steep price line tangent to point A'A represents the shift in prices experienced by large farms due to farm size effects: capital is relatively cheap and labor is relatively more expensive at the farm level. Conversely, relatively disadvantage in credit markets and greater intensity of management attention per unit area on smaller farms leads to a flatter price line tangent to the curve for small farms at point F'F. Relative to average price levels, capital is costlier and hired labor is cheaper on small farms.

Figure B illustrates that farm size effects tend to make smaller farms labor-using and capital-saving relative to large farms. Consequently, factor proportions can differ systematically by farm size even if all farms are economically efficient and if all farms have equal access to technology.

BIBLIOGRAPHICAL NOTES

For the sake of readability we have tried, with only partial success, to be sparing in the use of citations and footnotes. Sources for direct quotes and for statistical data have been given, with the exception of standard data drawn from the World Development Indicators (World Bank, 1984). Elsewhere we have borrowed ideas and information freely from many sources, the most important of which are mentioned in these bibliographical notes.

A recent essay, "The World Food Equation" by John W. Mellor and Bruce F. Johnston (1984) prepared for the Journal of Economic Literature, provides a comprehensive review of much of the relevant literature. Several books provide more comprehensive bibliographies along with a great deal of relevant evidence and analysis. Probably the most useful of these is the forthcoming book by Yujiro Hayami and Vernon Ruttan (1984), a thoroughgoing revision of their 1971 classic. We are deeply indebted to them for permitting us to make use of the manuscript version of that book which will be published in 1985 by Johns Hopkins University Press. A 1979 book by R. Albert Berry and William R. Cline, Agrarian Structure and Productivity in Developing Countries, with a valuable appendix by Surjit S. Bhalla on "Farm Size, Productivity, and Technical Change in Indian Agriculture," is the best book-length treatment of the theory and the empirical evidence on the relationship of farm size to productivity and technical change. However, the discussion of economies and diseconomies of farm size in Section III draws particularly on a 1983 paper by Hans Binswanger and Mark Rosenzweig, "The

Behavioral and Material Determinants of Production Relations in Agriculture." These issues are also examined in Redesigning Rural Development by Bruce Johnston and William C. Clark; an earlier book by Johnston and Peter Kilby, Agriculture and Structural Transformation: Economic Strategies in Late-Developing Countries, also examines these issues and in addition gives major attention to the interactions between agricultural and industrial development, drawing heavily on the historical experience of the U.S. and Japan and also on the more recent experience of Taiwan, India, and Pakistan. The recent book Food Policy Analysis by Peter Timmer, Walter Falcon, and Scott Pearson is especially valuable for its treatment of the influence of macroeconomic policies on the implementation of food and agricultural policies.

A recent book of readings edited by Carl Eicher and John Staatz (1984) contains reprints of articles and a few original essays dealing with a number of topics relevant to this paper. An overview essay by Staatz and Eicher provides a valuable review of the literature on agricultural development since 1950 and places the readings in the volume in historical perspective. Among the articles reprinted in the book, the following are especially interesting and relevant to this paper: "Food Price Policy and Income Distribution in Low-Income Countries" by John Mellor; "Price and Technology Policies" by Raj Krishna; "Choice of Technique in Rice Milling in Java" by Peter Timmer, with a comment by William Collier, et al., and a reply by Timmer; "Rural Small-Scale Industry: Empirical Evidence and Policy Issues" by

Enyinna Chuta and Carl Liedholm; "A Critique of Traditional Agricultural Credit Projects and Policies" by Dale Adams and Douglas Graham; "Benefits and Obstacles in Developing Appropriate Agricultural Technology" by Robert Evenson; "The Farming Systems Perspective and Farmer Participation in the Development of Appropriate Technology" by CIMMYT Economics Staff; and "Rural Africa: Modernization, Equity, and Long-Term Development" by Uma Lele.

Reference should also be made to the proceedings volume for the 18th International Conference of Agricultural Economists (Maunder and Ohkawa, eds., 1983). A paper by Hayami in that volume is noteworthy as an exceptionally clear and concise statement of the reasons why agricultural development based on an appropriate pattern of technological change is compatible with both the growth and equity objectives of development. Another paper in that volume by I.J. Singh contains a brief synopsis of his forthcoming book Small Farmers and the Landless in South Asia; we are grateful to him for making available a draft manuscript of that book. The book To Feed This World by Wortman and Cummings (1978) is valuable for its readable and competent treatment of the research and technical dimensions of agricultural development. A small book by Richard Harwood (1979) is particularly valuable for its treatment of the special problems of small farm development. The third edition of Readings on Taxation in Developing Countries, edited by Bird and Oldman (1975), only contains four papers on the important topic of agricultural taxation; two of them are papers by Stephen R.

Lewis which are excellent. A book of readings on agricultural credit and rural financial markets edited by Von Pischke, Adams, and Donald (1983) also merits attention. It includes extracts from a large number of important articles and a few original essays, including a very lucid and succinct note on "financial theory and economic development" by Millard Long. A collection of papers on Progress in Rural Extension and Community Development edited by Jones and Rolls (1982) is a valuable source on those topics. A 1980 volume Politics and Policy Implementation edited by Merilee Grindle is very relevant to the issues examined in this monograph. A paper by David Pyle on the problems of transition from a pilot project to an operational project and the concluding essay by Peter Cleaves merit particular attention. Finally, the recent books by Esman and Uphoff (1984) and by Leonard and Marshall, et al. (1982), are valuable sources on the role of local organizations and institutions in rural development.

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