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# The World Food Equation: Interrelations Among Development, Employment, and Food Consumption

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*This essay is a lineal descendant of our joint article (1961) on "The Role of Agriculture in Economic Development." Its distinguishing feature is its focus on factors that determine whether today's developing countries attain levels of food consumption that will ensure adequate nutrition for even the lowest deciles in their income distribution.*

*We have received particularly detailed and valuable suggestions from Brian Arthur, William Clark, Raymond Hopkins, Uma Lele, Per Pinstrup-Andersen, Vernon Ruttan, and T. N. Srinivasan. We are also grateful for suggestions from many other reviewers, some of whom we cite specifically. The contributions of Clark and Lele go well beyond their comments on successive drafts of this essay. The emphasis in Section V on a policy analysis perspective on issues of organization is a direct result of recent collaboration with Clark (Johnston and Clark 1982). Similarly, treatment of the growth linkages between agriculture and manufacturing and other nonagricultural sectors owes a great deal to Mellor's collaboration with Lele (e.g., Mellor and Lele 1973, 1975; Mellor 1976; Lele and Mellor 1981) as well as to Johnston's work with Peter Kilby (1975). Our indebtedness to Kazushi Ohkawa is indicated only in part, by references in the text to his 1972 essays: *Differential Structure and Agriculture*.*

### I. Introduction

SINCE MALTHUS published his "Essay on Population" (1798), "the world food equation" has commonly been viewed as a "race" between food and population. For Malthus, the prognosis was grim: famine, pestilence, and war would arise because "population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio." A century later, Sir William Crookes, echoing Malthus' pessimism, declared: "England and all civilized nations stand in deadly peril of not having enough to eat" and concluded that the increase in population would outstrip the expansion of production by 1931. In an essay first published in 1932, Joseph S. Davis presented "History's Answer to Sir William Crookes," emphasizing that "the wheat problem of 1931 was one of world surplus, not world shortage, actual or impending" (Davis 1939, p. 4).

Concern with world food scarcity is now focused almost entirely on the less developed countries. When Sir William Crookes gave his presidential address to the British Association for the Advancement of Science (1898), Europe and North America were still experiencing rapid population growth, and today's developing countries in Asia, Africa, and Latin America probably accounted for less than half of a world population of about 1.5 billion (Bennett 1954, p. 9). Between 1950 and 1980 world population increased from 2.5 to 4.4 billion, with the developing countries of Asia, Africa, and Latin America accounting for three-quarters of the total (World Bank 1982, pp. 110-11).

The unprecedented upsurge in population growth since the Second World War brought on a number of pessimistic predictions in the Malthusian tradition. Beginning with the "First World Food Survey," published by the United Nations' Food and Agriculture Organization (FAO)

in 1946, numerous attempts have been made to quantify the global extent of malnutrition (which, in current usage, subsumes "undernutrition"). Popular attention to the world food situation waxes and wanes with sequences of good and poor crops. Food shortages and a sharp upsurge in food prices during 1973-1974 focused attention on the views of neo-Malthusians; the excellent food crops of the early 1980s, in the context of a recession and its deflationary effects on food demand, turned attention in other directions. Nevertheless, while attentiveness to the food situation varies, the underlying problems of massive poverty and the inadequate, highly unstable food intake of large numbers of people remain.

The low-income countries in which these problems are concentrated have important structural and demographic characteristics in common. A large percentage of the population is dependent on agriculture for income and employment, and the growth rates of population and labor force are high. Those structural-demographic characteristics ensure that the decline in agriculture's share of employment will be slow and that the absolute size of the farm work force will continue to increase for many years.

For reasons summarized later, malnutrition cannot be defined with precision. There is, however, a consensus that the problem of ensuring adequate nutrition is primarily but not wholly dependent on overall food intake and that the aggregate deprivation is massive. Thus, there is a need to be concerned simultaneously with the rate of increase in food production and the means by which production is increased. Unless a country's "pattern" of agricultural development facilitates the absorption of large increases in the rural labor force into productive employment, even a large increase in food output will leave many households with inadequate access to food supplies.

The problem of expanding food supply has been made more complex and more dependent on technological progress by the encroachment of a burgeoning population on a limited land area. Rapid growth in the rural labor force in the low-income developing countries not only increases the problem of providing adequate employment, particularly in the face of diminishing scope for expanding the land area, but also reduces the possibility of solving poverty problems simply by a redistribution of assets and income flows.

Rather than as a race between food and population, the food equation is to be viewed as a dynamic balance in individual countries between food supply and demand that depends on complex relationships among a number of interacting variables. Equilibrium in this vital food equation can range from a low one of a small increase in food supplies and little purchasing power in the hands of the poor to high levels of each. The food supply-demand equation is most usefully viewed in a development context with a focus on the level and productivity of investment in food production and on the mobilization of labor in productive employment. There is a growing consensus among economists and practitioners of development who believe that a high-level equilibrium of food production and employment is not only desirable on social welfare grounds but also represents a strategy capable of achieving faster overall growth.

It is increasingly apparent that failure to choose and pursue this more nearly optimal growth strategy has led to a pessimistic view of prospects for reducing food deprivation through growth and it has turned attention, unproductively, to direct welfare-oriented approaches which seem likely to have adverse effects on efforts to achieve rapid and broadly-based development. Thus, the level at which the food supply-demand equation is balanced is largely dependent on the design and

implementation of a country's development strategy, especially as it influences the rate of expansion of employment.

Because of the dominant position of agriculture as a source of income and employment in low-income countries, we emphasize the central importance of a broad-based "unimodal" pattern of agricultural development, characterized by gradual but widespread increases in productivity by small farmers adopting innovations appropriate to their labor-abundant, capital-scarce factor proportions. This contrasts with the dualistic or "bimodal" patterns of agricultural development based on rapid modernization of a subsector of large, capital-intensive farm units, along with capital-intensive industrialization, that have been fostered in many developing countries.

Our review leads to the conclusion that reduction of malnutrition and related manifestations of poverty requires a set of interacting forces, characterized as a ring, that link nutritional need, generation of effective demand for food on the part of the poor, increased employment, a strategy of development that structures demand towards goods and services which have a high employment content, production of wage goods, and an emphasis on growth in agriculture. Moreover, the structure of rural demand generated by a unimodal pattern of agricultural development fosters more rapid growth of output and employment in manufacturing and other nonfarm sectors than development strategies characterized by pronounced dualism in capital allocations—too much to a capital-intensive industrial enclave and a subsector of large-scale farm units and too little to the overwhelming majority of small-scale farm units and to small- and medium-scale manufacturing firms.

The following section reviews past trends and current levels of food production, trade, and consumption. In Section

III attention is given to a controversial issue: the extent and seriousness of food deprivation. These sections lead to the same conclusion: the choice of development strategy is decisive in determining the level at which the food equation balances. An examination of contrasting development strategies and their implications for food production (Section IV) is followed by an exploration of the emerging consensus on the complex and difficult task of implementing a unimodal pattern of accelerated agricultural development, consistent with a high rate of growth in employment and food consumption. Interacting health-, nutrition-, and family-planning programs are viewed as important claimants of organizational and other resources. They directly increase human welfare, enhance the effectiveness of a country's labor force and restrain its rate of growth, thereby facilitating increased returns to labor and accelerated growth in incomes of the poor.

## II. *Trends in Food Production, Trade, and Consumption\**

Three dynamic features mark the contemporary global food scene. First, there is substantial variation among countries and regions in the extent to which food production growth rates differ from population growth rates. Second, a high growth rate in international food trade, comprised substantially and increasingly of exports from the most developed to the less developed countries (LDCs), is the major source of increased per capita consumption in developing countries as a group. Third, the growth in food crop production in developing countries is increasingly dependent on increased yields per unit area rather than area expansion.

\* We are particularly grateful to Leonardo Paulino, J. S. Sarma, Bruce Stone, and Nabil Khaldi of the International Food Policy Research Institute for their assistance with this section.

## *Production*

For the period 1961–1977 the growth rate of staple food production in developing countries has slightly exceeded their population growth rate—2.7 percent versus 2.6 percent (Table 1).<sup>1</sup> Thus, there has been little tendency for developing countries, as a group, to improve their inadequate food intake through their own production efforts.

However, Latin American and Asian food production growth rates have substantially exceeded those for population, by 18 and 12 percent, respectively. In sharp contrast, Sub-Saharan Africa has had a substantially faster population growth rate than Asia and a rate of food production growth that is only 58 percent of the population growth rate. Consistent with the data for regional groupings, the developing countries with slow per capita GNP growth rates, concentrated largely in Sub-Saharan Africa, have done least well in agricultural production.

Between 1961–1970 and 1971–1980, Asia and North Africa/Middle East increased their staple food production growth rate by 22 and 16 percent, respectively, while that rate declines by 50 percent in Sub-Saharan Africa and by 60 percent in Latin America (Table 2). The regions accelerating their staple food growth rates were the ones with the highest growth rates in output per hectare. Africa, with the slowest food production growth rate by far, also had the slowest growth in output per hectare. All developed-country groupings experienced substantially lower growth rates in output per

<sup>1</sup> In general we use the term "staple food" to cover crops that provide the bulk of human energy and occupy the greater proportion of cultivated land (footnote "a," Table 1). For convenience, we often shorten that to "food" and use the broader term, "agriculture," to cover the full range of land-based activities, including, for example, livestock production, beverage crops, and industrial raw materials such as cotton and jute.

TABLE 1

GROWTH RATES OF POPULATION, STAPLE FOOD PRODUCTION AND CONSUMPTION IN DEVELOPING AND DEVELOPED COUNTRIES, 1961-1977<sup>a</sup>

Country Group	Population		Production Growth Rate, 1961-1977	Consumption Growth Rate, 1961-1977 <sup>c</sup>	Production Growth Rate as % of Population Growth Rate	Consumption Growth Rate as % of Population Growth Rate	Production Growth Rate as % of Consumption Growth Rate
	Growth Rate, 1961-1977	Millions 1977					
Developing Countries <sup>b</sup>	2.6	2,092	2.7	2.9	103	111	93
By region							
Asia <sup>b</sup>	2.5	1,207	2.8	2.5	112	103	109
North Africa/ Middle East	2.6	240	2.6	3.5	97	132	74
Sub-Saharan Africa	2.7	311	1.6	2.4	58	86	67
Latin America	2.7	333	3.2	3.6	118	132	89
By GNP/Capita Growth Rate, 1966-1977							
Less than 1.0%	2.5	338	1.3	2.3	53	94	56
1.0% to 2.9%	2.5	1,019	2.9	2.6	117	105	111
3.0% to 4.9% <sup>b</sup>	2.8	279	3.0	3.3	110	120	91
5.0% and over	2.7	456	2.8	3.3	101	123	83
Developed Countries	1.0	1,139	2.6	2.3	274	237	115
EEC	0.6	269	1.8	1.1	290	178	163
East Europe and USSR	1.0	369	2.8	3.5	294	364	81
United States	1.0	217	3.0	0.9	291	91	321
Others	1.2	284	2.3	2.7	182	216	84
WORLD <sup>b</sup>	2.0	3,230	2.6	2.5	135	128	105

<sup>a</sup> As used here, "basic staple foods" include cereals, roots and tubers, pulses, groundnuts, and bananas and plantains; based on FAO data, these commodities accounted for about three-fourths of the average per capita intake in developing countries (about three-fifths, for the world as a whole) during 1973-1977.

The data are analyzed only through 1977 because the consumption data were available only through that date as of the writing of the paper. Because of interaction among supply and demand forces it is desirable to keep the same time periods for all items.

Trend growth rates are computed using the semi logarithmic trend equation fitted to the time-series data based on the least squares method.

<sup>b</sup> China, with a population of approximately one billion, is excluded from this table because the major disruptions occasioned by the Great Leap Forward in the early 1960s and the subsequent slow recovery make 1961-1977 a particularly biased period for the People's Republic of China. See footnote 2 for a discussion of trends for China.

<sup>c</sup> Because of the nature of available data sets the consumption growth rate was calculated between the 1961-1965 and 1973-1977 averages.

Sources: Calculated by Leonardo Paulino et al., International Food Policy Research Institute, from: FAO (1976b, 1980a, 1980b, 1981), International Food Policy Research Institute (1977), Paulino (forthcoming), United Nations (1979), and World Bank (1979).

TABLE 2

AVERAGE ANNUAL GROWTH RATES OF PRODUCTION, AREA HARVESTED AND OUTPUT PER HECTARE OF MAJOR FOOD CROPS IN DEVELOPING AND DEVELOPED COUNTRIES, 1961-1970 AND 1971-1980.

Country Group	Period	Production <sup>a</sup>	Average Annual Growth Rate		
			Area Harvested (Percent)	Output Per Hectare	Output Per Hectare Growth Rate as Percent of Production Growth Rate
Developing Countries <sup>b</sup>	1961-1970	2.9	1.5	1.5	52
	1971-1980	2.6	0.9	1.6	62
Asia <sup>b</sup>	1961-1970	2.7	0.8	1.9	70
	1971-1980	3.3	1.0	2.3	70
North Africa/ Middle East	1961-1970	2.5	1.2	1.2	48
	1971-1980	2.9	1.0	1.8	62
Sub-Saharan Africa	1961-1970	2.3	2.5	-0.2	-9
	1970-1980	1.2	1.1	0.1	8
Latin America	1961-1970	4.3	2.7	1.5	35
	1971-1980	1.7	0.6	1.0	59
Developed Countries	1961-1970	3.0	-0.5	3.5	117
	1971-1980	1.7	0.7	1.0	59
EEC	1961-1970	2.5	-0.5	2.9	116
	1971-1980	1.3	-0.4	1.7	131
East Europe & USSR	1961-1970	3.6	-0.8	4.4	126
	1971-1980	0.8	0.4	0.4	50
United States	1961-1970	2.6	-0.4	3.1	119
	1971-1980	2.8	1.5	1.3	46
Others	1961-1970	2.7	0.3	2.5	92
	1971-1980	1.7	1.0	0.7	41
WORLD <sup>b</sup>	1961-1970	3.0	0.5	2.4	80
	1971-1980	2.0	0.8	1.2	60

<sup>a</sup> Major food crops here exclude bananas and plantains for which estimates on area harvested are not available.

<sup>b</sup> Excluding China: See Table 1.

Source of basic data: See Table 1.

hectare in the second period. Only the United States accelerated growth of crop area enough to provide it with a faster overall food production growth rate in the second period.

### Trade

From 1961-1965 to 1973-1977, the net imports of staple foods of developing countries increased nearly fivefold, from 5 to 23 million tons per year (Table 3).<sup>2</sup>

<sup>2</sup> Data for the People's Republic of China are excluded for reasons noted in Table 1. The PRC showed no upward or downward trend in per capita food consumption for much of the period from the

Linear projections of consumption and production suggest an increase of net staple food imports to 80 million tons in

mid-fifties into the seventies. In the late seventies policy changes brought significant increase in per capita consumption, substantially through rapidly rising imports. Net food grain imports of the PRC averaged only 80,000 tons per year for the period 1950-1960, but rose to an annual average of 5.3 million tons for 1961-1976 and to 13.8 million tons in 1981. Net imports in whole grain equivalents rose from 2.8 percent of production in 1961-1976 to 5.0 percent in 1981. These data are calculated from total imports and production of foodgrains (including soybeans and tubers) in Zhongguo Guojia Tongjiju (1982, pp. 143, 384, 392) and Zhongguo Nongyebu (1981, p. 34).

TABLE 3

NET IMPORTS AND GROWTH RATES FOR IMPORTS AND EXPORTS, FOOD STAPLES, DEVELOPING COUNTRIES, 1961-1965, 1973-1977 AND PROJECTIONS<sup>a</sup> OF NET IMPORTS TO 2000

Country Group	Net Imports (Million Tons)			Annual Growth Rate Percent 1961-1965 to 1968-1973	
	1961-1965	1973-1977	2000 <sup>a</sup>	Exports	Imports
Developing Countries <sup>b</sup>	5.3	23.0	80.3	2.1	5.4
<u>By Region</u>					
Asia <sup>b</sup>	8.3	10.9	-17.9	2.5	3.5
North Africa/Middle East	3.6	10.6	57.3	-2.0	7.3
Sub-Saharan Africa	-0.9	2.9	35.5	-4.6	7.1
Latin America	-3.7	-1.4	5.4	3.6	6.9
<u>By GNP Per Capita Growth Rate</u>					
Less than 1.0%	1.6	8.0	39.5	-5.1	7.7
1.0% to 2.9%	2.8	-1.1	-48.5	1.8	3.3
3.0% to 4.9%	1.7	4.0	24.1	4.8	5.5
5.0% and over	4.7	12.1	65.2	2.9	6.6

<sup>a</sup> The projections are based on differences between extrapolations of 1961-1977 country trend production and the aggregate projections of demand for food, animal feed, and other uses; projections of demand for animal feed were assumed to follow the country growth rates of meat consumption, i.e. no change in feeding efficiency. A basis for such adaptation is being pursued at the International Food Policy Research Institute but the results are not yet available.

<sup>b</sup> Excluding the People's Republic of China: See Table 1.

Source of basic data and calculations: See Table 1.

2000 (Table 3).<sup>3</sup> Thus, net imports have risen from 1.5 percent of developing-country production in the mid-1950s to

<sup>3</sup> Past trends are a reflection of all the complex price relationships and price/nonprice distortions of the period; hence, the projections contain those same influences. Because of the complexity of these forces and their apparent stability for the large aggregations of countries and commodities presented here, such simple projections probably forecast events for the next decade or two better than would more complex approaches. Two factors cause the projections to be conservative: no accommodation is made for the rapid growth in staple food consumption per pound of livestock output; no account is taken of the potential for acceleration of per capita income growth rates and demand for food as more developing countries reach a take-off stage (although the base period is one of rapid growth in developing countries relative to historical performance). The projections are of net exports for the groupings and include projections of very large exports for a few developing countries: e.g., Argentina, Thailand, and Pakistan.

5 percent in the mid-1970s and are projected to reach 8.5 percent of production by 2000.

For each of the regional and GNP growth-rate groupings of developing countries, food imports grew more rapidly than food exports despite different records of growth in per capita food production. Sub-Saharan Africa, with the slowest growth rate for agricultural production, changed from a net exporter to a significant importer and is projected to account for a substantial share of world food imports by 2000. Production growth rates in Latin America have been relatively rapid, while the growth rate of imports has been similar to Sub-Saharan Africa and net exports have dropped by nearly two-thirds.

Concurrent with dramatic growth in

developing country imports of cereals, there has been the USSR's radical shift from a major exporter, prior to the 1960s, to a marginal exporter in the mid-1960s and to a large net importer of nearly 30 million tons of cereals in 1980.

The increased staple food exports from the developed countries has come principally from the United States, which increased its net cereal exports from an average of 37 million tons per year in 1961-1965 to 76 million tons in 1973-1977 and to 115 million tons in 1981.

The slower staple food production growth rate in the developed countries in the 1970s, compared to the 1960s; the sensitivity of short-term trends to the configuration of weather, and the small proportion of total production moved in international trade makes projections of exports from developed countries very sensitive to choice of the base period. Thus, with application of the same projection procedures used for developing countries to the food consumption and production of developed economies, only 60 percent of the exports needed to meet projected developing-country needs would be available in 2000 if 1966-1977 is used as the base period. More than twice the needed exports would be available if 1961-1977 is used. We will comment on this later.

### *Consumption*

Food consumption in developing countries grew at 111 percent of the population growth rate for the period 1961-1977 (Table 1). However, this improvement in per capita consumption came only modestly from growth in domestic production. The significant factor was rapid growth in net imports. Of the major regions, only Asia has had a faster growth rate of production than consumption. However, this was largely due to changes in India: reduced imports were associated with a stag-

nating level of per capita consumption.<sup>4</sup>

Countries with the slowest GNP growth rates, largely in Sub-Saharan Africa, also had such poor agricultural growth records that per capita consumption fell despite high growth rates in imports. Without the rapid import growth, staple food consumption in the slow per capita GNP growth rate countries would have grown at only 53 percent of the population growth rate instead of at 93 percent.

Countries with high rates of growth in agricultural production also tend to have large and increasing food imports. We will turn shortly to an explanation of this apparent paradox. The relationship is described dramatically by reference to 16 developing countries with the fastest growth rates in staple food production for 1961-1976. They more than doubled their net imports of food staples in that same period (Kenneth L. Bachman and Paulino 1979).<sup>5</sup> As a group their staple food output grew at the extraordinary pace of 3.9 percent per year. Despite the fast growth of production, the percent of consumption met from domestic production declined from 96 to 94 percent during this period. Most striking, Taiwan, which in its colonial period was a substantial net exporter of cereals to Japan, is cited as a success

<sup>4</sup> Omitting India, which accounts for nearly half of both production and consumption of basic food staples in Asia (excluding the PRC), the rest of the region had growth rates of 2.9 percent in production and 3.3 percent in consumption during the 1961-1977 period.

<sup>5</sup> Those countries are: Brazil, Colombia, El Salvador, Ghana, Iran, Ivory Coast, Malaysia, Mexico, Morocco, Pakistan, Paraguay, the Philippines, Sri Lanka, Sudan, Thailand and Tunisia. The Bachman-Paulino study was based on data available only through 1976. Presumably El Salvador and Iran would not be included as countries with rapid growth of food production if data for more recent years were considered. The inclusion of Ghana, even for 1961-1976, seems doubtful and may be a statistical illusion, reflecting reduced under-reporting of production in 1976 as compared to earlier years. Needless to say, agricultural production estimates for less developed countries must be treated with reserve, although we have confidence in the broad trends that they reveal.

story in agricultural development; but it switched from being a small net exporter in the early 1950s to importing about 60 percent of its total cereal consumption in 1980.

### *Sources of Growth*

Between the 1960s and the 1970s increased yield per unit area of land has increased from 52 percent to 62 percent its weight, relative to expanded area, in explaining increased production of staple food crops in developing countries (Table 2). It is notable that among the major developing country regions, the growth rates of yield exceed two percent only for Asia and, then, only in 1971–1980. However, more than half the previously-referred-to 16 countries with fast growth rates of staple food production (Bachman and Paulino 1979) had growth rates in yield exceeding two percent.

Front-runners in agricultural development, with highly developed systems of technology development and highly responsive agricultural economies, such as the United States, have averaged 3.1 and 1.3 percent annual rates of growth of yield per acre in the 1960s and 1970s, respectively. However, developing countries may experience faster growth rates while "catching up." The Punjab of India experienced a 13.9 percent annual growth rate of wheat output and a 10.2 percent growth rate in foodgrain production from 1967/1968 to 1971/1972 at the height of the "Green Revolution." Even this unusually rapid rate was significantly dependent on an area expansion rate of 6.9 and 2.5 percent per year for wheat and foodgrains, respectively. For the longer period, 1967/1968–1981/1982 the growth rate of Punjab foodgrain production has been a still rapid 6 percent. In a detailed analysis of components of production increase in India, Mellor estimated that a foodgrain production growth rate of 4.9 percent per year would occur for the pe-

riod 1969–1970 to 1983–1984 if each component was projected at a technologically feasible rate—roughly equal to the highest of past levels (Mellor 1976). The actual growth rate, however, has been less than three percent.

The economic transformation, involving rapid growth in nonagricultural employment, entails substantial growth in per capita food consumption (Section IV). The food production growth rate as a percent of population growth represents the extent to which domestic agriculture is able to provide that food (Table 1). Contemporary high population growth rates demand much more of agriculture than was the case for the early developers. For example, note that Japan's foodgrain production growth rate of 1.6 percent, from 1880 to 1920, was equal to 160 percent of the population growth rate. India, in its recent period of fastest growth rate of foodgrain production, achieved a rate of growth over 100 percent higher than Japan in its early phase, but the rate of growth of foodgrain production in India was only 138 percent of the population growth rate. With the burden of expanding production falling increasingly heavily on obtaining higher yield per unit area, the requirements of modern yield-increasing technology are very heavy.

### *Phases of Supply-Demand Balance*

The extraordinary quantities of grain that now move in international trade, the growing imports and declining self-sufficiency of even developing countries with high growth rates for staple food production, and the virtual monopoly of exports by high-income developed countries tell an important story about transitions in food supply-demand balances during the course of development. A simplification and division of this continuum across aggregates which are sufficiently large to roughly equalize natural resource endowments produces three phases: first, rough

parity of domestic supply and demand with real food prices constant, except for sharp year-to-year, weather-induced fluctuations; second, rapid growth in demand that generally exceeds growth in domestic supply resulting in either an upward trend in the real price of food or a rapid growth in net imports; and third, virtual cessation of demand growth while production growth is maintained at a high level with a consequent downward trend in the real price of food or rapid growth in net exports.<sup>6</sup> In each phase major structural changes in supply and demand forces are primary determinants of production and consumption. The effects of relative price changes will be quite different according to the configuration of these underlying structural forces.

In the first phase, typified by low-income countries prior to accelerating their growth rates, slow population growth is associated with slow growth in effective demand that is substantially met by applying a slowly growing labor force to an expanded land area or by raising yield per unit area. Equilibrium between supply and demand is maintained without significant trade or price change except for weather-induced fluctuations. To the extent that accelerated population growth brings diminishing returns per capita income tends to decline, illustrating the built-in balances. Of course, in this phase large foreign resource transfers (e.g. foreign aid, rising oil prices) can greatly accelerate growth in demand for food and foster large imports. In this phase, domestic agricultural production will tend to be inelastic with respect to price due to non-price constraints.

The second phase typifies developing countries as they first accelerate their growth. When per capita income growth initially accelerates the marginal propensity to expend on food for the laboring

classes is high, typically 0.7 to 0.9 (Mellor 1978). Thus, if the growth strategy provides rapid growth in employment, demand for food will grow rapidly. Subsiding population growth rates are likely to further accelerate per capita income growth. Agricultural growth itself is likely to have strong employment multipliers in other sectors (Mellor and Lele 1973; Mellor 1976; Clive Bell, Peter Hazell, and Roger Slade 1982; C. Rangarajan 1982). Because of these multipliers and other income-related forces, it becomes increasingly difficult for food supply to keep pace with demand. It is these relations that provide the powerful links between food production, an employment-oriented strategy of economic growth, and improved nutrition, discussed in Section IV.

In phase two, growing demand for livestock products becomes the major factor in growth of per capita demand for cereals (Mellor 1966/1983). Thus, the income elasticity of demand for livestock products averages about one for Asia and the Far East while that for cereals for direct human consumption averages 0.22 (FAO 1978). For the income range appropriate to Asia, projecting to 2000, the cereals elasticity declines to 0.02, while the livestock elasticity remains constant at 1.0.<sup>7</sup>

Effects of the low conversion efficiency of primary (plant) calories to secondary (livestock product) calories on food supply tend to be intensified with rising livestock production. Initially livestock are often fed mainly waste and by-product feeds, the supply of which is inelastic with respect to livestock production. As demand grows rapidly, cereals usable for direct human consumption are fed increasingly

<sup>6</sup> These relations were initially spelled out in Mellor (1966) and were later elaborated by him (1983). See, *al.*, Tsujii (1982).

<sup>7</sup> In the Soviet Union growth in consumption of meat has presumably been restrained by periodic unavailability. That, combined with a poor economic environment for food production growth and at best a modest quality of land resources, suggests that the Soviet Union is a delayed example of the Second Phase and therefore likely to remain a major importer for sometime (Padma Desai 1981; D. Gale Johnson and Karen M. Brooks 1983).

to livestock. This change in the "feeding ratio" is influenced by a shift in the composition of livestock production, most notably towards poultry, pigs, and milk, depending on the region, which reinforces the trend towards higher feeding ratios (Sarima, forthcoming). These tendencies are reflected in a 63 percent increase in use of animal feeds in the Middle East compared to a 49 percent increase in livestock production for the period 1966–1970 to 1976–1980 (Khaldi, forthcoming). The data for Taiwan are dramatic. From 1961 to 1981 meat production rose 5.2 times; cereals used for feed rose from 16,000 tons to 3.4 million tons (Taiwan 1981). In 1961 feed use of cereals was less than one percent of total use; in 1981 it was 60 percent!

Note that the income elasticity of total demand for cereals tends to fall and then rise as per capita incomes rise and livestock consumption increases. The component values are such that the weighted income elasticity of demand for cereals may well rise to a value larger than the initial value of the elasticity for food use alone.<sup>8</sup> This shifts the rate of growth in demand for cereals above the production

<sup>8</sup> The demand relationship is represented by

$$N_y = N_f B + N_n (1 - B);$$

where  $N_y$  is the income elasticity of demand for total grain;  $N_f$  is the income elasticity of demand for food;  $N_n$  is the income elasticity of derived demand for feed;  $B$  is the ratio of food use to total use. If the parameters take on the values assumed in the last three columns below (consistent with data for South Asia, in recent decennial periods) then the overall income elasticity falls then rises. The sharp fall in the proportion of cereals for food, necessary for these results, cannot be achieved only by differential elasticities. It also requires a rapid increase in the feeding ratio. Increases shown for  $B$ , as well as the other variables, are consistent with Taiwan's recent history and for other countries achieving income levels consistent with the values of  $N_f$ . (For an in-depth comparative analysis, see Sarima, forthcoming.)

$N_y$	$N_f$	$B$	$N_n$
.275	.22	.95	1.29
.264	.15	.90	1.29
.398	.10	.75	1.29
.670	.05	.50	1.29

growth rates achieved by the countries successfully accelerating food production. Given the normally low initial weight of imports in cereals consumption, net imports may then have a period of explosive growth.

Given the diminishing returns to limited land area, plus the great difficulty and lack of experience with increasing the yield per unit of land by more than two percent per year, we can expect this phase to be one of rising real prices or rising imports of food. Even for countries with substantial areas of unexploited land, expansion of output in pace with demand is likely to be difficult because of deficiencies in their physical and institutional infrastructure, as discussed in Section V.

In the third phase the marginal propensity to spend on food (measured at the farm) eventually declines to near zero in accordance with Engel's Law. The institutions that support a substantial rate of food production growth are likely to be in place so that food supply shifts more rapidly than demand. Stocks or exports constantly increase or food prices decline drastically. At this stage the relative size of the agricultural sector declines sharply, rural-urban income disparities are substantial, and income transfers, to redress those disparities, become likely. Developed countries have usually carried out such income transfer through higher prices that provide additional incentives to increase production.

This delineation of the changing structural relations of production and consumption helps explain the contrasting elements of the global food scene at a single point in time as well as how it will evolve over time. Clearly, within these broad tendencies factor endowments affect the food supply-demand balances in any given phase of development. For example, Thailand may export food throughout its development and western Europe may generate smaller exports later in its development than North America.

Similarly, agricultural price policy may change the levels of production and consumption within the context of changing structural relations. It is widely believed that public policy manipulation of foreign exchange rates and input and output prices has caused relative food prices in developing countries to be much lower than in developed countries (e.g., Theodore W. Schultz 1978). This is difficult to demonstrate conclusively because comparing commodities across countries presents a problem. W. L. Petersen (1979) is an example of the heroic assumptions required in such analyses.

It is generally agreed that in developing countries, over the short and medium term, aggregate food supply tends to be highly inelastic with respect to price—on the order of .1 to .2 (e.g., Robert Herdt 1970). Differences in interpretation arise as the adjustment period is extended. Those attempting to measure very long-run response to price through cross-section analysis, using country observations from very different levels of development, tend to argue that the whole set of policy differences between developed and less developed countries are induced by relative price differences that are themselves a matter of public policy (Petersen 1979; Yujiro Hayami and Vernon W. Ruttan 1971). However, it is probably more useful to separate public policies and macrorelationships which may change independently of price, even though price changes may also induce changes in those policies and relationships. Thus we discuss (Part V) acceleration of growth rates in staple food production as basically a function of complex institutional changes needed to accelerate the generation and adoption of appropriate technology. Within that slowly changing context, price policy has an important but subsidiary role.<sup>9</sup>

<sup>9</sup> Lele (1977) discusses the institutional complexities and the need for an interventionist policy for agricultural prices in the context of technological

### *Global Prospects*

The preceding analysis defines long-term structural processes such that the developed countries will tend to generate a faster shift of food supply than demand, and conversely for developing countries. These forces seem unlikely, at least in aggregate, to become spent during the next few decades. In that context three questions need particular attention.

First, will the pace of development in the developing countries be maintained? By past standards, the pace was unusually rapid in the 1960s and 1970s. If that growth is closely linked to the growth rate in the developed countries, as argued and illustrated in several World Bank reports (e.g., 1983), and if the growth of developed countries slows as they further mature, then one can expect slower growth in developing countries and, hence, in their imports of staple foods. On the other hand, if, as W. Arthur Lewis (1980) argues, intradeveloping country trade, and technological and organizational improvements can proceed rapidly, then further increase in the aggregate growth rate of developing countries can still occur and thereby further accelerate growth in food imports.

Second, will the developed countries food exports continue to grow rapidly? The rate of increase in yields clearly slowed in the 1970s and, except for the United States, so did production (Table 2). However, large future yield increases from the "new biology" of genetic engineering are plausible (L. W. Shemilt 1983). The United States has large areas of land that could come into production with, at most, a modest increase in real prices (Don Paarlberg 1982). It is also argued that aggregate staple food supply elasticities in the United States are between 1 and 2 (Luther Tweeten and C. Leroy Quance

change in agriculture as an antidote to a simple "get your prices right" nostrum.

1969; Zvi Griliches 1959). And, Koester (1982) projects that European Community net exports of cereals will rise from 3 million tons in 1980 to 25 million tons in 1990 if current policies are unchanged. And, as argued above, it is by no means certain that even substantial price changes will substantially reduce production growth rates from present levels.

Third, will Africa continue to have an extraordinarily low growth rate in food production and rapid growth in staple food imports financed largely by oil revenues or foreign aid? Given that accelerating African food production growth rates is bound to be a lengthy process (Lele 1975, 1979, 1983) and real oil price increases have abated, a growth in imports depends, in the next decade, substantially on the political context of foreign assistance to Africa. In the past, rapid increase in foreign aid has accompanied African food difficulties.

History is unlikely to give a direct answer to these questions. Data for the past 125 years show no trend in real maize prices, although wheat prices have declined closer to parity with maize during that period (Michael V. Martin and Ray E. Brokken 1983).<sup>10</sup> Except for the unusually stable conditions in the 1950s and 1960s, real cereal prices have fluctuated 50 percent and more at least once every half-dozen years throughout the period. However, there have been intermediate time-segments of 10, 25, and 30 years when prices trended strongly downward and others of 15 and 25 years when they trended upward. Malthus (and, of course, Ricardo) were clearly writing when Europe was well into a phase of demand out-running supply. Sir William Crookes was rather prescient since he wrote between long periods of declining and rising real cereal prices. Joseph Davis wrote at the

end of a 10-year period of declining cereal prices. The configuration of supply and demand forces differed substantially during these successive periods of rising and falling real prices (Willard Cochrane 1979). The current period is also unusual with, on the one hand, unprecedentedly large populations moving into the phase of very rapid growth in demand for food; and, an unprecedentedly large portion of the world in the late phase of little growth in demand and high, institutionalized rates of supply growth. The implicit and yet inconclusive judgment from the preceding analysis is that in developing countries demand will continue to shift more rapidly than supply and that exports from developed countries will meet this demand with at most modest increases in real food prices.

While the evidence is inconclusive about the intermediate term trend in the real price of staple foods, it is much clearer on variability in prices. In the 1950s and 1960s the United States chose to maintain large stocks of staple foods, holding world food prices unusually stable. The United States is no longer willing to do so. In the meantime, the very processes of application of the biological sciences, that accelerate the growth rates in yield, seem associated with increased variation relative to the level of production.<sup>11</sup>

The demand of very low income people for staple foods is quite elastic with respect to price, due to their high-budget-share of food. Hence, food supply changes impose the bulk of adjustment on the poor, with consequent great privation (Mellor 1978). Programs of food subsidies and employment guarantees or flexible public works programs play an increasing role

<sup>10</sup> Severe difficulty arises with the deflator for the early part of the period, when cereals were a major component of consumption and labor a major component of production cost.

<sup>11</sup> Shakuntla Mehra (1981) and Hazell (1982) have done careful analyses of India, and Hazell's forthcoming work on the U.S. demonstrates this relation in countries accounting for the bulk of trade in staple foods. Although explanation may be multiple and complex, narrowing of the genetic base of crop varieties grown over large areas is likely an important explanation.

in protecting low-income consumers from these fluctuations (Section III). At the international level, the IMF cereal facility can finance expanded food imports to alleviate a short-term deficit.<sup>12</sup> Over the very long term, as livestock consumption continues to grow rapidly, and as rising incomes of the poor lower their demand elasticity for staple foods below those of higher income consumers of livestock products, fluctuations in livestock numbers and production can become a major device for absorbing fluctuations in grain supplies.

In the meantime, fluctuations in welfare of the poor are immense. The proportion of the rural population in India which is below the poverty line, using Ahluwalia's poverty index, has fluctuated repeatedly over the wide range of 40 to 60 percent—largely due to the effects of changing agricultural production and prices (Mellor and Desai, forthcoming). Such fluctuations involve major changes in the nutritional status of the rural population. The next Section analyzes those issues.

### III. *Nutritional Implications of Food Supply—Demand Balances\**

Food ranks at the top of the hierarchy of human needs, while the concept of diminishing marginal utility of income af-

firms the view that redistribution of income in favor of the poor is just. The importance of food arises not only from the priority given to it in the expenditure patterns of the poor, but also from the importance of food to health, activity, and dignity. Thus the discussion of income distribution, poverty, food intake, and nutrition tend to be inseparable until food needs are met. While relative poverty may be the relevant concept in advanced countries, the discussion of low-income countries has focused substantially on absolute poverty, often related to a nutritional base. This relationship probably derives from the importance of nutrition to human welfare and from an expectation that nutritional science provides some clear absolutes for measurement. In fact, defining nutritional requirements is inevitably imprecise.

#### *Nutrition: I Requirements and the Extent of Malnutrition*

FAO has periodically presented calculations of per capita food availability derived from food balance sheets, expressed as a percentage of estimated energy requirements. According to those estimates, the nutritional situation in the developing countries does not appear to have changed significantly since 1961 when the average per capita availability of food provided 2130 calories, or 93 percent of defined requirements, compared to 2950 calories, 115 percent of defined requirements, for developed market economies (FAO 1976a, p. 76; FAO 1982, p. 52). Estimates of this nature are, of course, only rough indicators. There are serious deficiencies in the underlying estimates of food production and utilization. The nutritional implications of national averages are highly uncertain because of the large variation in food consumption levels among households and individuals within a country. And "requirements" for energy

<sup>12</sup> Alberto Valdes (1981) published a wide-ranging treatment of food security issues at the national and international levels. For a discussion of the forces leading to the IMF Cereal Facility, see Richard H. Adams, Jr. (1983).

\* We have drawn heavily on a background paper, "Nutrition as a Basic Need," prepared for the World Bank (Doris Howes Calloway and Christina Wood 1978). We are deeply indebted to Doris Howes Calloway for a critical reading and constructive comments on earlier drafts of this section. Also, we are particularly indebted to Reynaldo Martorell. Comments by Guillermo Arroyave, George Beaton, Per Pinstrup-Andersen, Shubh Kumar, Eileen Kennedy, Thomas T. Poleman, and T. N. Srinivasan have also been helpful.

and other nutrients cannot be defined with precision for reasons that are examined shortly. Nevertheless, the broad picture is clear and is consistent with the review of trends in food production and trade in the preceding section. Even in terms of national averages, food consumption has remained marginal in much of Asia and Africa.

Recent estimates by FAO and the World Bank have attempted to take account of the variation in levels of food consumption within countries that is associated with different levels of income. According to FAO estimates in the *Fourth World Food Survey* (1977), the number of persons in developing countries consuming less than a "critical minimum energy intake" increased from 400 million in 1969-1971 to over 450 million during 1972-1974.<sup>13</sup> In a 1976 World Bank monograph, Shlomo Reutlinger and Marcelo Selowsky (1976) estimate that 1.1 billion persons had "calorie deficient" diets in the mid-1960s.<sup>14</sup>

It is disconcerting to find such huge discrepancies between estimates of the global extent of malnutrition.<sup>15</sup> Although the statistical techniques used by FAO and by Reutlinger and Selowsky were different, a major reason for the discrepancy is that the FAO approach was related to estimates of the "critical minimum energy intake" for survival whereas Reutlinger and Selowsky used a requirement concept

relevant to "moderately active" individuals. But how significant are these attempts to quantify the global extent of malnutrition?

It seems to us that such worldwide assessments are not very important or useful beyond emphasizing that malnutrition, however defined, is a huge and pervasive problem in less developed countries. Most nutritional scientists familiar with the situation in the LDCs would tend to agree with Calloway's qualitative assessment that "food deprivation, resulting in an insufficient intake of energy, is the most pervasive among the constellation of poverty-related problems in the world today" (Calloway and Wood 1978).

There are three fundamental difficulties in assessing nutritional status. The first problem is that nutritional status is a *continuum* so that it is extremely difficult, if not impossible, to define "minimum requirements" with precision, and yet the desire to define absolute poverty lines for public policy purposes urges a drawing up of specific requirements. Energy requirements for adults, for example, depend not only on sex, body size, and age but also on the level of activity. Hence, an individual's energy requirement depends on the level of activity that is "necessary" or "desirable." Second, there is considerable biological variability that gives rise to different nutritional requirements among individuals of the same size and other measurable characteristics. Requirements may also be increased by infectious or parasitic diseases. Third, energy and other nutritional requirements for an individual are often conditioned significantly by past food intake that has restricted growth and ultimate body size. This last factor means that the low levels of food intake characteristic of the poor in low-income countries tend to be correlated to a considerable extent with lower requirement levels unless the effect of body size is offset by a higher level of activity because members

<sup>13</sup> This represents a slight increase from 24 to 25 percent of the LDC population; however 1972-1974 "includes years when food production fell in many countries due to adverse climatic conditions" (FAO 1977, p. 53).

<sup>14</sup> Poleman (1981) provides a useful summary and critique of the more important attempts at global assessments of nutritional status. See also P. V. Sukhatme (1977) and Srinivasan (1981).

<sup>15</sup> Malnutrition is a broad term, defined as an impairment of the state of health due to nutritional causes (Sheldon Margen 1978, p. 103). It would include such conditions as anemnia, rickets, and goiter as well as those due to general lack of food and energy. The latter are designated more precisely as "undernutrition."

of poor households are obliged to work harder or longer.

Although human beings have a considerable capacity to adapt to substandard levels of nutrient intake, this entails a cost to the individual and to society (C. Gopalan 1978).<sup>16</sup> Children have the greatest potential for adapting to restricted food intake because, in addition to restricting their level of activity, they adjust through a slower rate of growth and a reduction in the body size attained. Martorell (forthcoming) has presented comparative figures on the heights of seven-year-old children from high and low socioeconomic groups in Brazil, Costa Rica, Guatemala, Haiti, Jamaica, Nigeria, India, and Hong Kong. The intercountry differences among children of high economic status are small. Only the children from Hong Kong are more than about 2 centimeters shorter than the tallest group of children from other high socioeconomic groups. The differences between low and high socioeconomic groups are much larger. Martorell offers persuasive evidence that environmental factors are far more important than genetic factors in accounting for most of the observed differences in body size within and among countries.

### *The Distinctive Nutritional Problems of Small Children*

The adjustment of children to a slower growth trajectory and a smaller attained size may or may not have serious conse-

<sup>16</sup> A severe but carefully controlled reduction of energy intake from over 3,000 calories to a semistarvation diet of roughly 1,550 calories apparently did not result in long-run damage to healthy adults in a sheltered environment. Severe consequences and eventually death would have resulted if the semistarvation diet had been continued much longer than the experiment's six-month period. The young men in the experiment lost, on average, about 24 percent of their body weight and experienced physiological symptoms such as anemia, edema, and slowed heart-beat. In addition, they reduced their level of activity (except for certain prescribed tasks), tired easily, and showed apathy, a lack of endurance, and increased irritability (Ancel B. Keys et al. 1950).

quences, depending mainly on the severity and timing of food deprivation and on sanitation and related environmental factors.<sup>17</sup> Smaller body size clearly reduces food requirements for adults. Requirement estimates for children usually allow for the possibility of catch-up growth but, in fact, the potential for catch-up growth seems to be somewhat limited (Martorell et al. 1979, p. 388). The evidence is convincing that the malnutrition so common among infants and small children in developing countries often has serious adverse consequences for both physical and cognitive development and is a major cause of infant and child mortality.<sup>18</sup> In contrast, it seems unlikely that the smaller size of school children and adults in Japan, before

<sup>17</sup> David Seckler (1980) has stressed the proposition that people can be "small but healthy." And he asserts that truly malnourished individuals in India probably account for 10 to 20 percent of the population, as suggested by weight-for-height data, rather than the 40 to 50 percent figures derived from weight-for-age measurements. A recent study of nutrition in rural India accepts Seckler's argument in emphasizing that "safe drinking water, sanitary living conditions, and personal hygiene can be more important in ensuring good health than a greater weight-for-age" (J. G. Ryan et al. 1983, p. 59). However, most nutritionists regard both height-for-age (stunting, which reflects past history of food intake and other conditioning experiences) and weight-for-height (wasting, reflecting currently inadequate intake) as significant indicators of malnutrition. As noted in footnote 18, restricted activity may cause developmental lags in children even in the absence of visible stunting.

<sup>18</sup> According to a large-scale investigation of mortality in children, carried out under the auspices of the Pan American Health Organization, nutritional deficiency was the underlying or associated cause of death in 52 percent of 33,826 deaths among children under five years of age (Ruth Puffer and Carlos Serano 1973). Arrested growth in small children is one of the most significant indicators that a child is "at risk" of impaired physical and cognitive development. Physiological impacts on mental development probably only occur with severe malnutrition at a very early age. But adverse behavioral consequences—restricted activity, apathy, and poor interaction with parents and others—may impair cognitive development even with mild or moderate malnutrition occurring between one and five years of age (Josef Brozek 1982; Ernesto Pollitt 1982). Nutritional deprivation of the unborn child is also a

as compared to after World War II, resulted in serious functional consequences. Because of fairly good hygiene and sanitation the slower growth trajectory in the earlier period probably was not associated with the extremely high morbidity characteristic of so many children in low-income countries today, and the almost universal consumption of *miso*, a fermented soy product, and widespread consumption of small but nutritionally significant quantities of fish enhanced the quality of the Japanese diet.

It is important to emphasize that malnutrition among infants, small children, pregnant, and lactating women represents a distinctive set of problems. Those groups are exceptionally vulnerable because of the special nutritional requirements for growth, fetal development, and lactation. In addition, excessively high rates of mortality and morbidity among infants and small children are usually related to interactions between food deprivation and infection; frequent episodes of illness reduce food intake and inadequate and inappropriate food intake increases the duration, severity, and case-fatality of infection (Rajesh K. Chandra 1982; Martorell 1980). Although increasing the availability of food at the household level facilitates efforts to improve the nutritional status of these particularly vulnerable groups, there is also a need for social service programs that include a judicious mix of hygiene and nutrition education, immunization programs, environmental sanitation, a safe and more adequate water supply, and selected promotional activities related to oral rehydration therapy and family planning. The effectiveness of such programs depends on achieving a broad coverage of the rural population. This means that difficult problems of orga-

nizational design and implementation must be overcome. Section V suggests programs which may do so at a cost that even low-income countries can afford.

#### *Energy-Protein Malnutrition and the Benefits of Balancing Food Supply and Demand at "High" Levels*

In the 1960s and early 1970s a "protein gap" was commonly regarded as the major nutritional problem in less developed countries. The current consensus among nutritionists is that energy-protein malnutrition is the major problem. It is emphasized that nutritional deficiencies, including protein malnutrition, "are the result of inadequate intake of *food*, being thus unavoidably associated with inadequate intakes of energy" (FAO/WHO 1976, p. 33).<sup>19</sup> Because most foods, and more especially *diets*, provide a spectrum of nutrients, inadequate intake of food generally means a lack of some essential vitamins or minerals. In the case of protein the connection is more direct: if energy intake is inadequate, a part of the dietary protein will be "burned" for energy and therefore will not be available to perform its distinctive functions in supporting growth and tissue repair (FAO/WHO 1973).

The emphasis on a protein gap in the early 1970s coincided with an explosion of interest in the "nutrition factor" (Alan Berg 1973). During that same period there was also a burst of enthusiasm for "nutrition planning" based on "the working premise . . . that a few resources plus good planning and programming inputs"

<sup>19</sup> Diets that include large quantities of cassava or bananas/plantains, as in parts of tropical Africa, may be an exception because the quantity and quality of their protein is exceptionally poor. In addition, the protein requirements of infants and small children, per kilogram of body weight, are exceptionally high in terms of quantity and quality. Moreover, they often have difficulty ingesting sufficient energy and protein because of the bulkiness of starchy foods that dominate typical weaning diets.

critical problem because low-birthweight babies have especially poor survival prospects under the conditions prevailing in most developing countries (Martorell 1979).

could have a very significant impact on malnutrition (John Osgood Field 1977, p. 238; Johnston 1982). The assumption was that this new approach to nutrition planning would be far more powerful than earlier approaches such as the "applied nutrition programs" that had concentrated on nutrition education, better child feeding practices using locally prepared weaning foods, and home production of leafy green and yellow vegetables and fruits rich in vitamins and minerals. Once it is recognized that the fundamental nutrition problem is inadequate food intake, it should be obvious that there are no simple, low cost solutions.<sup>20</sup>

It is noteworthy that in Taiwan the dietary availability of food energy increased from about 2,300 to 2,700 calories per person, per day between 1953 and 1970 (C. H. Chiu 1976). This was a period in which Taiwan was achieving fuller as well as more efficient utilization of its labor force, especially through reducing underemployment in agriculture. This increase of 400 calories in total energy availability represented nearly a doubling in energy available for activity, since the energy cost of maintenance would have remained unchanged.<sup>21</sup> Improvement in the quality of the diet has been even more pro-

nounced. Increased per capita consumption of meat and other livestock products and of fruits and vegetables has no doubt been mainly a response to food preferences as the purchasing power constraint was relaxed. These changes have, however, undoubtedly yielded nutritional benefits as well as increased palatability. Higher consumption of fruits and vegetables has meant a more generous intake of vitamins A and C, calcium, and other vitamins and minerals. Livestock products, especially eggs and milk, contain high-quality protein and tend to supplement the amino acids available in cereal proteins even more effectively than beans and other legumes. The high prevalence of iron deficiency anemia in developing countries is due mainly to poor absorption of iron from cereals and beans, but when they are eaten with even very small quantities of meat their iron is much more available.

The great importance and the massive quantities of food required to meet the broadly defined nutritional needs defined above is reflected in individual behavior by the high (0.5 to 0.9) marginal propensities to spend on food, demonstrated by very large numbers of people in developing countries (e.g., FAO 1977; Mellor 1978; Cheryl Williamson Gray 1982). To meet such large increases in food supply and in purchasing power of the poor seems achievable only in the context of a broad-based strategy of development—a complex task to which we now turn.<sup>22</sup>

<sup>20</sup> There are a few instances in which that "working premise" is valid. There are still regions, for example, where goiter is a serious problem, and allocating "a few resources" and providing the good programming required to ensure that people in those regions use iodized salt can prevent goiter at remarkably low cost. There are also many areas where deficiencies of vitamin A or iron are a major problem, and specific nutrition interventions to eliminate those deficiencies may have a very favorable benefit-cost ratio. See George B. Briggs and Calloway (1979) for information and references on vitamin A, iron, and iodine deficiencies. On the issue of food fortification, see the contributions by Stanley N. Gerstoft, F. E. Viteri, Guillermo Arroyave et al. in Nevin S. Scrimshaw and Mitchell B. Wallerstein (1982).

<sup>21</sup> See FAO/WHO (1973, pp. 37-38) for a general discussion of maintenance requirements and energy available for work and other activities. The statement in the text that the change in total energy availability in Taiwan represented a virtual doubling

in the energy available for activity is a conservative estimate by Doris Howes Calloway (personal communication, June 1983).

<sup>22</sup> In the context of development strategies that provide slow growth in food supplies and employment there are substantial political and humanitarian pressures for a more direct attack on poverty. Narrowly targeted approaches are generally not successful; hence, the widespread use of broad food subsidies and rural employment schemes. The effectiveness of such programs in improving incomes and nutritional status of large numbers of the poor as well as the high costs in public revenues is well dem-

#### IV. *Development Strategy, Employment, and Food*

"That it is possible for a 'developing country,' by choice of techniques that are too capital-intensive, to expand employment in its modern sector less rapidly than it might have done is nowadays familiar" (John Hicks 1977, p. 19, reprinting his Nobel lecture). The passage of an additional decade has certainly made that observation more familiar; less familiar are the causes, the means of rectification, and their intimate relation to the interaction of development strategy, employment, and food.

The combination of rapid population growth in the dominant rural sector, a small initial capital stock, and highly capital-intensive growth in the "modern" sector fosters a dualism that provides not only slower rates of capital formation and employment, as deduced by Hicks, but concomitantly causes lower growth in effective demand for food and poorer performance in agriculture. This lessens the domestic supply of food and causes a poorer export performance that reduces the capability to finance food imports. Thus the food equation balances at low levels of food production, employment, in-

come of the poor, effective demand for food, food intake, and nutrition.

It is the high rates of population growth that add to a large stock of agricultural labor used at very low average and marginal productivities which make the labor absorption problem much more difficult for contemporary developing countries than for their predecessors. The problem is exacerbated by a depleted land frontier. In this context, agriculture can play a critical role in restraining the growth in capital intensity in the industrial sector. It provides wage goods essential to mobilization of labor and facilitates a level and structure of demand consistent with appropriately labor-intensive techniques of production. These, in turn, facilitate increased exports. The advantage from applying modern agricultural science can offset other disadvantages faced by contemporary developing countries. To reap this advantage, concentration of capital in a capital-intensive industrial sector must not deprive agriculture of the capital essential to use the technology potentially available.<sup>23</sup>

Given the global food prospects presented in Section II and in the context of an economy open in every respect except for massive migration of labor, the operative constraint to balancing the food equation at a high level is rapid growth in employment and purchasing power of the poor. We will first discuss this constraint and then return to the role of

onstrated (Raisuddin Ahmed 1979; P. S. George 1979; Kumar 1979; James D. Cavan and Indrani Sri Chandrasekera 1979). Where alternative use of these resources is not for growth in agricultural production and employment, food subsidies may play an essential political stabilizing role while an effective growth strategy gets underway. In these contexts food aid may play an effective supportive role in raising food consumption without depressing producer incentives (Joachim von Braun 1983). The complex question of food aid in this context is discussed by Paul S. Iserman and Hans W. Singer (1977). The widespread use of food subsidies, their high proportions in national budgets, and the large size of food aid make these important issues of national nutrition, income distribution, and fiscal policy and also in foreign assistance allocation. Johnston and Clark (1982, pp. 258-65) stress the opportunity cost of subsidies and other short-term welfare measures in diverting resources and attention away from measures to expand employment opportunities and to strengthen social services. See also Srinivasan (1977).

<sup>23</sup> These relations, including the dualism in investment, the relation of agriculture to labor intensity of nonagricultural production, the implications to trade, the policies required for a less dualistic approach, the impact on welfare and the political implications of the alternative strategies are spelled out in detail by Mellor (1976) and are illustrated with a wealth of data available for India and probably not available for any other developing country. New cost-reducing technology bringing changes in purchased input and managerial requirements, may spread unevenly with important production and income distribution effects. For extensive treatment of these relationships see Mellor (1978), Singh (1983), and Mellor and Desai (forthcoming).

domestic agricultural production growth.

Recognition of the immensity of the employment problem has probably most discouraged the expectation that the effective demand-employment side of the food equation can be brought into balance through success on the agricultural production front. While East Asia provides the best documentation of such success, perhaps more convincing, because of the wide range of circumstances, are the examples of the 16 developing countries cited in Section II. They achieved the highest rates of growth among developing countries in staple food production and yet they still faced growth in effective demand for food sufficient to require a concurrent, near doubling of food and feed imports. As we shall see later, this must have been achieved through high rates of growth of employment.

#### *Structural and Demographic Characteristics: The Farm Labor Force*

In the course of development the occupational structure shifts from predominantly agricultural to predominantly non-agricultural. Eventually the absolute size of the agricultural labor force declines. In early stages of development the transformation proceeds slowly because of high population growth rates and the initially dominant weight of the agricultural sector.<sup>24</sup> The supply of labor to non-agri-

cultural occupations is highly elastic; optimal choice of techniques will be highly labor intensive for a considerable period of time. We note below the restraining effect on employment growth of an inelastic supply of wage goods (food).

For Japan, the population growth rate was 1.2 percent for the period 1872-1942. In contemporary Asia, population growth rates are much higher, even though they are now trending downward. For the period 1980-2000 India's labor force is expected to grow at 2.0 percent per year; China's at 1.4 percent. But, for developing countries as a group, labor force growth is expected to rise at a 2.7 percent rate and the projected rate for the middle income subset is 2.6 percent (World Bank 1982). In Africa the rate of population growth is still steadily increasing in a progression from 2.1 percent in 1950-1955 to 2.8 percent in 1975-1977 (Dudley Kirk 1971, p. 392, from U.S. Bureau of Census).

In India, a 66 percent increase in the number of farm households between 1953-1954 and 1971-1972 was accompanied by an increase in the cultivated area of only 2 percent. As a result, the number of landless or nearly landless households (less than one acre) increased from 15.4 to 35.6 million and the average size of a farm holding declined from 6.3 to 3.8 acres (V. S. Vyas 1979).

Projections for Kenya, extending to the year 2024, are particularly sobering because of an exceptionally rapid growth of the country's population and labor force and the extent to which the land area for expanded cultivation has already been reduced by past growth of the farm population. On the basis of what they judge as the most likely of six scenarios of changes in fertility, mortality, and rural-urban location, Mahendra M. Shah and F. Willekens (1978) project that Kenya's rural work force would increase fourfold between 1969 and 2024. That projected increase is in spite of an assumed sixteenfold

<sup>24</sup> This is apparent from the well-known identity (Folke Doving 1959) which shows the rate of change in the agricultural labor force ( $L'_a$ ) as determined by agriculture's share in the labor force ( $L_a/L_t$ ) and the rates of change in the total labor force ( $L'_t$ ) and in the nonagricultural labor force ( $L'_n$ ):  $L'_a = (L'_t - L'_n) (L_a/L_t)^{-1} + L'_n$ . Johnston (1969, pp. 67-69) emphasized the implications of this identity by hypothetical growth paths of the total, farm, and nonfarm labor force over a 50-year period with alternative initial conditions ( $L_a/L_t = .5$  or  $.8$ ) and with  $L'_t = 1$  percent or 3 percent and  $L'_n = 1.5$  percent, 3 percent, and 4.5 percent. Johnston and Clark (1982, p. 41) show the time required to reach the "turning point" when the absolute size of the farm labor force begins to decline for various combinations of  $L'_t$ ,  $L'_n$ , and  $L_a/L_t$ .

increase in the working age population in urban areas which would reduce the share of the rural labor force from 87 percent of the total in 1969 to 65 percent in 2024 (Shah and Willekens 1978, pp. 29, 38). The pressure on all capital resources is illustrated by the Kenyan Government's hope that with more effective family planning programs the increase in the number of children of primary school age will be limited to "only" 75 percent between 1978 and 2000 instead of the 141 percent increase anticipated with fertility unchanged (Kenya 1979, p. 63).

### *Capital Availability*

Extremely low initial capital-labor ratios in a dominant rural sector are at the heart of the development problem. This deficiency lies particularly with the human capital of skills and technical and organizational knowledge. The scarcity of the latter further limits capacity to coordinate the growth of various forms of capital so as to keep the respective rates of return roughly aligned (Harry G. Johnson 1969, p. 9).

Since W. Arthur Lewis' statement (1955) that the difference between a developing and nondeveloping country is the difference between a 12 and a 6 percent savings rate, it has become apparent that marginal savings rates do, in fact, rise quickly once development is underway and rates of return rise. Most Asian countries now have domestic savings rates well over 20 percent of GDP (World Bank 1982). The high marginal savings rates of farmers in the Punjab, when returns to investment in wells and fertilizer soared with new technology in the late 1960s, are notable in this context. In much of Sub-Saharan Africa where net domestic savings rates are typically under 10 percent of GNP (World Bank 1982), it can be shown that the bar to domestic savings is the low rate of return to investment due to price distortions and gross misallo-

cation of the existing capital stock (Lele 1975, 1983). Savings and investment by African farmers in the past have been very high on occasion, when there were attractive investment opportunities, e.g., planting cocoa trees.

Thus, while savings rates seem to rise rapidly with development the required rate seems higher than Lewis presumed because of the tremendous labor absorption problem and because of gross misallocation of capital. It is to the latter that we now turn.

### *Capital-intensive Development Strategies*

It has been common for developing countries to follow strategies that foster dualism, concentrating capital in large-scale, capital-intensive industries. The intellectual base for India's second Five-Year Plan provides the most notable case (Mahalanobis 1953; Jagdish N. Bhagwati and Sukhamoy Chakravarty 1969; Mellor 1976). This approach is essentially the same as that of the People's Republic of China (Anthony M. Tang and Stone 1980), and the Soviet Union (G. S. Feldman as stated in E. D. Domar 1957) and has close intellectual links to the family of Harrod-Domar related growth models.

Growth is seen as a direct function of growth in the capital stock, which is to be accelerated by channeling resources into the capital goods industries, away from consumption. Then, the output from capital goods production is reinvested to provide a high marginal savings rate and, hence, a rapidly rising average savings rate. Employment growth, consistent with a view of fixed factor proportions, is seen as a direct function of growth in the capital stock. Since labor is assumed to be not only in surplus, but also to be consuming its subsistence needs, no further supply of consumer (wage) goods would be needed as employment increased (for example, Chakravarty 1969). In India, it was understood that improved welfare for the

laboring classes was to be postponed in favor of large increases in the future; in the short run, agriculture and the cottage industries were to provide employment and consumer goods without drawing on the scarce capital of other sectors. The Chinese strategy of "walking on two legs" was analogous. Thus the approach was explicitly, highly dualistic in capital intensity.

The following problems have arisen with such dualistic approaches. Capital intensity of the modern sector was even greater than expected and increased over time (Mellor 1976). This was for reasons inherent in the investment pattern, including inability to operate large-scale, capital-intensive industries at a high percentage of capacity and under-investment in infrastructure. The consequence was slower growth and a lower savings-reinvestment rate than expected. The strategy of relying on extremely low capital intensity in agriculture and the cottage industries was not as successful as hoped in either producing goods or mitigating poverty. Thus, the strategy neglected agriculture even though that was not the intent. Hence, despite low growth rates in employment, an upward pressure on food prices took hold with deleterious social effects and a drain of foreign exchange (Mellor 1976; Tang and Stone 1980). The investment strategy put severe demands on forms of capital requiring foreign exchange at the same time that resources were diverted from traditional export industries (Mellor and Lele 1975). Thus, foreign exchange became a limiting factor, leading to the peculiar two-gap analyses that distinguished between domestic resource-based capital and foreign exchange-based capital (e.g., Hollis Chenery and A. M. Strout 1966).

The import substitution strategy, substantially founded on presumed poor prospects for exports and assuming deteriorating terms of trade for primary

commodities (Raul Prebisch 1971), starts conceptually with displacement of imports from relatively labor-intensive industries and proceeds to more capital-intensive ones. With neglect of agriculture, the structure of domestic demand growth tends to be narrow, urban-based, and oriented to high-income consumers, accelerating the increase in capital intensity (Celso Furtado 1964). The result is innately highly dualistic with all the characteristics indicated above (Bhagwati 1978; Anne O. Krueger 1978).

Economies characterized by either of the preceding two approaches tend to have grossly overvalued exchange rates, discriminating further against the agricultural sector. Argentina is a prime example (Domingo Cavallo and Yair Mundlak 1982), as is Colombia (Jorge Garcia Garcia 1981) and the bulk of African countries. Not only are direct price incentives to agriculture dulled but, far more important, critical government attention is diverted from the policy and institutional needs of agricultural development (Lele 1983).

Given the highly dualistic nature of the above strategies and in particular the slow growth of both food production and employment, it is not surprising that a strong interest developed in redistributive and structuralist approaches to poverty reduction. In this context, growth strategies tended to be associated with the term "trickle down," in reference to the slow rate of amelioration of absolute poverty. In India there was continuing concern for redistributive measures and programs for fulfilling basic human needs (India 1961), perhaps in recognition that the time preference of planners would not be shared by the poor. These concerns were reinforced in India when growth proved slower than expected, and spread more widely in the late 1960s and early 1970s with the World Bank's strong association with a more direct attack on poverty, (Mahbuk ul Haq 1971; Robert McNamara

1973). These "basic needs" approaches became pervasive in the foreign assistance community in the 1970s and even into the 1980s.

Unfortunately, widespread concern with the failure of dualistic strategies of growth to ameliorate poverty was coincidental with the early technological breakthroughs in food production; hence, the two were often associated, including a literature purporting to establish causality (for example, Keith Griffin 1979).<sup>25</sup>

### *Food and Labor-Intensive Development*

Food production plays two vital roles in labor-intensive development. It contributes to a structure of demand appropriate to low capital-labor ratios and to capital accumulation as well as providing the wage goods essential to labor mobilization. Both needs were glossed over in the dominant thinking about development strategies in the 1950s and 1960s.

#### *a) Rural Demand, Capital Intensity, and Capital Accumulation*

If a large share of increased food output were paid directly to low income laborers it would be largely consumed by labor with, of course, direct income and nutritional benefits to the poor. Since, in practice, modern, high-yield crop varieties distribute a large factor share to land and therefore to landowners, employment is inelastic with respect to such output. Conversely, food sales, cash income, and demand for other goods and services are all elastic with respect to the increased output (Mellor and Lele 1973; Mellor 1976). In India, for example, the rural consump-

tion of manufactured consumer goods is two-and-a-half times that of the urban consumption of those goods (C. Rangarajan 1982). Thus, the base on which increments to rural consumption of manufactured consumer goods occurs is large in low-income, dominantly rural countries.

In Asia, peasant farmers typically spend some 40 percent of increments to income on locally produced nonagricultural goods and services (Hazell and Ailsa Röell 1983). The income multipliers are substantial—on the order of 0.7, (Mellor and Lele 1973; Bell, Hazell, and Slade 1982; Rangarajan 1982)—and the employment multipliers are probably larger, given the nature of the production processes. However, if agricultural development is highly concentrated in a large-scale subsector (rather than in the peasant agriculture more typical of Asia) with consequent concentration of added income within high-income families, the capital and import intensity of the goods and services may be much higher (Furtado 1964; Johnston and Kilby 1975, Ch. 7). Thus, the nature of consumption linkages as well as production relationships, to be discussed in Section V, argue for a broad unimodal pattern of agricultural growth.

In Africa growth linkages between agriculture and other sectors seem weaker than in Asia. Hazell and Röell (1983) note this in comparing the Gusau District of Northern Nigeria, and the Muda region in Malaysia. Robert P. King and Derek Byerlee (1978) find a much lower (about 0.12) marginal propensity to spend on rural nonfood products in Africa than is usual in Asia. They also find much higher marginal propensities to spend on imported products than on products from large urban centers or even all urban centers combined. The weak domestic linkages in Africa can be traced to the much lower average productivity of labor utilized in agriculture, the consequent lesser differentiation of the rural economy (Mel-

<sup>25</sup> Mellor (1978) discusses the equity implications of food supply and price relations. For a broader discussion of agricultural production-equity relations from many points of view see Mellor and Desai (forthcoming), and for particular emphasis on interaction with population growth and the availability of land, see Yujiro Hayami and Masao Kikuchi (1982).

lor in Mellor and Gunvant M. Desai, forthcoming), less well-developed infrastructure, and a particularly sub-optimal pattern of nonagricultural investment.

An important interaction between the effects of agricultural growth on capital intensity and capital accumulation should be noted. Given the labor market conditions in developing countries, the more labor-intensive the goods and services demanded, the more elastic will be the supply. However, if there is a capital constraint, the fact that the cost of agricultural production has been reduced by technological progress provides scope for agriculture to contribute to breaking that constraint. This applies whether the capital constraint is in public sector infrastructure and education, calling for higher local or national taxes on agriculture; in small-scale rural industries, for which direct investment by prosperous agriculturalists may be appropriate; or, in a more distant industry, where a temporary change in terms of trade against agriculture may be in order. T. H. Lee (1971) documents for Taiwan a consistent net flow of resources from agriculture to other sectors from 1895 through the 1960s, but with major changes from time to time in the transfer mechanism. Agriculturalists, or at least their children, will benefit if transferred resources are used productively. In many developing countries, perhaps especially in Africa, agriculture has been "taxed" heavily, but the resources transferred from agriculture have often financed inefficient investments and supported non-farm income and wages far above the income levels of the farm population. The Ivory Coast represents a sharp contrast to many other African countries by "taxing" agriculture heavily but reinvesting substantially in agriculture (Mathurin Gbetibouo and Christopher Delgado 1984).

Taiwan epitomizes these processes of rapid growth and rising productivity in

agriculture stimulating growth in other sectors. Increases in factor productivity accounted for well over half of the 3.5 percent annual rate of agricultural production increase in the decades preceding and following World War II (Lee 1971). Widespread increase in the commercialization of the agricultural sector provided incentive for investment in roads, electrification, and telephones as well as for strictly agricultural infrastructure such as irrigation. The growth of nonfarm activities was also stimulated by increasing rural demand for consumer goods and services and for agricultural inputs as farm cash incomes rose. The growth pattern of rural demand in Taiwan had its greatest impact on the growth of output and employment in decentralized, small- and medium-scale manufacturing firms that employed labor-intensive technologies and economized on the use of capital and foreign exchange. Expanded manufacture of unsophisticated farm equipment played an especially significant role in fostering the growth and diffusion of metalworking skills that are so important to industrial development (Johnston and Kilby 1975, Ch. 8).<sup>25</sup>

#### *b) Food Production Technology and the Price of Wage Goods*

Accelerated growth in productive non-farm employment accelerates growth in the wage bill and in demand for wage goods. Since the marginal propensity of laborers in developing countries to spend on food is on the order of .7 to .9 (Mellor 1973) the supply of wage goods may constrain employment growth. Thus labor supply is usefully described as a function of simultaneously determined labor and

<sup>25</sup> For simulation of an India-like country that has growth assumptions consistent with the preceding and which moves from 30 percent of the rural labor force initially unemployed to full employment in 15 years, see Mellor and Mohinder S. Mudahar (1974).

food markets (Lele and Mellor 1981). Given the inelasticity of the aggregate production of food in developing countries (Herdt 1970), the food market is a function of technological change in agriculture and the factor bias of that technology. The strong factor bias towards land of modern yield-increasing technology and the low marginal propensity of landowners to spend on food tends to favor rapid growth in food marketing (elastic, with respect to output) and therefore act to restrain growth in capital-labor ratios at any given level of capital formation.

The key role of technological change in food production in relation to the choice of techniques is made dramatically by Amartya K. Sen (1968). Sen concluded, probably from observing the capital intensity of Indian irrigation investment, and no doubt conditioned by Ricardian views of diminishing returns in agriculture, that the capital intensity of wage goods (food) production was very high at the margin and that their prices would rise sharply in response to rising demand. Because Sen, at that time, saw the choice of capital-intensive technology as inevitable for agriculture, the solution to the employment problem had to lie with rapid capital accumulation in the nonagricultural sector, albeit used at a high capital intensity. Thus, while Sen's approach was through a two-factor production model, it came to the same strategy choice, neglecting agriculture, as the one-factor Harrod-Domar and Fel'dman-Mahalanobis models.

### *c) Comparative Advantage and Domestic Food Production*

In general it is not reasonable to think in terms of economies so closed that employment is constrained by rapidly rising domestic food costs relative to international prices. However, India, in the 1960-1964 period of an unusually rapid growth in nonfarm employment did experience

rapidly rising real food prices even while food imports, including food aid, were growing at an unprecedented rate (Mellor 1976).

Whether a developing country has a comparative advantage at the margin in food production depends on the underlying land resource and the pace and pattern of technological possibilities for agriculture. Intuitively, a country with the bulk of its rapidly growing population in food production, facing immense labor absorption problems in nonagriculture, and with limits on net capital inflows or labor outmigration faces a bleak prospect indeed if it does not have a comparative advantage for a very considerable expansion of food production! Given the balance-of-payments difficulties of most developing countries, relief from food import pressures must appear attractive at least until export expansion accelerates. Perhaps more importantly, the market-broadening feature of income expenditures generated by domestic agricultural development provides training for later entering the export market of manufactured products, a factor of considerable importance to Taiwan's early export success (Kou-shu Liang and Lee 1972). Finally, the bulky nature of food causes the difference between export and import prices to be large, further encouraging food production for domestic use.

There is a biological logic to the argument that the agro-climatic conditions that allowed the growth of large stocks of surplus agricultural labor are conducive to further large productivity gains from new agricultural technology. That is, where rural population densities are already high, a comparative advantage is likely to lie with large increases in food production through modern technology (Mellor in Mellor and Desai, forthcoming). This is so by definition, because such areas have generally favorable conditions for agricultural production and the modern

high-yield varieties respond best to favorable conditions (for example, with respect to water and fertility). As that happens, labor mobilization for nonfarm employment may proceed rapidly.<sup>27</sup>

Less certain are the prospects, in regions such as the drier areas of West Africa where labor productivity in agriculture has been too low to have permitted "surplus" labor and where the average and marginal product of agricultural labor are roughly comparable at close to the subsistence level (Mellor in Mellor and Desai, forthcoming). In such circumstances, labor transfer not only adds to food demand but detracts from food supply. The technology package must include both land-augmenting and labor-augmenting innovations.

Because accelerated agricultural growth is itself apt to be region-specific, at least at a particular point in time, and because of the strong local linkages (in itself a generally desirable feature) such growth is likely to exacerbate regional disparities, although obviously not to the same extent as capital-intensive urban development (Mellor 1976). However, the problem of regional disparities tied closely to ethnic differences may be a particularly serious political barrier to such an approach to development in Africa. It is to the difficult problems of achieving accelerated technological change in agriculture that we now turn.

<sup>27</sup> It is interesting to speculate as to why such growth did not occur earlier. Colonial regimes typically stifled the growth of modern industry while destroying major elements of traditional industry, with the consequent creation of a large, underemployed, rural, landless class. (For a striking case, note India's preeminent, precolonial position in textiles: Mattiabelle Gittinger 1982.) Subsequently, the take-off is delayed if these same conditions lead to very low rates of capital accumulation or, a propos of recent development history, if a dualistic growth strategy concentrates capital on only a small portion of the labor force. Note the self-inflicted damage to India's textile industry in the 1950s (Mellor and Lele 1975).

#### V. *Lessons from Past Experience: Structure, Organization, and Human Resources*

Achieving accelerated growth in the agricultural sector, essential to balancing the food equation at a high level, involves problems that are so complex and ill-structured that intellectual cogitation alone is an inadequate basis for useful policy analysis. Analysis needs to be supplemented by interactive learning from past experience and from ongoing programs (Johnston and Clark 1982, pp. 23-28). In drawing on past experience we emphasize Japan, Taiwan, and South Korea where it is well documented, and economic development has run its course to the point where relatively confident conclusions can be drawn. More recent experience (e.g., India's Punjab, Malaysia, Thailand, Indonesia, and in some of Kenya's high potential farming regions) provides additional evidence while at the same time directing attention to various constraints on the transferability of the East Asian experience.

The common feature of the success achieved in Japan, Taiwan, and Korea is that each country created an effective agricultural research system, a good rural infrastructure and comprehensive input delivery system, and a deep and broad educational system. These are the basic building blocks of rural development.<sup>28</sup>

<sup>28</sup> For a full statement of the elements of agricultural development, see Mellor (1963); Hayami and Ruttan (1971). John C. H. Fei and Gustav Ranis (1975) have stressed that the development of rural infrastructure (especially irrigation) and the increase in agricultural productivity were less impressive in Korea than in Taiwan. However, apart from the 1939-1945 and 1949-1952 periods when production was disrupted by wartime conditions, the rate of increase in Korea's agricultural output since 1930 has been about as high as in Taiwan but with greater variability. For example, the growth rate of total output was only 2.25 percent during 1965-1973 but rose to an annual rate of 8.81 percent between 1973-1977. The growth of output was associated with only modest increases in total inputs despite rapid growth in the use of current inputs, especially fertilizer. Thus, in Korea, Taiwan and Japan, increases in total

The difficult problems confronting contemporary developing countries are: What kind of a rural structure is needed to accommodate them? What are their organizational requirements? And, how do these interact with development of the necessary human resources? Those problems need to be addressed at both the short-term, tactical level and also in the framework of a long-term strategy. K. Sen has rightly emphasized that in today's developing countries a "shift in focus to technological and institutional details is long overdue" (as quoted in Guy Hunter 1978, p. 37). In Japan, Taiwan, and Korea careful attention was given to those "details"—but in the context of a strategic perspective that took account of the complementarities among program interventions and of the long-term consequences of investment decisions and policy choices.

### *The Structure of Agricultural Production*

The East Asian countries followed a "unimodal" pattern of development in their agricultural sectors, characterized by widespread but gradual increase in productivity and expansion in the use of purchased inputs by small farmers. Their experience demonstrates that agricultural strategies can provide broad participation if technological change is oriented toward the needs of small farms.

The relevance of the experience of these East Asian countries has frequently been challenged. Thus Alain de Janvry (1981, p. 262) asserts that it is only in "countries where there have been extensive redistributive reforms (e.g., Taiwan and South Korea), [that] the poor may benefit from accelerated growth." That is a serious charge because the success of land reforms in Japan, Taiwan, and South

Korea was dependent on special circumstances prevailing in each country following World War II.

In the prewar period, the ownership of land in Japan, Taiwan, and Korea was highly skewed and contributed importantly to an unequal pattern of income distribution. Often overlooked is the fact that farm operational units were small and the bias of technological change was in a labor-using, capital-saving direction. The explanation, in brief, is that the large landowners found it profitable to rent out their land to tenant households operating uniformly small units (Thomas C. Smith 1959).<sup>29</sup>

The preceding discussion is consistent with the view that small operational units are clearly most economic. This is substantiated by the famous "inverse relationship" between farm size and land productivity: small farmers, whether owner-cultivators or tenants, tend to use non-land inputs, and especially labor, more intensively than larger farmers.<sup>30</sup> Albert R. Berry and William R. Cline (1979, p. 134) note that "the special efficiency advantages of small farms tend to disappear" when the opportunity cost of labor

<sup>29</sup> Recent papers by Hans Binswanger and Mark R. Rosenzweig (1981) and Gerald David Jaynes (forthcoming) clearly support earlier work by D. Newberry, Joseph Stiglitz, and others in emphasizing that share tenancy often performs a useful role where a land reform may not be possible. A few areas in the world are still dominated by feudal systems in which large landowners have a great deal of monopoly power over renting land and hiring labor. In such circumstances, particularly common in Latin America, land redistribution may well be a necessary condition for moving toward a unimodal pattern.

<sup>30</sup> Berry and Cline (1979) provide a useful review of theories on the relationship between farm size and productivity and summarize a large body of empirical evidence; an Appendix on India by Surjit Bhalla demonstrates that "the inverse relationship was still significant during the Green Revolution years of 1968–1969 to 1970–1971, though there was a moderate tendency for this relationship to weaken over time." See also Pranab K. Bardhan (1973) and Lawrence Lau and Pan Yotopoulos (1971).

factor productivity have accounted for much of the increase in output (Sung-Hwan Ban 1982, pp. 174, 181, 184; Johnston and Kilby 1975, Chs. 5, 6).

is relatively high. Ohkawa (1972) reports a narrowing of the inverse ratio in postwar Japan, but he emphasizes that small farms will tend to have an efficiency advantage over large farms as long as labor is relatively abundant and wage rates are low, provided that yield-increasing biological and chemical innovations are available. That tendency may be offset, however, by "differentiating factors" such as a policy environment in which small farmers do not have access to credit or large farmers have access to tractors at artificially low prices.<sup>31</sup> In our view, the most significant implication of the induced innovation hypothesis of Hayami and Ruttan (1971) is that the indirect, long-term effects of price distortion on the orientation of research and on the bias of technological change may well be even more important than their adverse effects on short-run, allocative efficiency.

A widespread belief that economies of scale are important in agriculture has been a pervasive force contributing to bimodal patterns of agricultural development. Quite apart from those with a vested interest in preferential treatment of a large-scale subsector, many economists, agricultural scientists, and other specialists assume that only large and fairly capital-intensive farm units can be "modern" and efficient. An emphasis on economies of scale has also been a persistent tenet in Marxist views on agricultural development (Karl Wittfogel 1971; Z. Kozłowski 1975).

In a number of socialist regimes in tropical Africa (e.g., Nkrumah's Ghana, Tanzania, and Mozambique) state farms have been established because of the presumed importance of economies of scale as well as to facilitate purchases of grain for urban areas. Inasmuch as the concentration of scarce resources of capital, foreign ex-

change, and trained manpower in a subsector of large mechanized state farms is achieved at the expense of depriving the great majority of the farm population of inputs and supporting services, the inevitable consequence is a bimodal pattern of agricultural development.

In other countries, especially in Latin America, land reform has often been linked with the objective of instituting group farming. The performance of group farming schemes has almost invariably been poor.<sup>32</sup> This fact, together with the common lack of enthusiasm for collective farming among small farmers has probably weakened support for land reform in a number of countries.<sup>33</sup>

The creation of large operational units, whether for group farming or by private landowners, creates strong pressures to make excessive investments in labor-displacing mechanization. Because of the biological nature of the agricultural production process, operations are spread out in time and space. Hence, a big operational unit that relies on a large work force, whether hired laborers or members of a group farm, encounters difficult problems of supervision in seeking to avoid shirking. Owing to the high degree of variability that characterizes farming activities, there are numerous "on-the-spot supervisory decisions" to be made by individuals performing what are normally routine tasks (John M. Brewster 1950). Efficient production based on labor-using, capital-

<sup>32</sup> See Peter Dorner (1977), John Wong (1979), and John G. Gurley (1963, pp. 117-23). The Israeli kibbutz is probably the best example of a sustained "success story" in group farming, but it has "failed to absorb immigrants from developing countries" and runs a "risk of becoming an enclave of collectivism with growing irrelevance to its surroundings" (Ye-huda Don 1977, p. 61).

<sup>33</sup> A major motivation for collectivization in the Soviet Union was to increase the political power of the State vis-à-vis the farm population (Alec Nove 1971; M. Lewin 1968). Presumably, that factor has also been important for more recent revolutionary regimes.

<sup>31</sup> Lele (1981) notes how subsidization of credit and inputs in a context of excess demand favors the larger and more powerful farmers.

saving technologies therefore depends on decentralized decision-making and the incentive which owner-cultivators or tenants have to exercise judgment and initiative because of their direct interest in the outcome. The manager of a large operational unit, whether private or collective, finds it attractive to use capital-intensive technologies to minimize the problems of supervising a large work force; but the social opportunity cost of using scarce capital to displace labor for which alternative employment opportunities are not available is high. Even for the People's Republic of China, Azizur R. Khan (1983, p. 229) has noted: "recent official indictments raise serious questions about the effectiveness of the institutional-organizational framework of the commune system in generating an acceptably high rate of growth."

Ohkawa emphasizes the importance of biological-chemical innovations, adapted to local conditions and capable of being used efficiently by small farmers. This points to an especially important requirement for a successful unimodal pattern of agricultural development. In many countries the neglect and ineffectiveness of agricultural research programs has seriously limited the possibilities for increasing agricultural productivity and output by the progressive and widespread modernization of the entire agricultural sector. Profitable technological innovations suited to the needs of small farmers have simply not been available. In many Asian countries that situation has changed substantially as the Green Revolution has demonstrated that high returns are possible with improved varieties, adapted to local environmental conditions. Expenditure on national research systems in developing countries has increased in real terms at an annual rate of 10 percent during the past decade (Peter A. Oram, forthcoming). Nevertheless, many of these systems remain ineffective.

The great variation in farming systems associated with differences in the physical environment and in socioeconomic conditions limits the effectiveness of traditional approaches to research and extension—especially in Sub-Saharan Africa and other areas where farming is mainly dependent on rainfall rather than controlled irrigation. During the past decade a great deal of attention has been given to Farming Systems Research (FSR) as a means of increasing the relevance of research to the needs of small farmers. This approach emphasizes on-farm adaptive research in specific "recommendation domains" characterized by relatively homogeneous farming systems associated with similar agroclimatic conditions. A recent paper by Byerlee, Larry Harrington, and Donald Winkelmann, economists with CIMMYT (the International Center for Maize and Wheat Improvement in Mexico), gives an exceptionally succinct statement of the importance of on-farm research based on a farming systems perspective as an important element in national research programs. They share the current optimism about FSR's potential contribution to the effectiveness of agricultural research, but they are concerned that expectations may be disappointed because of unfocused efforts and failure to apply cost-effective methods in data collection, in selecting technological alternatives for experimentation, and in identifying important opportunities in light of farmer circumstances.<sup>34</sup>

<sup>34</sup> The paper by Byerlee, et al. (1982) contains references to several CIMMYT publications and to important contributions by M. Collinson, P. E. Hildebrand, D. W. Norman, W. W. Shaner, H. G. Zandstra, and others who have been doing pioneering work on Farming Systems Research. With the exception of some Farming Systems Research at ICRISAT (the International Crop Research Institute for the Semi-Arid Tropics in India), little attention has been given to the special importance, for rainfed areas, of equipment and tillage innovations to improve soil and water management. It is sometimes argued that publicly supported research on farm

*Agricultural Development as a Systemic Problem: Organizational Requirements*

Many years ago S. C. Hsieh and Lee (1966, pp. 103, 105) asserted that "the main secret of Taiwan's development" was "her ability to meet the organizational requirements." Failure on that point has been conspicuous in Sub-Saharan Africa. Moris lists a number of problems impeding African rural development that arise from lack of organizational capacity, including: (1) a severe revenue/expenditure squeeze, (2) excessive politicization of technical functions induced by acute scarcities of resources, and (3) the emergence of distinctive "LDC managerial styles" that are subject to a number of "routine operational difficulties" such as: "a bad fit between objectives and organizational capacities," "high rates of staff transfer and turnover," "top staff overworked while bottom staff loaf," a "large amount of energy [by the top staff] required to accomplish routine tasks," "inability to adhere to schedules," "unreliable technical and support services," "failure to repair or maintain equipment," and "low morale of field staff" (Jon R. Moris 1983, p. 11). This long and depressing litany by Moris is consistent with many other reports, e.g., the excellent book on "Lessons from Africa" by Lele (1975,

1979) and the 1981 World Bank publication *Accelerated Development in Sub-Saharan Africa*.

The common failure "to meet the organizational requirements" of rural development cannot be explained as simply a problem of "weak management." It is the result of a "system of interactions" in which managers are "put again and again into impossible working situations." The proximate difficulties that result in "persistent administrative malfunctioning" are compounded by failures of macroeconomic management that result in inflation, overvalued exchange rates, and import restrictions that raise the prices of imported and locally manufactured products and generally distort relative prices (C. Peter Timmer, Walter P. Falcon, and Scott R. Pearson 1983, Ch. 5). Pricing policies of marketing boards for export crops add to the effect of overvalued exchange rates in discouraging export production which intensifies the scarcity of foreign exchange and reliance on licensing and other controls on imports.<sup>35</sup> A common consequence, increasingly in evidence in some African countries, is a severe shortage of farm inputs and consumer goods in rural areas (Lele 1983). The agricultural sector's terms of trade may also be affected adversely by "cheap food policies," a common manifestation of the "urban bias" of government policy in many less developed countries (Michael Lipton 1977). To be sure, various external factors and the historical legacy of colonialism have contributed to the failures of macroeconomic management. However, we

equipment is inefficient as compared to "induced innovation" in the private sector. R&D to identify and promote wider use of animal-powered and other simple but well-designed equipment, affordable by small farmers, does face special difficulties. Engineers working on their own cannot be expected to accomplish very much because the need is for equipment that farmers will find useful in implementing improved tillage methods so as to increase productivity: e.g., by improving soil and water management, more accurate placement of seeds and fertilizer, or better weed control. It seems important, however, to evolve effective methods, perhaps similar to those developed at the International Rice Research Institute, for carrying out such research because of its importance in accelerating the increase in farm output and also in fostering widespread growth of rural-based manufacturing firms (Johnston and Clark 1982, pp. 95-96; Johnston and Kilby 1975, Ch. 8).

<sup>35</sup> It is often alleged that developing countries fail to meet nutritional and other basic needs because of promoting export crops. To a considerable extent, such views simply reflect a lack of understanding of the development process. However, in a bimodal situation expanding export production can, indeed, exacerbate problems associated with highly unequal distribution of income. The rapid growth of soybean exports in Brazil is a case in point (Fernando Hornem de Melo 1983).

focus here on domestic policies and the possibilities for action by individual governments to deal with the problems of organization and management that have so adversely affected the achievement of development goals.

Mellor (1976, p. 289) points to a fundamental factor underlying the foregoing problems when he states: "Imbalance between public sector responsibilities and the availability of resources is particularly likely, yet receives little explicit attention in planning exercises." Recent discussions of Africa's "food crisis" have put particular emphasis on the "imbalance" between the heavy responsibilities assigned to parastatals and the limited administrative capacity of those organizations.<sup>36</sup> There is little doubt that administrative problems have been especially serious when quasi-governmental organizations have been given *operational* responsibilities related to the production and marketing of food crops. Robert Bates (1981) has presented a particularly vigorous critique of the adverse effects of government agricultural interventions in Africa.<sup>37</sup> In fact, he comes close to endorsing the Jeffersonian dictum: "that government is best which governs least." Similarly, the World Bank (1981) places great emphasis on the need for "privatization" of operations now being performed ineffectually and at high cost by parastatals.

In considering issues of organizational performance, it is useful to view organization in general terms, "as a framework for calculation and control through which col-

lections of individuals determine what each should do and ensure that each does what is expected of him."<sup>38</sup> There are a variety of social techniques available for performing the tasks of calculation and control—the hierarchical techniques of bureaucratic organizations, the bargaining techniques of small local organizations, voting or other methods of delegating authority, and exchange techniques as epitomized by market and price mechanisms.

The various tasks of calculation and control can be performed by at least three different types of organizations: (1) local "participatory" organizations that link rural people with each other and with the larger social system, (2) bureaucratic organizations staffed by government employees, and (3) private firms or cooperatives that may serve as alternatives for both (1) and (2). S. Olayide and Francis S. Idachaba (1983) emphasize the distinction between a government ministry and a parastatal that has somewhat greater flexibility, e.g., in being able to pay more attractive salaries. However, they also suggest that there should be a transition from "parastatals that engage directly in farm input supply and food marketing" to "facilitating institutions" which, for example, provide market information and coordinate price policies. They also stress the importance of improvements in a country's road and communication network, storage facilities, etc. A recent paper by William O. Jones (forthcoming) also focuses on identifying the most useful roles that governmental marketing boards might perform in promoting more efficient marketing of food crops in tropical Africa.

In recent years there has been an up-

<sup>36</sup> There is, of course, considerable variation in the performance of different parastatals. In its recent treatment of "Management in Development," the World Bank (1983, p. 85) singles out TANESCO, The Tanzania Electric Supply Company, Limited as an example of a parastatal that has achieved high standards of management and performance.

<sup>37</sup> Bates emphasizes that the interventions provide patronage for influential groups and have therefore been quite rational in terms of the political interests of government leaders.

<sup>38</sup> The quotation is from Johnston and Clark (1982, p. 156) but the concept derives from Robert A. Dahl and Charles E. Lindblom (1953). The following paragraphs draw heavily on Clark's treatment of "organizational programs" in Johnston and Clark (1982, Ch. 5).

surge of interest in promoting "participation" in local organizations. Unfortunately, there has been a tendency "to treat participation as a free good, desirable in unlimited quantities" (Johnston and Clark 1982, p. 171). Participation should, however, be viewed as a form of investment: individuals will not invest their time and effort in local organizations unless they perceive that the benefits to be derived from collective action exceed the costs of that participation.<sup>39</sup>

Clark's review of the experience of local organizations in less developed countries has led him to emphasize three "design features" as major determinants of the success of efforts to induce participation: the attractiveness of benefits, the harmony of objectives (influenced by the homogeneity of the organization's members and the range of objectives being pursued), and the simplicity of techniques that can be utilized to realize the organization's objectives. Given the reliance of local organizations on bargaining techniques, the advantages of a small membership are obvious. However, the difficulties encountered in assigning, coordinating, monitoring, and legitimating individual responsibilities and rewards within an organization will also be influenced strongly by what Clark refers to as "communality" (Johnston and Clark 1982, p. 182). When participants contribute their labor and other resources to a common productive activity, the tasks of calculation and control are bound to be more difficult than when individual contributions are directly reflected in individual rewards, e.g., payment for milk that a

farmer delivers to a cooperative creamery.

Given these problems of "communality," it is not surprising that the performance of group farming schemes has been consistently poor. Nor is it surprising that in Japan, Taiwan, and Korea groups for carrying out farming as a collective enterprise were of no importance whereas irrigation associations played a major role. The economies of scale in constructing irrigation and drainage systems are significant, and there are distinct advantages in local participation in their design and management, as well as in the mobilization of resources of money and labor for projects in which local farmers have a direct interest. (Felipe B. Alfonso 1983: He describes concisely a particularly interesting effort by the National Irrigation Administration in the Philippines to acquire the knowledge and skills required to foster effective local participation in the design and management of irrigation systems.)

Inducing the emergence of effective participatory organizations with problem-solving capabilities, the capacity to bring to bear local knowledge and mobilize local resources, and the ability to enforce accountability is a difficult, time-consuming process. Moreover, promotional efforts by government run a risk of stifling the local initiative and independence essential for success. Nevertheless, the effort may be highly rewarding. As with irrigation, rural health programs appear to represent a set of activities for which efforts to promote local participation may be particularly desirable and feasible. Indeed, we suspect that government funds for investment in a pump or tubewell to improve the quality and quantity of water available in a rural community should be made only as grants-in-aid to a local organization that provided the greater part of the resources required, in addition to assuming responsibility for management and maintenance.

It is also noteworthy that price and mar-

<sup>39</sup> Samuel Popkin (1979), uses a similar "investment logic" in analyzing the conditions that make for success in creating effective peasant organizations in spite of the "free rider" problem. He emphasizes particularly the role of "political entrepreneurs" perceived by potential participants as being credible and effective, and the advantage of focusing initially on "local goals and goods with immediate payoffs" (p. 262).

ket mechanisms and private firms and farmers' associations played a major role in the three East Asian countries in fulfilling many tasks of calculation and control that are essential to agricultural development. Nor is it surprising that numerous problems have resulted from the ambitious attempts in many developing countries to determine prices administratively and to rely on parastatals for the performance of essentially commercial functions. John K. Galbraith, who can scarcely be accused of having an instinctive preference for a price and market system, has emphasized that market mechanisms "economize on scarce and honest administrative talent" whereas reliance on detailed planning and administratively-determined prices is likely to jeopardize the prospects for rapid and efficient growth: "The consequence—reliance on a large, centrally planned and administered public sector—is that the greatest possible claim is placed on the scarcest possible resource. That is administrative talent, with its complementary requirements in expert knowledge, experience, and discipline" (Galbraith 1979, p. 111). Moreover, the large literature on "the political economy of rent seeking" emphasizes that quantitative restrictions on imports and other measures that give rise to "contrived rents" result in a dead-weight loss to society because of resources that are wasted in competing for those rents (Krueger 1974; Robert D. Tollison 1982).

The other side of the coin is equally important: there is a wide range of activities in which direct government action is indispensable because markets would perform poorly, if at all. Agricultural research and extension programs and investments in roads and other rural infrastructure are important examples. Certain types of social service programs, to which we now turn, also merit priority attention as quasi-public goods.

### *Determining Priorities for Social Service Programs*

Japan, Taiwan, and Korea supplemented their production-oriented programs with strategic interventions to enhance the quality of human resources. A broad base of the rural population had access to formal education which enhanced their ability to evaluate innovations, to participate effectively in local organizations, and to influence public institutions so as to achieve responsiveness to their interests. Expansion of their institutions of higher education also performed a critical role in providing the large number of trained people required by institutions serving a modernizing agriculture—from research to credit institutions.<sup>40</sup>

They were also in the vanguard in applying modern medical knowledge and public health technologies and in promoting improvements in health. Infant and child mortality in Taiwan and Korea were already relatively low in 1960, and subsequent progress has been impressive. Moreover, this improvement in child survival prospects has been associated with a sharp reduction in fertility.

Recent demographic experience has demonstrated that the unprecedentedly rapid reduction in mortality in today's developing countries can be followed by a similarly rapid reduction in birthrates (Kirk 1971). Ten countries achieved "significant" declines in fertility between 1960 and 1981, defining a "significant" decline arbitrarily as a reduction in the crude birthrate of 14 points or more (Table 4). In Taiwan the crude birthrate declined from 39 to 21 per thousand between 1960 and 1978 while the crude death rate declined from 7 to 5 per thousand. Therefore, Taiwan's rate of natural increase in 1978 was a relatively modest

<sup>40</sup> S. Hirashima (in Mellor and De: ni, forthcoming) spells out how the specific nature of this investment was critical to its success.

TABLE 4

CRUDE BIRTH RATES, INFANT MORTALITY, CHILD DEATH RATES, AND AGRICULTURE'S SHARE IN THE LABOR FORCE, 1960 AND 1981, IN COUNTRIES WITH SIGNIFICANT DECLINES IN FERTILITY<sup>a</sup>

Country	Crude Birthrate (Per 1,000)		Infant Mortality Rate (Per 1,000)		Child Death Rate (Ages 1-4) (Per 1,000)		Agriculture Share in Labor Force (Percent)	
	1960	1981	1960	1981	1960	1981	1960	1981
China	39	21	165	71	26	7	n.a.	69
Colombia	46	29	103	55	14	4	51	26
Costa Rica	47	30	83	27	8	1	51	29
Cuba	32	18	66	19	5	1	39	23
Korea, Republic of	43	24	78	33	9	2	66	24
Malaysia	45	31	72	30	7	2	63	50
Taiwan	39	21 <sup>b</sup>	56	25	8	1	56	37
Thailand	44	30	103	53	13	4	84	76
Trinidad and To- bago	38	23 <sup>b</sup>	54	31	4	1	22	10
Tunisia	49	34	159	88	36	9	56	35
10-country average <sup>c</sup>	42	26	94	43	13	3	49	39
32 Low-income countries <sup>c</sup>	42	44	163	124	36	21	82	73
59 Middle-income countries <sup>d</sup>	43	35	127	81	22	11	62	45

<sup>a</sup> A "significant" decline in fertility is defined as a decline in the crude birthrate of 14 per thousand or more. Hong Kong and Singapore also experienced "significant" declines but are special cases as city states.

<sup>b</sup> Estimates for 1978 and 1980 for Taiwan and Trinidad respectively (World Bank 1978, 1982).

<sup>c</sup> Unweighted average.

<sup>d</sup> Population-weighted averages; these figures for 32 low-income countries exclude China and India (where the decline in the birthrate was from 44 to 35 per thousand).

Source: World Bank (1983).

1.6 percent, just half the rate that would have prevailed without the reduction in fertility.

Slowing the growth of population and labor force will clearly ease the labor absorption and other problems discussed in Section IV. In addition, interventions that lead to better health of infants and small children and reduced fertility do more than ease the task of increasing the coverage of education programs: children whose physical and cognitive development have not been impaired by frequent infections and malnutrition can be expected to perform better in school and to become more productive workers.

Moreover, a broad-based employment-oriented development strategy increases the likelihood that investments in education and health will have an economic payoff. And, in turn, widespread involvement of a country's population in processes of technical and economic change appears to facilitate a reduction in fertility.

The determinants of levels of and changes in fertility are so complex that it is not surprising that there is limited understanding of the importance of various causal factors (Robert H. Cassen 1978, p. 332). There is even sharp disagreement between those who are highly optimistic

about the effect that family planning programs can have in reducing fertility and those who contend that the effects of socioeconomic change are all important.<sup>41</sup> We find the eclectic view of W. Parker Mauldin and Bernard Berelson (1978) most persuasive. On the basis of their analysis of the impact of various socioeconomic variables and of family planning programs on fertility, they conclude that family planning effort has a significant, independent effect; but they stress that the best results are obtained when family planning programs are associated with a favorable social setting, particularly for health and education.

New policies and programs adopted in Indonesia and in Mexico in the early 1970s led to increases in family planning that cannot be explained solely in terms of the influence of socioeconomic change (Jorge Martinez Manautou 1982; McNicoll and Singarimbun 1982). The Indonesian experience is especially interesting. In Java and Bali, where the initial efforts were concentrated, the percentage of married women using contraceptives increased from 3 percent in 1971 to 50 percent in 1981.<sup>42</sup> Geoffrey McNicoll and Masri Singarimbun (1982, p. 33) stress the importance of socioeconomic and cultural factors but also emphasize that the government program "speeded the process, especially as it has affected the rural poor." The experience of both countries seems to demon-

strate the importance of strong political support and of the administrative capacity of the implementing agency or agencies.

The 10 countries in Table 4 that experienced "significant" declines in fertility are quite diverse. However, they all had family planning programs rated as "strong" or "moderate." In contrast, of 94 countries classified according to their family planning effort, more than 70 percent had weak programs or no programs at all (Mauldin and Berelson 1978, p. 110). For the 10 countries per capita GNP in 1981 ranged from \$300 in China and an estimated \$770 in Thailand to nearly \$5700 in Trinidad and Tobago. All 10 ranked relatively high in education but with considerable variation (World Bank 1983, pp. 148-49, 196-97). In 1980 agriculture accounted for less than 30 percent of the labor force in Colombia, Costa Rica, Cuba, and Trinidad whereas in China and Thailand the percentage was still 69 and 76 percent respectively. Six of the eight countries in which agriculture's share was still in excess of 50 percent in 1960 have experienced fairly broad-based agricultural development. Tunisia and especially Colombia are the exceptions; but it is noteworthy that in Colombia agriculture's share declined sharply from 51 percent in 1960 to only 26 percent in 1980. A detailed analysis of fertility change among rural households in Taiwan by Eva Muelier (1971) supports the view that active involvement in technical and economic change facilitates the spread of family planning.

Probably the most striking common feature that emerges from Table 4 is that by 1981 the infant and child mortality rates in the 10 countries were, with one exception, far below the average levels in low- and middle-income countries. Tunisia's estimated infant mortality rate in 1981 was slightly above the group average for middle-income countries, but it is significant that the reduction in both infant

<sup>41</sup> Amy G. Tsui and D. J. Bogue (1978) represent the optimistic view which Paul Demeny (1979) has challenged. Like many Marxist development specialists, de Janvry (1981, pp. 87-89) accepts Mahmood Mamdani's view that people "have large families because they are poor" and asserts that the impact of family planning programs has been "insignificant." He cites Costa Rica as a country where women, on average, have 8.6 children by the age of 34 and does not mention that since 1960 Costa Rica has realized a "significant" decline in fertility (Table 4).

<sup>42</sup> The service statistics appear to somewhat overestimate contraceptive use-rates; there is no doubt but that the increase has been remarkable (McNicoll and Singarimbun 1982, pp. 70-73).

and child mortality in Tunisia between 1960 and 1981 was exceptionally large. These characteristics of countries with "significant" declines in fertility are consistent with the "child survival hypothesis" that parents are more receptive to family planning when they have confidence that their children will survive to maturity. The spontaneous change in attitudes is likely to be slow, and for some time the fertility reduction will be smaller in magnitude than the mortality reduction (S. H. Preston 1975). However, experience in a number of demonstration projects and the achievements of some national programs, seem to suggest that by linking health and family planning activities the awareness of improved survival prospects can be increased and the changes in attitudes and behavior speeded up (Carl Taylor 1977; Johnston and Anthony J. Meyer 1977; and Johnston and Clark 1982, pp. 148-54).

It was noted in Section III that there is now considerable evidence that well-designed programs which emphasize a limited range of preventive and promotional activities can reduce infant and child mortality substantially and fairly quickly. A review of 10 demonstration projects by Davidson R. Gwatkin, Janet R. Wilcox, and Joe D. Wray (1980) also indicates that the cost of such programs is low enough to be affordable even in low-income countries. There are also significant complementarities among family planning, health, and nutrition activities and other development objectives.

The availability of an appropriate technology for health, nutrition, and family planning programs does not mean that it is easy to secure the necessary political, financial, and administrative support for their adoption and implementation. Experience in Costa Rica is of special interest in demonstrating the feasibility of introducing a rural health program without the sort of social control that characterizes

communist nations such as China or Cuba (C. J. Mata and E. Mohs 1978). Recent experience in Indonesia is also promising (Jon Eliot Rohde and Lukas Hendrata 1982). Amitai Etzioni (1979, p. 556), G. P. Ness (1979, pp. 36-37), and others have stressed the importance of the involvement of local community organizations in the promotion of family planning; peer pressure may even help overcome a divergence between the private and social calculus of benefits and costs associated with limiting family size. More generally, community participation is important when "new norms and group processes are needed to support behavior change" (Frances Korten 1983, p. 195). Hence, community involvement is likely to facilitate the behavioral changes required for better hygiene, child feeding practices, and waste disposal as well as family planning. Group efforts can also reduce dependence on outside funds and personnel by mobilizing local resources, and they may lead to greater accountability and to emphasis on cost-effective preventive and promotional activities rather than individual curative care.

The policy implications of these lessons from past experience can be distilled as follows: The outlines of the actions for unimodal rural development are clear from a now wide experience and those actions can be successfully applied in a broad range of land ownership patterns. Given the diseconomies of scale, however, it is essential not to promote large-scale units on which capital resources are concentrated with a consequent misallocation of capital within a bimodal pattern of development. The organizational requirements for rural development are so complex that they require allocation of substantial responsibilities to private sectors and to local organizations and a clear setting of priorities among the activities to be carried out by the public sector. Developing necessary organizational structures and alloca-

tion of responsibilities is a time-consuming process which is greatly facilitated and accelerated by use of market forces and prices for much of the allocation. Having stated the importance of market forces it must also be recognized that their role is limited and government initiating activities and organization are crucial. Within this context, interacting health, nutrition, and family planning programs are important claimants of organizational resources: they not only directly increase human welfare but they also enhance the effectiveness of the labor force and restrain its growth in size. The latter is essential to eventual increase in real wages and accelerated growth in the incomes of the poor.

## VI. Conclusion

Will the world food equation be balanced at a high or low level? Clearly, there is no simple answer. In the future, as in the past, outcomes will vary from country to country. Achieving a balance between food supply and demand at levels high enough to eliminate malnutrition and other manifestations of poverty will require sustained and effective action to accelerate the growth of food production, to expand employment opportunities, to improve human capital, to strengthen organizational capabilities, and to slow population growth. These are complex, dynamic processes. Given their large budget share which is allocated to food the poor suffer particularly from the large and probably increasing instability of food supplies and prices.

Trade flows of agricultural commodities from developed to developing countries can be expected to continue to grow rapidly. This is because of the long-term structural forces at work, causing changes in staple food production growth rates to occur rather slowly over time and the growth rate of effective demand to increase rapidly in early stages of growth

and to recede to practically zero in mature economies. Whether these intermediate term movements cause some upward or downward movement in real prices is much less certain.

First, there is a difficult question as to the definition of real prices—deflated by “all” other prices? developing country wage rates? an index of prices of developed country manufactures? or developing country manufactures? The answer surely matters. Second, within the vast panoply of influential forces, the most important dynamic factors in relation to global food supply and demand balances are the elasticity of land input in the developed countries (because of the “stickiness” of yield changes) and the growth rate of per capita income in the developing countries. Neither of these forces is well understood or predictable, least of all the growth rate in developing countries. It is notable that high growth rates in per capita income are likely to be associated with high growth rates in domestic food production. Nevertheless, the configuration of forces is such that it is reasonable to expect that concurrent high growth rates in per capita income, in the bulk of the developing world, will cause at least some intermediate term increase in the real price of staple foods at the global level.

Although estimating aggregate nutritional inadequacies is uncertain and fraught with questions, it is clear that the needs are massive. Further, nutritional inadequacies seem inseparable from broader issues of poverty. However, the high marginal propensity of the poor to spend on food means that major reduction of poverty will bring massive increases in food consumption that will carry per capita consumption well beyond the lower levels of energy intake now prescribed by international agencies as minimum requirements—à la Taiwan. We have, therefore, emphasized that improvements in

nutrition require a set of interacting forces: accelerated growth in agriculture; wage goods production; a strategy of development that structures demand towards high employment content goods and services; increased employment; and, increased effective demand for food on the part of the poor. Agricultural growth not only satisfies the need for food to meet nutritional requirements (which is the other side of the wage-goods coin), but fosters a favorable employment-oriented demand structure as well. Agriculture's role in generating a structure of demand, favorable to rapid growth in employment, is central.

The fact of diminishing returns to agriculture in the face of population growth and limited land area make land-augmenting technological change essential to agriculture playing its productive role. It is lack of such opportunity that would be the basis for an argument of agriculture not having a comparative advantage for substantial expansion. Continuous technological change for an accelerated rate of growth in agriculture requires a complex organizational structure and massive investment in human capital—an investment fully consistent with the welfare objectives of improved food intake. The employment-oriented effective demand is most likely to arise from a smallholder agriculture, which is also fully consistent with high rates of technological change. Where labor productivity is unusually low, as in Sub-Saharan Africa, or where seasonal bottlenecks occur, labor-augmenting technological change may also be necessary.

The most common barrier to the inter-related strategy indicated is pronounced dualism in capital allocations—too much to industry and the unproductive elements of the public sector rather than to agriculture and to capital intensive elements within those, as well as to large-scale and therefore capital-intensive allo-

cations within agriculture. The outcome of the strategy will depend upon national-level decisions about macroeconomic policies, exchange rates, interest rates, and investment allocations among sectors and regions, not just within agriculture itself. Indeed the whole strategy fails if it is viewed simply as the responsibility of agriculture ministries. Higher levels of foreign economic and technical assistance can, of course, improve the prospects of success—but only if aid programs are also focused on the same high-priority, strategic objectives.

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