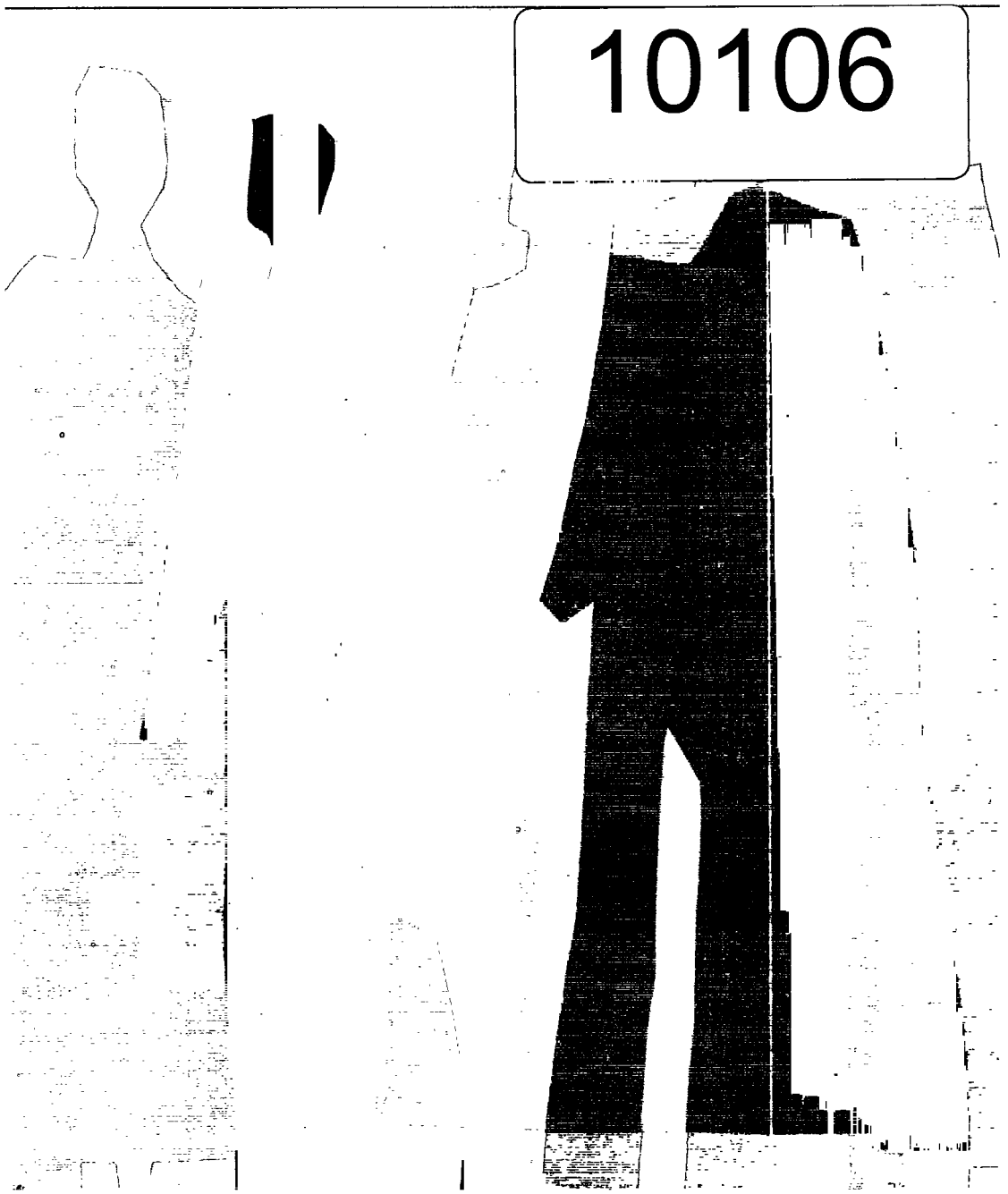
Malnourished People
a policy view

Poverty and Basic Needs Series
June 1981

Alan Berg



A. BRAVERMAN

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This is one of a series of booklets prepared by the staff of the World Bank on the subject of basic needs. The series includes general studies that explore the concept of basic needs, country case studies, and sectoral studies. The work by the Bank staff on basic needs was coordinated by the Policy Planning and Program Review Department.

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Preface

Despite the impressive level of economic growth the developing world has achieved over the past quarter century, some 800 million individuals there remain caught up in absolute poverty: a condition of life so limited by malnutrition, disease, illiteracy, low life expectancy, and high infant mortality as to be beneath any rational definition of human decency.

The self-perpetuating plight of the absolute poor has tended to cut them off from the economic progress that has taken place elsewhere in their own societies. They have remained largely outside the entire development effort, able neither to contribute much to it, nor to benefit fairly from it.

Unless specific efforts are made to bring them into the development process, no feasible degree of traditional welfare, or simple redistribution of already inadequate national income, can fundamentally alter the circumstances that impoverish them.

The only practical hope, then, of reducing absolute poverty is to assist the poor to become more productive. The World Bank has put a major emphasis on that strategy in its lending operations over the last several years: projects specifically designed to enhance the earning power of the poor.

A critical component of that approach is for governments of developing countries to provide better access for the absolute poor in their societies to essential public services, particularly basic education, primary health care, and clean water. These fundamental services—combined with the better shelter and nutrition that improved incomes can afford—are the key to the poor's being able to meet their own basic needs.

None of this can be achieved, of course, except in a climate of economic growth. But growth alone—essential as it is—cannot assist the poor unless it reaches the poor. And it does not reach the poor well enough today in much of the developing world. It all too often passes them by.

In this situation the right kind of public services are those which not only reach the poor, but help them alter their personal circumstances so that their own inherent potential can be more fully realized.

What the Bank's experience clearly demonstrates is that investment in the absolute poor's human development is not merely more equitable social policy, but very sound economics as well.

Robert S. McNamara

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Chapter 1
The Need for Nutrition Actions

Nutrition is fundamental to life, work, and well-being. Inadequate nutrition—or malnutrition—is responsible for human and economic waste of consequential proportions. In developing societies, malnutrition plays a part in substantial numbers of deaths, and inadequate diet and related illness interfere with the learning ability, capacity to work, behavior, and well-being of large segments of the populations. The nutritional state of the populace both influences and reflects the level and pace of national development. Adequate nutrition therefore must be viewed not only as an objective but also as a means of economic development. And efforts to attack the problem of malnutrition must address the needs of people of all ages and both sexes—in contrast to the tendency of most national nutrition planning to focus almost exclusively on the needs of children and pregnant and lactating women.

It is now apparent that the dominant malnutrition problem in large populations is insufficient intake of food energy, or calories, which is related essentially to the problem of inadequate income. Steps to increase the per capita incomes of the poor—ranging from increased employment to reduced population growth—will have a fundamental and powerful effect on a country's nutritional status. In the long run, nutritional improvement will depend largely on national economic growth and the pattern of that growth. But for most of the world's malnourished, the growth process is too slow. Even under optimistic growth assumptions, national growth would take much more than a generation to push nutrition to adequate levels. The process is long because per capita incomes of the poor increase slowly and because their energy intake rises less than half as rapidly. People tend to spend proportionately less on food as their incomes rise and to consume more expensive, though more nutritious, foods such as fruits and milk. They tend also to switch from low-cost sources of energy to more expensive sources, even though those shifts—from coarse grains to polished rice, for example—may cause losses in nutritional value. Such shifts tend to occur even in low-income households where energy intakes are inadequate.[1]

Malnutrition in large populations has been measured primarily by comparing people's actual diets with what nutritionists regard as adequate diets. Opinions differ, however, as to what is adequate. The energy, or calorie, requirements established by the Food and Agriculture Organization of the

United Nations (FAO) and the World Health Organization (WHO) are considered by some to be too high. Others believe that while people can adjust their output of energy to accommodate lower intakes, this adjustment is part of the problem rather than its solution. The argument is moot, however, when the question becomes, How many more people die as the number adequately nourished declines? For this study, the effect of malnutrition on mortality was tested through multivariate analysis of data from thirty-nine countries.* The findings are striking. Energy deficiency is a key determinant of life expectancy, growth, and both infant and child mortality. More important for policy, the effects of energy deficiency cannot be explained away by inadequate income, health care, or education. Income is a primary determinant of energy (or calorie) deficiency, but energy deficiency is a better indicator than income of life expectancy, growth, and mortality, and it remains statistically important even after the influences of education and health programs have been controlled for. Even when famine is not a problem, inadequate energy intake has a significant effect on the death rate. Analysis of several estimates of mortality for 1978, a good crop year in most countries, suggests that malnutrition was a factor in the deaths of at least 10 million children.

A traditional response to the nutrition problem has been to grow more food. Increasing the food supply is fundamental to meeting the problem of inadequate nutrition, but the often impressive agricultural development of the past twenty years has demonstrated that it is not enough. At the height of India's Green Revolution, for example, while agricultural production in the Punjab became a model for that of the world, the poor nutritional status of the low-income population did not improve.[2] There is widening recognition that programs aimed at increasing the production of food, even if they are successful, must be accompanied by efforts designed to affect the distribution of income and patterns of diet.

The present world agricultural output per capita of grain alone could supply everyone with more than 3,000 calories and 65 grams of protein daily. If distribution of that production were ideal, nearly all the 500 million malnourished people in the world would be well nourished. Crude as the calculation is, the obvious disparity between reality and possibility justifies the search beyond agricultural science and production techniques for means of meeting basic needs for nutrition.

Solutions to the problem of malnutrition are not easy, and analysis suggests that responses must be more carefully differentiated by occupation and other characteristics of the malnourished than they have been. Small farmers can be helped by improving their production and their access to markets, and much attention is now justifiably given to them. An estimated 15 percent—$1.7 billion—of the World Bank's lending program in

See Appendix B for a definition of the variables used and for the multiple regression results.

fiscal 1980 was directed toward small farmers. This represents half of all the Bank's lending to the agriculture sector, an increase of $1.0 billion in five years.

Unfortunately, even if the rural development effort to reach small farmers were to be completely successful, it would not solve the problems of the urban poor, the rural poor not engaged in farming, the landless agricultural laborers, and the unemployed. In most countries these groups constitute more than half the malnourished population—and in some countries considerably more than half. Their nutritional problems demand different programs.

The extent to which the nutritional needs of a country are being met is often related to social organization. Countries politically committed to eliminating most overt malnutrition seem to be capable of doing so. Generally, if the distribution of income in a country improves, so does its nutritional status. Some countries in which per capita incomes are high have considerable malnutrition and certain low-income countries have little. Yet even among countries that have similar political and economic systems, nutritional status seems to vary. In recent years many governments have become involved in nutrition, whether for reasons of distributive justice, economic gain, or political necessity. It appears that there are compelling reasons beyond equity and compassion to attend to basic needs in nutrition.

Almost all political and development policies and activities have an effect on nutrition. It is because development efforts are largely ineffective with respect to nutrition, however, that something special in this regard appears to be needed. The problem of the malnourished can be viewed as part of a complex tangle of poverty. But malnutrition is more than a poverty problem. While virtually all those who suffer from deficiencies of food energy, or calories, are poor, not all the poor suffer from energy deficiencies or any other nutritional deficiencies. Without in any way minimizing the importance and complexity of the fundamental causes of poverty—which take us back to the shortcomings of the development process and of economic, political, and social systems—overcoming these formidable problems for most countries is likely to be a slow process. The concern of this study is with actions that can lessen malnutrition within the present generation.

Efforts to improve nutrition are often regarded as a palliative rather than as a solution to basic needs—a repugnant form of government charity, or a political act to allay political unrest. They are attacked for distracting attention from the need to change a system that has failed and for diverting and wasting resources that could be used to bring about an equitable distribution of income and wealth and broader participation by the poor in policymaking and decisionmaking. Clearly, changes must be pursued, but to forgo nutrition programs while waiting for basic change to take place is to accept avoidable human waste, damage, and death.

There is a group of nutrition programs that are widely accepted and well documented. But certain important aspects of nutrition—for example, the effects, both positive and negative, of agricultural policies on nutritional status and the potential significance of large-scale consumer food subsidies— have been generally neglected. These sometimes contentious subjects must be addressed in a serious discussion of meeting basic needs. Nutrition policy and food policy are treated separately in most countries. Here the extent to which adequate nutrition depends on building considerations of nutrition into food policy is emphasized. Widely recognized programs such as nutrition education and institutional feeding and the concomitant problems of management and implementation are treated in a highly distilled form. The links between health and nutrition are treated briefly because health problems and approaches are well reviewed elsewhere.[3] Viewing nutritional problems from the perspective of health-delivery systems, moreover, invites solutions that are limited in both outreach and scope. The objective here is to consider broad approaches to the problem of reducing deficiencies among the widest number of malnourished persons.

Chapter 2
The Many Facets of the Nutrition Problem

The need for food is second only to the need for air and water. Nutrients are required for survival, for growth and reproduction, and for the capacity to work, to learn, and to function in society. More than forty dietary nutrients that the body cannot make are essential to these processes. They include the energy-yielding substances as a group—fats, starches, sugars, alcohol—and other substances usually referred to as the "essential nutrients"—nine amino acids that are the basic components of proteins, one fatty acid, at least nineteen or twenty minerals, many of which are needed only in very small amounts, and about thirteen vitamins. Standard international levels of intake have been established only for energy, protein, three of the minerals, and eight of the vitamins (see Table 1 and Appendix E).

People whose diets fall short of these levels suffer from *malnutrition,* which is defined rigorously as the pathological condition brought about by inadequacy (or excess) of one or more of the essential nutrients. *Undernutrition* is the term applied to conditions that are the result of eating inadequate amounts of food and, thus, an inadequate supply of calories or food energy. In common usage, *malnutrition* is applied to both. Thus it serves here to reflect the fact that when their intake of food is too low, people are undernourished, because their diets supply too little energy, and are almost surely malnourished as well, because some of the essential nutrients are missing from their diets.

Most nutritionists regard insufficient intake of calories, or food energy, as the most serious nutritional problem in the world today. Until the early 1970s, protein deficiency was held to be the greatest problem. But recent surveys and studies from several parts of the world indicate that efficient use of protein depends on an adequate intake of food energy. Only among groups whose dietary staples are cassava, yams, and plantains is the lack of protein the more serious problem; in those groups, an expanded intake of energy without an expanded intake of protein could lead to serious problems, particularly in the very young. Nutrition scientists still differ over the amount of protein required. The significance of an inadequate intake of calories, however, is widely accepted. Other widespread nutritional problems, of considerable importance in some regions, are iron-deficiency anemia, whose symptoms are physical and mental sluggishness, including fatigue in physical performance; vitamin-A deficiency, which affects growth, the severity of infectious diseases, and vision and may lead to blindness; and iodine deficiency, which leads to goiter and, in severe cases, deaf-

Dietary Standards for Daily Nutritional Intake[a]

Age group	Body weight (kilograms)	Energy[b] (kilocalories)	Energy[b] (megajoules)	Protein[b] Egg or milk (grams)	Protein[b] Score 60[c] (grams)	Vitamin A[d,e] (micrograms)	Vitamin D[f,g] (micrograms)	Thiamine[d] (milligrams)
Children less than 1	7.3	820	3.4	14	23	300	10.0	0.3
1–3	13.4	1,360	5.7	16	27	250	10.0	0.5
4–6	20.2	1,830	7.6	20	34	300	10.0	0.7
7–9	28.1	2,190	9.2	25	41	400	2.5	0.9
Male adolescents								
10–12	36.9	2,600	10.9	30	50	575	2.5	1.0
13–15	51.3	2,900	12.1	37	62	725	2.5	1.2
16–19	62.9	3,070	12.8	38	63	750	2.5	1.2
Female adolescents								
10–12	38.0	2,350	9.8	29	48	575	2.5	0.9
13–15	49.9	2,490	10.4	31	52	725	2.5	1.0
16–19	54.4	2,310	9.7	30	50	750	2.5	0.9
Male adults (moderately active)	65.0	3,000	12.6	37	62	750	2.5	1.2
Female adults (moderately active)	55.0	2,200	9.2	29	48	750	2.5	0.9
Pregnant women (latter half of term)		+350	+1.5	38	63	750	10.0	+0.1
Lactating women (first 6 months)		+550	+2.3	46	76	1,200	10.0	+0.2

[a] *Energy requirements are average requirements of moderately active persons; other values are recommended daily allowances and are intended to meet the requirements of 97.5 percent of the population.*

[b] Energy and Protein Requirements, *Report of a Joint FAO/WHO ad Hoc Expert Committee, Rome, 22 March–2 April 1971, FAO Nutrition Meetings Report Series no. 52, WHO Technical Report Series no. 522 (Rome: Food and Agriculture Organization of the United Nations, 1973).*

[c] *Scores are estimates of the quality of the protein usually consumed in relation to that of egg or milk; score 60 would represent a diet based primarily on cereals, roots, and tubers.*

[d] Requirements of Vitamin A, Thiamine, Riboflavin, and Niacin, *Report of a Joint FAO/WHO Expert Group, FAO Nutrition Meetings Report Series no. 41, WHO Technical Report Series no. 362 (Rome, 1967).*

[e] *As retinol.*

[f] Requirements of Ascorbic Acid, Vitamin D, Vitamin B_{12}, Folate, and Iron, *Report of a Joint FAO/WHO Expert Group, FAO Nutrition Report Series no. 47, WHO Technical Report Series no. 452 (Rome, 1970).*

Table 1

Ribo-flavin[d] (milli-grams)	Niacin[d] (milli-grams)	Folacin[f] (micro-grams)	Vitamin B_{12}[f] (micro-grams)	Ascorbic acid[f] (milli-grams)	Calcium[h] (grams)	Iron[f,i] (milli-grams)	Zinc[f] (milli-grams)	Age group
0.5	5.4	60	0.3	20	0.5–0.6	5–10	3–12	Children less than 1
0.8	9.0	100	0.9	20	0.4–0.5	5–10	4–16	1–3
1.1	12.1	100	1.5	20	0.4–0.5	5–10	4–16	4–6
1.3	14.5	100	1.5	20	0.4–0.5	5–10	4–16	7–9
								Male adolescents
1.6	17.2	100	2.0	20	0.6–0.7	5–10	7–28	10–12
1.7	19.1	200	2.0	30	0.6–0.7	9–18	7–28	13–15
1.8	20.3	200	2.0	30	0.5–0.6	5–9	7–28	16–19
								Female adolescents
1.4	15.5	100	2.0	20	0.6–0.7	5–10	7–26	10–12
1.5	16.4	200	2.0	30	0.6–0.7	12–24	6–22	13–15
1.4	15.2	200	2.0	30	0.5–0.6	14–28	6–22	16–19
								Male adults (moderately active)
1.8	19.8	200	2.0	30	0.4–0.5	5–9	6–22	
								Female adults (moderately active)
1.3	14.5	200	2.0	30	0.4–0.5	14–28	6–22	
								Pregnant women (latter half of term)
+0.2	+2.3	400	3.0	30	1.0–1.2	[k]	8–30	
								Lactating women (first 6 months)
+0.4	+3.7	300	2.5	30	1.0–1.2	[k]	14–54	

[g] *As cholecalciferol.*

[h] Calcium Requirements, *Report of a Joint FAO/WHO Expert Group, FAO Nutrition Meetings Report Series no. 30, WHO Technical Report Series no. 230 (Rome, 1962).*

[i] *The lower value applies when more than 25 percent of the energy in the diet comes from animal foods; the higher value applies when animal foods represent less than 10 percent of the energy.*

[j] *WHO. The lower figure is for diets containing generous amounts of animal foods and refined cereals—zinc absorption 40 percent—and the higher figure is for diets based on coarse cereals and legumes—zinc absorption 10 percent.*

[k] *For women whose intakes of iron throughout life have been at the level recommended in this table, the daily intake of iron during pregnancy and lactation should be the same as that recommended for women of childbearing age who are not pregnant or lactating. For women whose status with respect to iron is not satisfactory at the beginning of pregnancy, the requirement is increased, and in the extreme situation of women with no stores of iron, the requirement can probably not be met without supplementation.*

mutism and cretinism. Which problem is of primary concern in a given population group differs with local circumstances. But caloric or energy deficiency is a significant factor in most countries and among all age groups. The food provided in programs designed to meet calorie deficiencies, moreover, commonly helps to meet deficiencies of other nutrients.

The amount of energy, or calories, that a person consumes affects his bodily processes (his basal metabolism), his physical activity, and his growth.* Energy is the only nutritional parameter regulated this way. Maintaining balance between energy expended and energy taken in thus constitutes the most basic nutritional requirement. When adults fail to meet their energy requirements, they use body tissue to make up the deficit and they lose weight. For those whose body weight is constant, the intake and output of energy are in balance. Even though that balance may be precarious, energy requirements of such persons are, by strict definition, being met; the quality both of their lives and of the society suffers, however.

When intake of nutrients is chronically low, all the body's adaptive mechanisms, both metabolic and behavioral, are fully activated to conserve the nutrients for their most critical functions. In this sense, diminished growth of children must be viewed as an adaptive physiological response to nutritional deficiency. Thus, judgments as to the adequacy of intake by children can be made only by comparing growth during a specified period to an accepted norm.†

Energy Standards

An Expert Committee convened by the Food and Agriculture Organization (FAO) and the World Health Organization (WHO) has defined the energy requirements of adults at various levels of physical activity, according to occupational category.‡ Generally, the physiological minimum amount of

Activities of the internal organs, the nervous system, and resting muscle require energy; measured under defined conditions, the sum of these activities constitutes the basal metabolism, or, when expressed at the rate at which units of energy—calories or joules—are expended, the basal metabolic rate (BMR).

†*Ideally, these judgments would be based not only on height and weight but also on other attributes that are less readily measured.*

‡*These levels are for light activity or for persons who are moderately active, very active, or exceptionally active. The FAO/WHO category that coincides with the needs of most people in the developing societies is "moderately active": eight hours spent at work—in light industry, general farm work, fishing, general construction, work in the home without mechanical household appliances—four to six hours spent sitting or moving about in only light activity, and two hours of walking, active recreation, or nonoccupational work, plus eight hours of rest. For men who weigh sixty-five kilograms and for women who weigh fifty-five kilograms, that sort of life would require an average intake of 3,000 and 2,200 calories a day respectively. Habitual intakes below these levels would cause loss of body weight if a normal pattern of activity were maintained—as it must be to meet seasonal demands in agriculture, for example.*

The level of energy intake required to sustain essential functions is not the same for everyone, of course. Men's and women's needs differ because of differences in body size and composition and because of culture-related differences in what members of each sex are expected to do. Within age and sex groups there are also differences in requirements that are attributable to natural biological variability.[1]

any nutrient required within any age and sex category to sustain essential functions is assumed to follow a normal pattern of distribution, but there is no evidence that this is true of all nutrients. Certainly, total energy requirements are not normally distributed. Among low-income segments of a population, for example, energy requirements may be less than the average for those who are urban unemployed and greater for those whose lot is hard physical labor.

Obviously there is a lower limit to the amount of energy a person must take in to care for his bodily functions and the minimum activity necessary for personal care.* If he must work, he will lose weight up to a certain limit.† Whenever possible, however, body weight is defended at the cost of reducing discretionary activity—that is, recreation and work that is not necessary to survival.

Standards established for the energy needs of children, like those for the needs of adults, are based on basal metabolism and physical activity, with an additional allowance for growth. The amount of energy needed for growth is quite small, about 2–3 percent of the total intake of a two-year-old child—about 30 calories of a required 1,360. Children whose energy intake is low become less active than they should be but continue to grow at expected rates if their intake is equal to about 70 percent of standard allowances. When their intake falls below this level, growth slows, and if low levels of feeding persist, their stature as adults is less than the genetic potential. Conversely, when intakes of food are generous, the rate of growth is accelerated, maturity is reached earlier, and adults are taller, as the progressive increase in the average height of adults in the lower socioeconomic groups in privileged societies demonstrates.[3]

One seeming peculiarity in the failure of children to grow is their inability in some instances to eat enough to meet standard requirements even though food is available in the household. Chronic infection, unpalatability or monotony of their food, reduced appetite, and the caloric density of the food may be at fault; some foods are so wet, starchy, and fibrous that under ordinary conditions children simply cannot take in enough to meet their needs. It is likely that a similar limitation exists for adults and that they require minimum amounts of fat or fatty foods if their intakes of energy are to reach standard levels.

Consequences of Inadequate Intake

If the productivity of low-income, inadequately fed workers is to be improved, their energy intake must be supplemented. Increased incomes and the market will generally, but not always, take care of that. Their

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**It is now believed that this figure, for both adults and children, is about 1.5 times the basal metabolic rate, with a coefficient of variation of about 10 percent.*

†The amount of weight loss that can be tolerated depends on the amount of reserve body fat the person has. Persons who are well nourished but not obese can lose about 20–25 percent of body weight with seemingly full recovery on refeeding.[2]

incentives to increase their output will still be a matter of choice, of course.* Similarly, programs that are designed to increase the productivity of women and children—school or kitchen gardens, small-animal production projects, and so on—or to give them additional tasks—sanitation measures, for example, aimed at improving the living conditions and health of their families—must either provide additional food for the women and children or eliminate equivalent tasks on which their energy is now spent. Even where underused resources exist, communities and individuals will not develop if the people lack the food energy to put the resources to use, to interact, and to innovate.

There has been a continuing debate as to whether small size in itself is in any way disadvantageous. Where scarcity of food is the norm, might not the nutritional savings realized from being small be decisive for survival? These questions are difficult to answer because it is difficult to isolate the nutrition factor among the deprivations suffered by affected populations. Many studies have shown, however, that the decrease in growth, in both height and weight, associated with various degrees of malnutrition is accompanied by decreases in the circumference of the head, the size of the brain, and the number of brain cells, an alteration of the metabolism of the brain—amounts of important enzymes and neurotransmitters are decreased—and, even in less-than-severe cases, a lowering of scores on tests of cognitive and sensory ability.[5] With respect to cognitive ability it does appear that bigger *is* better, under conditions in which malnutrition and other hardships inhibit growth.

Costs in Mental Development

Early malnutrition affects different regions of the brain differently, depending on whether or not cell division is still actively taking place. But all regions suffer from the decreased cell division that accompanies malnutrition in the womb and in the first year of life. Thus, infants who succumb to marasmus—a severe wasting caused by lack of food energy—in their first year of life have smaller brains with fewer cells than normal; children who die of energy-protein malnutrition that occurs in their second year of life show little deficit in the number of brain cells, but they do show decreased brain weight.[6]

The chronology of the deficiency is important to the subsequent behavioral deficits. Marasmus usually occurs during the peak period of brain development and is reflected in long-term debilitation that limits the interaction of the child with his environment and in severe deficits is

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**Workers given food supplements were found in one study to have gained weight rather than increasing their production or to have taken up more active recreational activities rather than cutting more sugarcane. If the incentive is great enough, as some wartime studies have shown, industrial production will be increased at the expense of body weight. But sustained industrial production, even in wartime, varies directly with the energy intake of workers.*[4]

reflected in his intellectual development—his development quotient is one or two standard deviations below the mean for his population group.*

The later malnutrition occurs, the less it seems to damage cognitive function. Improvement has been seen in adaptive and motor behavior after treatment of children who experienced energy-protein malnutrition later than the first six months of life, but not in those afflicted at less than six months of age. Severe, short-term energy-protein malnutrition in the second year of life generally does not retard intellectual function permanently.[8]

The structural alterations and deficits in the brain and body caused by malnutrition may be manifested in functional disability, but malnutrition may also affect development less directly. Learning problems that begin with time lost because of illness go well beyond the first year. The apathy and reduced physical activity of the malnourished child diminish his interaction with the environment and deprive him of stimulating experiences and learning opportunities that may not come again.† These are likely to be consequences of moderate malnutrition, a condition that is much more prevalent than severe malnutrition but less often studied.‡ And because malnourished children usually come from families whose level of energy intake is low, they lack the stimulus of interaction with parents and siblings.§

Limitation of growth that leads to short adult stature may reduce physical ability as well as mental ability and thus limit the earnings of workers. A direct relation has been found between body size of adults of low to normal weight and height and the capacity to perform standard work tasks, as

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*Children who have been rehabilitated after early severe malnutrition still show lags in development of motor activity, hearing, speech, social and personal behavior, problem-solving ability, coordination of eye and hand, and abstract thinking. And tracings of electrical activity of the brain reveal persistent abnormalities in response to visual and auditory stimuli. Irreversibly deficient intellectual development was evident in a group of South African children tested fifteen years after their treatment for severe marasmus in infancy. These children had decreased head circumference and faulty visual-motor activity.[7]

†Studies made in Guatemala suggest that malnutrition decreases the capacity to assimilate information and that this decrease in attention span may persist in spite of rehabilitation and cause poor performance on intelligence tests.[9]

‡In an extensive logitudinal survey of nutrition and mental development in Guatemala it was found that even mild to moderate malnutrition, when it is chronic, affects cognitive development independent of other conditioning variables.[10] And an analysis of data in the U.S. National Health Examination Survey suggests that when family background and home environment variables are held constant, poor health and nutrition of American children have significant adverse effects on IQ and school achievement; the effects of low birth weight and inferior nutritional status are especially important in low-income groups.[11]

§The culture of chronic underfeeding may keep a child from attaining his full potential, even if he is not so severely malnourished as to warrant medical attention. There is evidence that supplementing the nutrition of women during pregnancy and lactation and that of their infants after the first few months of life is beneficial. In a study of rural Mexican communities, infants in families that received supplements attained higher scores on tests of mental development and physical activity than did infants from families that did not receive supplementary nutrition.[12]

measured by rate of heartbeat and use of oxygen.* The capacity for work has, in turn, been shown to be correlated with daily output of work of Colombian and Sudanese cane cutters. In a recent study of Guatemalan agricultural laborers it was found that taller workers cut more sugarcane at all ages than did shorter workers.[13] The output of men in light industry in India has been linked to body weight.[14]

Costs in Resistance to Disease

There has long been empirical evidence to suggest that malnutrition decreases resistance to disease. Persons who are malnourished seem more likely to contract infectious diseases, to suffer more severe cases, and to die more readily from disease than those who are well nourished. Infectious diseases, when they are associated with fever or diarrhea and with high worm loads—tapeworms, hookworms, and the like—increase energy requirements. Thus malnutrition and infection appear to act synergistically, each augmenting the pathological effects of the other.

- Studies of patients in hospitals in developed countries show that those whose food intake is limited or who cannot absorb food adequately because of defects or injuries to the gastrointestinal tract become emaciated, are unable to respond adequately to challenges to the immune system, and frequently succumb to infection, even in clean environments. It is thus not surprising that undernourished children in unsanitary environments experience greater mortality and morbidity from infection than do well-nourished children. Not all immune responses are affected to the same extent. Indian children whose weights were 71–80 percent of the standard weights for their ages showed measurable deficiencies in one component of the immune system; those whose weights were 60–70 percent of standard showed deficiency in a second component as well, and it could be assumed that the risk of their contracting diseases to which they were exposed was greater. In a group of malnourished African children, immune responses returned to normal after rehabilitation with adequate feeding.[15]

The decreased ability of malnourished children to mount immune responses is an important factor in vaccination programs. The poor reactions to typhoid, diphtheria, influenza, and yellow fever vaccines that have been seen suggests that administration of vaccines, particularly those containing live attenuated viruses, may pose some additional risk to the malnourished.[16]

Serious diarrheal disease, which is closely linked to malnutrition, is the most common health problem among children in developing countries. Such ordinary childhood diseases as whooping cough and measles often push children across the margin into frank clinical states of malnutrition. In

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*These comparisons are valid only for groups with similar patterns of habitual activity and other health conditions. Function of heart and lungs declines in sedentary persons, and in severe anemia the capacity of the blood to carry oxygen is not sufficient to maintain high levels of activity.

one study, measles was the precipitating cause in half the cases of children who were hospitalized for malnutrition. Malnutrition is also a contributory cause in a third to a half of the deaths from diseases among children less than five years old.[17]

Costs in Infant Development

There is extensive evidence of an association between malnutrition of pregnant women and low birth weight of their infants.* Supplementation of caloric intake during pregnancy does increase the weight of the infant at birth. This suggests that measures to improve nutrition of the fetus, and thus birth weight, might be more effective in reducing infant mortality and less costly than providing intensive medical care for the mass of underweight and premature babies born to undernourished women.[20]

Pregnant women who have suffered early malnutrition and enter pregnancy in a depleted state run high risks of miscarriage, premature delivery, and stillbirth. The demands of pregnancy and lactation impose a serious strain on their already deteriorated physical condition, and their increased body weight increases the amount of energy they need to do their work. The high incidence of nutrition-related disorders—edema, goiter, anemia, osteomalacia—and premature appearance of aging among women in developing countries indicate that the problems of mothers are serious.[21]

Until recently, it was generally thought that at least the quality of milk if not always the quantity remains adequate in a malnourished mother.† It has been found, however, that milk from malnourished mothers is low in vitamins, its fat content is below normal, and its protein content is at the lower limit of the normal range.[23]

In a study made in the United States in 1969 a perinatal mortality rate of 12.4 per 1,000 live births was found among infants weighing 3,001–4,000 grams; the rate doubled when birth weights were 3,000 grams or less. Surveys show mean birth weights between 2,700 and 3,000 grams in developing countries, while in Western industrial nations the mean is 3,300 grams.[18] Small and immature babies have much lower potential for survival than those weighing about three kilograms and born at term. Low weight at birth has been found to be the main determinant of infant mortality when age, race, and socioeconomic conditions are considered. Infants of low birth weight are forty times as likely to die before they are a month old and five times as likely to die between the ages of one month and a year as infants of normal birth weight. There is also a high incidence of visual and hearing defects, cerebral palsy, and epilepsy among infants having low birth weights. In a comparison of neonatal mortality rates, although mortality was higher in a Guatemalan Indian village than in a sample U.S. population, the differences proved to be slight when birth weight was taken into account.[19]

†*It is generally agreed that a healthy, well-fed, lactating woman produces enough milk of sufficient quality to meet the nutritional needs of a healthy infant during the first six months of life. If the woman's intake of energy is less than the sum of her own needs for metabolism and physical activity and the cost of lactation, then lactation will be maintained to some extent at the cost of her tissues. The malnourished woman's period of adequate lactation is shorter than normal, however, and even in healthy women in developed countries, there is new evidence that low body weights and low intakes of food are associated with poor lactation. There is also limited evidence that supplementing the diet of poorly nourished mothers increases the volume of milk.*[22]

Costs in National Development

Improved nutrition as a means of reducing deaths, lessening the severity of infections, and preventing various forms of retardation, blindness, anemia, and other malnutrition-related problems is, in itself, sufficient justification for investment in better nutrition. Adequate nutrition is now widely accepted as part of the purpose of development and need not be justified as a means to development. The case for investment in better nutrition, however, extends also to many of the processes that contribute to national growth.[24]

Productivity. Overcoming deficiencies in nutrition produces stronger, more energetic workers, reduces the number of work days lost because of illness, lengthens the working life span, and increases cognitive skills. The flow of earnings is thereby increased above what it would have been in the absence of improved nutrition and health.[25]

Education. Because malnutrition interferes with a child's motivation and his ability to concentrate and learn, it limits the potential returns on an investment in education. As if the malnourished child's listlessness and his mother's lethargy were not a sufficient disadvantage, the youngster often misses school because of his frequent bouts with nutrition-related illnesses.* Though nutritional improvement alone may not significantly improve the learning capacity of the disadvantaged child, there is little doubt that malnutrition contributes to poor performance, to low aspiration toward higher levels of education, and to the substantial rates of scholastic failure or dropout often found among the poorly fed.

Family Planning. In many poor areas, where large percentages of children die before reaching a productive age, uncertainty and the overcompensation that it induces have been found to be significant factors in the bearing of large families. Thus, reducing malnutrition, which is the prime contributor to child mortality, appears to be a necessary part of efforts to reduce birth rates. If a substantial further reduction of child mortality is a precondition of reducing the number of births desired, the sooner action is taken the better. The longer action is delayed, the larger will be the population base from which future generations will be reared.[26]

Redistribution of Income and Other Economic Benefits. Nutrition programs can be a direct and effective way of redistributing income. Most organized activities dealing with nutrition are of direct benefit to those in need, boosting both the health and the real incomes of the poor.† The large

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**In four Latin American countries, children missed more than an average of fifty school days a year because of illness; this constitutes as much as a third of the scheduled school days.*

†*Nutrition programs in Botswana can increase the income of the poorest 30 percent of the population by almost an eighth. Food programs in Lesotho can provide a family with almost as much income as a two-acre farm.*[27]

income earned by the well-nourished worker will improve the living standards and probably the future productivity of his dependents. And reducing the incidence of communicable diseases among the adequately nourished will bring economic benefits to others by reducing their exposure to disease.

Social Mobility. Changes in nutrition can also be expected to have some intangible effects. In societies that place a premium on social mobility, a strong obstacle to attainment of this goal may be the intellectual loss caused by malnutrition. A child's chances for advancement are greatly restricted if he is malnourished, no matter what else he may be offered by education or by other means designed by policymakers to facilitate upward movement within a society.

Well-being. In some ways the most important benefit of better nutrition is its contribution to human well-being. Even those who are economically very poor have the potential for enjoying a wide range of intangible benefits that are not quantifiable in the national accounts—nature, love, friends, the joy of children. Those who are apathetic and physically debilitated by frequent bouts with nutrition-related diarrhea and other ailments that accompany malnutrition, however, cannot enjoy these potential riches. It is well-being more than income that determines whether a person has the capacity to enjoy certain fundamental sources of satisfaction. It is not likely that in the near future many low-income countries can provide a very much wider range of material goods to those at the lower levels of income, but it may be within the power of public policy to improve the level of nutrition, which, in turn, can increase the capacity of a substantial part of the population to enjoy whatever sources of human satisfaction are available.

Chapter 3
The Short-run Inadequacy of the Growth Process

The traditional response to the problem of improving nutrition has been to focus on supply and thus to attempt to produce more food. As the low demand and low purchasing power among the poor and malnourished have been recognized, increased attention has also been given to the need for faster growth in the incomes of the poor. Bringing about growth in the incomes of the poor will depend not only on increasing the per capita amount of national income but also on the distribution of that income. The relative prices of staple foods, which are governed primarily by the rate at which the supply grows in relation to growth in the demand, are another important element of nutritional adequacy. And the relation of growth in intake of food to growth in incomes is yet another influential factor.

In five large countries where malnutrition is a problem, perhaps half the population cannot afford diets that contain an adequate amount of food energy. In India, Pakistan, Bangladesh, Brazil, and Morocco, the shortfall of calories in the daily diets of some people is as high as 40 percent.* But the quantity of food needed to eliminate the energy deficit in these countries is the equivalent of only about 8.5 percent of the calories in the existing food supply—approximately 17 million tons of food grain. Yet a 10 percent increase in the food supply of these countries clearly could not eliminate nutritional deprivation. In India, for example, a substantial amount of malnutrition persisted despite the unusually favorable harvests of the 1977–79 crop years.

Lowering the energy requirements on which these estimates are based would not alter the fact that access to food is the nub of the nutrition problem. Estimates of the number of persons subsisting on diets that contain less food energy than is adequate are, of course, highly sensitive to the requirement levels taken as the standard. Some experts suggest that estimates

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**The period 1972–74 was the most recent three-year period for which FAO data were available at the time the analysis was performed. Per capita consumption during this period was virtually the same as that recently reported by the FAO for the nine-year average, 1969–77, in the five countries. The selection of countries was based on the availability of detailed data on food consumption by household in nationwide representative samples. The calculations and others that follow in this section were undertaken for this study by Shlomo Reutlinger and Harold Alderman.*[1]

should be based on minimal requirements for survival—the level needed simply to maintain body composition and health—while others believe they should reflect what is necessary for functioning at a reasonable level.

The standard requirements established by the FAO and the WHO, on which the calculations in Tables 2 and 3 are based, are those for average persons, classified according to sex, age, and body weight, performing at a moderate level of activity, and, in the case of children, growing at a desirable rate. In many developing countries, the norm for work and leisure activities is below these levels. Indeed, large segments of the populations of some countries subsist on energy intakes lower than the FAO/WHO recommended levels without giving evidence of deterioration in body weight or showing visible signs of malnutrition. Since there is no clear agreement about how national estimates of energy needs should be made, the estimates used here may be seen as a general description of the relative size of

Table 2

Numbers and Percentages of the Populations of Five Selected Countries Whose Energy Intakes Are below Requirements, 1972–74 and Projected for 1995[a]

		1995			
		Growth in income[b] (constant food prices)		Growth in income[b] (1 percent annual rise in food prices)	
Country	1972–74	Low	High	Low	High
	Persons having energy deficits (millions)				
India	276	243	87	351	199
Pakistan	58	37	5	72	17
Bangladesh	61	93	68	102	89
Brazil	45	41	26	50	29
Morocco	9	7	0	10	2
Total	449	421	186	585	336
	Percentage of population having energy deficits				
India	47	25	9	37	21
Pakistan	[c]	31	4	60	14
Bangladesh	77	71	52	78	68
Brazil	43	22	14	27	16
Morocco	50	22	0	33	8
Total	54	30	13	42	23

[a] *Average daily energy requirements in calories, as estimated by the Food and Agriculture Organization of the United Nations and the World Health Organization are: India, 2,110; Pakistan, 2,258; Bangladesh, 2,200; Brazil, 2,390; Morocco, 2,475. Requirements differ because of the varying percentages of the population in each age group and because of varying average body weights.*

[b] *Low and high rates of growth in income per capita are assumed to be as follows: India, 1.3* and 2.6; Pakistan, 2.0 and 3.1*; Bangladesh, 0.5 and 1.5; Brazil, 3.0 and 4.8*; Morocco, 2.1* and 4.0. Asterisks denote rates of growth achieved between 1960 and 1978.*

[c] *Reliable estimate unavailable.*

Table 3

Deficit of Calories in the Average Daily Diet of the Undernourished Population and the Aggregate Calorie Deficit as Percentage of Total Calories Consumed in Five Selected Countries, 1972–74 and Projected for 1995[a]

		1995			
		Growth in income (constant food prices)		Growth in income (1 percent annual rise in food prices)	
Country	1972–74	Low	High	Low	High
	Average daily calorie deficit in affected population				
India	357	282	268	334	239
Pakistan	228	53	35	87	37
Bangladesh	444	403	285	462	335
Brazil	468	302	291	345	388
Morocco	650	299	—	406	—
Total	353	291	271	328	266
	Calorie deficit as percentage of total calories consumed				
India	7.5	2.9	0.9	5.2	1.9
Pakistan	10.8	0.7	0.1	2.3	0.2
Bangladesh	18.7	14.1	6.7	19.3	11.1
Brazil	8.0	2.2	1.2	3.2	1.9
Morocco	15.3	2.2	0	4.6	0
Total	8.5	3.5	1.3	5.7	2.4

[a] *See footnotes to Table 2.*

the problem, as a gap between existing intakes of energy and the requirements, and not as a clear description of the prevalence of malnutrition in these populations. However, even if the standard FAO/WHO levels, which are criticized by some nutritionists as being too high,[2] represent an overstatement by as much as 20 percent—which is unlikely—the total number of persons in these five countries whose diets were deficient in energy in 1972–74 would still be about 150 million.* A direct attack on the problem of malnutrition would thus be easier and less costly than the tables imply, but the policies and the time required to bring about a change would not be materially affected.

Projected Changes through the Growth Process

If rates of growth in income of the five countries followed the high projections to 1995 used in Tables 2 and 3 and if food prices remained constant, substantial reductions could be made in the proportion of the population whose diets are inadequate in calories and in the magnitude of

*Data in the tables reflect the average energy intake of all individuals belonging to subgroups in the population that have varying levels of average income per capita. Ideally, the determination woud be based on intakes of individuals and their energy requirements. If the average calorie intake per capita of a group is lower than the national average, all individuals in the

Table 4

Levels and Growth Rates of the Supply of Food Energy Required if the Demand Is to Be Met, under Different Assumptions as to Future Incomes and Prices, in Selected Countries, 1972–74 and Projected for 1995[a]

		1995			
		Growth in income[b] (constant food prices)		Growth in income[b] (1 percent annual rise in food prices)	
Country	1972–74	Low	High	Low	High
	Annual food-grain equivalents (millions of tons)				
India	136	247	275	233	260
Pakistan	13	30	31	29	30
Bangladesh	15	28	30	26	28
Brazil	28	58	63	57	62
Morocco	4	10	12	9	11
Total	196	373	411	354	391
	Annual rate of growth in the supply (percent)				
India		2.9	3.4	2.6	3.1
Pakistan		3.7	4.0	3.6	3.7
Bangladesh		2.9	3.3	2.5	3.0
Brazil		3.6	4.0	3.5	3.9
Morocco		3.9	4.7	3.6	4.4

[a] *The rates of growth of population are assumed to be as follows: India, 2.3 percent; Pakistan, 3.1 percent; Bangladesh, 2.5 percent; Brazil, 2.9 percent; Morocco, 2.8 percent.*

[b] *See Table 2, footnote b.*

their food deprivation. This would require a quite substantial increase in the supply of food, as Table 4 indicates. World Bank projections of foods traded internationally suggest that to meet the growth in market demand, real

subgroup are judged to be in deficit. Although this calculation reflects an aggregation bias within income groups, it is a step forward in that it reduces the aggregation bias substantially from the per capita figures generally published. This technique, developed initially by Shlomo Reutlinger and Marcelo Selowsky, is not put forward as wholly satisfactory but as the best permitted by the state of the art today and as an advance over techniques used heretofore.[3] *Some in the nutrition community suggest that the requirement per capita of a lower-income group is less than the average for the whole population. They note that in the lower-income groups there is a higher ratio of children to adults, there is frequently less opportunity for physical activity—that is, there is forced unemployment—and there are many adults whose body weights are lower than average, perhaps as a consequence of malnutrition in early childhood. In turn, however, it must be noted that the average number of calories per capita required by low-income groups may be greater because they engage in occupations that require more physical exertion, their household chores are more laborious, they incur more pregnancies and do more breast-feeding, the ratio of young and middle-aged to older adults is higher, and they are subjected to more infectious diseases and parasites that impair absorption of calories. There is general agreement that calorie requirements may vary among individuals whose other characteristics are similar. Whether it is appropriate to conclude that all members of a group whose average intake is less than the average amount required are in deficit depends on the variability of intakes and requirements. Estimates of the correlation between the two of the kind reported here are not very sensitive to interpersonal variability in requirements and intakes.*[4]

prices of food must increase 25 percent—or about 1.3 percent a year—by 1995. Thus, even the projections based on the 1 percent annual increase in food prices are optimistic. The probable course of development as depicted in Tables 2 and 3 will call for extraordinary attention to growth in the national product and to its composition and distribution. There can be no deterioration in relative or absolute incomes of the poor, and there must be a high rate of growth in the availability of food. Nevertheless, the absolute size of the affected population is likely to remain large. If there is little growth in income and if food prices rise slightly, it is likely that the absolute number of this deprived population will increase. If the growth rate of income is high and the annual increase in relative food prices is 1 percent, the number of people whose diets are inadequate in calories will decline only 25 percent by 1995, but the energy deficits will drop from about 8.5 percent of the food supply of these five countries to only 2.4 percent in 1995.

The Time That Elimination of the Deficit Would Require

Projecting from actual growth rates between 1960 and 1976, only in Pakistan could it be expected that the entire population could enjoy adequate diets within less than thirty years (see Table 5). In the other countries, underfeeding of some segment of the population would persist for generations, even under optimistic prospects. Past performance of developing countries taken together (see Table 6) corresponds closely to the most pessimistic projections of changes in the underfed population of the five countries—low growth in income coupled with an annual increase of 1 percent in food prices. A reduction of a mere 8 percent can be expected in the share of the population that is underfed during the period of eight years, or approximately 1 percent a year. Since a large increase in total population is likely, this means a sizable increase in the number of underfed people.

Yet this speculation is probably optimistic, since the distribution of income tends to grow worse during the early stages of development. The traditional sector, where the poor and malnourished are concentrated, grows more slowly than the economy as a whole. In addition, world food prices increased substantially between 1960 and 1976, in spite of the moderating effect of the green revolution. Thus the real purchasing power of the poor, who spend most of their incomes on food, probably grew at a slower rate than that implied by the estimates in Table 5. It is likely that between 1964 and 1974 the percentage of the population in developing countries who were malnourished remained roughly constant, so the number of people unable to meet adequate energy standards increased significantly.

Another shred of evidence that the course of development in the past has done little to diminish the prevalence of calorie malnutrition is the record of the per capita consumption of food grain in India. It has remained essen-

Table 5

Number of Years Required for Elimination of the Average Energy Deficit in the Lowest Decile of the Population in the Normal Course of Development, in Selected Countries[a]

Country	Growth rate of per capita income (percent)	Number of years required	
		No price change	1 percent annual rise in food prices
India	1.3[a]	60	167
	2.6	30	45
Pakistan	2.0	35	49
	3.1[a]	22	28
Bangladesh	0.5	235	not possible
	1.5	79	157
Brazil	3.0	50	68
	4.8[a]	31	38
Morocco	2.1[a]	43	69
	4.2	22	27

[a] *Average annual growth rate, 1960–76.*

Table 6

Estimated Percentage Change in the Share of the Population and in the Absolute Number of Persons Having Energy-deficient Diets, by Region, between 1964–66 and 1972–74[a]

Region	Change in share of population having energy-deficient diets		Change in number of persons having energy-deficient diets	
	Diets less than FAO/WHO requirements	Diets less than 80 percent of FAO/WHO requirements	Diets less than FAO/WHO requirements	Diets less than 80 percent of FAO/WHO requirements
Africa	−1	0	27	30
Middle East	0	−31	24	−12
Asia	−11	−15	6	3
Latin America	−5	−4	21	25
All regions	−8	−11	13	10

[a] *In both periods it is assumed that the energy intakes of various groups in the population are determined by an energy-consumption function that specifies the relation between energy intake per capita and income, the distribution of income, and the supply of energy per capita. See Shlomo Reutlinger and Marcelo Selowsky,* Malnutrition and Poverty *(Washington, D.C.: World Bank, 1976). The estimates are predicated on the assumption of an energy income elasticity of 0.3, at the level of meeting requirements, and represent values interpolated from the step functions computed originally. In the absence of better information it was assumed that the relations between energy intake and income and between energy intake and the distribution of income have remained unchanged throughout the period. Differences in energy intakes, therefore, reflect changes reported by the FAO in the supplies of energy per capita during the two periods.*

tially unchanged for twenty years, averaging approximately 450 grams a day. Since the food supply per capita was essentially constant, the increase of 25 percent in average per capita incomes simply drove up the price of food grains. The poor, the increases in whose incomes averaged less than 25 percent, could buy less food than they had formerly been able to buy. In addition, bad weather in some years caused supplies to drop as much as 15 percent, driving up prices in those years by well over 15 percent. Here again those bearing the brunt of the price increases are the poor, who even in the best of times have difficulty achieving minimum levels of nutrition.

It seems almost unavoidable that growth in incomes and food production will fall far short of what is required to meet current estimates of nutritional needs. The shortfall may be less than estimates here imply if the more optimistic observers of nutritional requirements and production prospects in developing countries are right, or greater if the more pessimistic are borne out. In any event, the number of underfed persons will be staggeringly large—in the hundreds of millions. Whether the number is 200 million or several times that many, the problem of meeting the basic nutritional needs of the world is severe, and the kinds of responses needed are likely to be much the same.

Even though growth in incomes and food supply is not a *sufficient* condition for meeting basic needs in nutrition, it is a *necessary* condition. The availability of food must increase as fast as population and incomes increase. Otherwise, the relative prices of food will rise, at least partly offsetting any increases in the incomes of the poor. Tables 4 and 5 show the importance of food prices—and hence of growth in production—in reducing the numbers of the undernourished. If high priority is not given to increasing food production, prices could well rise more than the 1 percent a year estimated here; the effect on the number who are inadequately nourished and the severity of their deficit will be considerable. Balance-of-payments constraints will make it impossible for most countries to obtain a major part of the food that they need through imports.

Similarly, without rapid growth in incomes, the numbers of the underfed in 1995 will have increased by hundreds of millions in the five countries examined. There is a critical need to take the steps required for rapid, poverty-oriented growth, if the poor are to have the jobs and incomes that will enable them to afford enough food and if governments are to have the finances that will enable them to carry out nutrition programs and other measures to help the poor. And the inevitable pressures toward even more inequitable distribution of income during the early stages of development re-emphasize the need to see that the poor are beneficiaries of increases in income, through such measures as programs to help the small farmer. In short, increases in both the production of food and the incomes of the poor should receive high priority, both for the improvement of nutrition and for other reasons. Of the two, incomes might justify more attention even than

food-production programs, since less progress has been made in increasing incomes.

The Nutritional Impact of Income Redistribution with Growth

There is a large potential for reducing energy deficiences through redistributive growth. As Table 7 indicates, if growth in income is concentrated in the lower deciles of national income, it is plausible for all the countries except possibly Bangladesh to reduce energy deficits substantially with only a slight effect on the weighted national growth in income. In India, with an annual growth rate of 2.6 percent, neutrally distributed, thirty years would be required to eliminate energy deficiencies in the lowest decile (see Table 5); with a growth rate of only 2.1 percent redistributed in proportion to the energy deficit in each decile of the population, the same could be done in twenty years (see Table 7). In Brazil, with a growth rate of 2.2 percent, suitably distributed, the problem could be eliminated in half the time that would be required if the historic rate of 4.8 percent prevailed and there were no changes in the distribution of income. Similarly, a study of calorie deficiencies in Cali, Colombia, shows that they could be eliminated by a mere 0.9 percent increase of total incomes, if all the increase went to the groups whose diets were deficient. If, on the other hand the distribution of income remained unchanged, the required increase would be 18.6 percent.*

*In the calculations it was assumed that food supplies would increase sufficiently to meet the additional needs at unchanged prices.[5]

Table 7

Rates of Growth in Income per Capita Required for the Elimination of the Average Energy Deficit in All Deciles of the Population within Twenty Years, in Selected Countries

Decile	*India*	*Pakistan*	*Bangladesh*	*Brazil*	*Morocco*
			(percent a year)		
1 (lowest)	4.0	3.4	6.0	7.7	4.6
2	2.2	2.7	4.0	4.5	3.0
3	1.2	2.4	3.0	2.6	2.7
4	0.6	2.2	2.3	1.1	1.5
5	0.1	1.9	1.9	—	0.6
6	—	1.7	1.5	—	—
7	—	1.5	1.0	—	—
8	—	0.9	—	—	—
9	—	0.2	—	—	—
10 (highest)	—	—	—	—	—
			Weighted country average rates of growth[a]		
	2.1	2.2	2.5	2.2	2.2

[a] *To be politically realistic, a minimum growth rate of 2 percent was assumed for each decile.*

Any redistribution of income would, of course, also increase supply requirements above the increases projected with income spread neutrally over the population or skewed to upper-income groups. A strong, committed government could be expected to make significant progress in solving the nutrition problem by directing growth in national income toward the lowest deciles or by taxing the relatively well off and transferring some of their income to the poor. Political and economic realities being what they are, however, income growth in most countries is more likely to resemble the neutral projections. Indeed, in most countries it may be a huge task merely to hold the line at existing levels of inequality. Even with moderate success in directing general development into accelerated growth in the income of the lowest deciles—combined with a strong effort to increase food production—strong complementary measures will be required to increase the level of food consumption of the poor. The expected course of national growth is not a promising means of meeting this generation's shortfalls.

Chapter 4
The Range of Possible Actions

Since in the probable course of meeting development needs there is little prospect of providing adequate nutrition within an acceptable length of time, special steps need to be taken to improve nutrition. One important approach to the problem is the inclusion of nutritional measures in public policies that may affect nutritional well-being—for example, in policies governing the supply and prices of nutritionally important foods. A better-known and more commonly used approach to nutrition problems is through more narrowly focused projects such as institutional child-feeding programs, nutrition education, and other nutrition-related actions provided through health services.[1]

The nutritional benefits of broader public policy measures are difficult to evaluate because of the difficulty of controlling for changes in the many outside variables that large-scale programs encompass. How, then, can it be determined whether measures designed to provide better nutrition will have favorable effects? The findings of carefully controlled, smaller, more direct actions may be instructive. Recent evaluations of the results of a group of projects that integrated nutrition and health programs, for example, offer insights into the question whether special steps to improve nutrition can make a difference.* The analysis of ten carefully directed and generally well-controlled projects, summarized in Appendix C, gives a clear indication that well-designed and effectively implemented measures can promote physical growth and reduce mortality. Taken together, the ten actions present a persuasive case that, under projects in the hands of able administrators, in populations of 60,000–70,000, infant and child mortality can be reduced by a third to a half within five years. These projects, and particularly their committed and skilled leaders, may be hard to replicate, but they serve to indicate how much can be accomplished by efforts that explicity address the malnutrition problem.

Selection of Actions

The selection of particular nutrition actions within a country should flow from an analysis of the nature of the problem and of those it affects. The needs of urban and rural populations differ, as do the needs of those with land and those without. Ethnic, cultural, and occupational distinctions are

*The evaluations undertaken for this study by Davidson R. Gwatkin, Janet R. Wilcox, and Joe D. Wray appear in Appendix C.[2]

further influences in the selection of nutrition actions. Yet another set of factors concerns the nature of the problem—whether it is seasonal, whether it is regional, what means is appropriate to reach the target population. A consumer food subsidy would only be helpful, for example, if people got their food through commercial channels; even then it would be necessary to know whether they bought in supermarkets or small neighborhood stores, how often they shopped, and so on. Responses must be aimed at solving specific nutrition problems. Where there are micronutrient deficiencies—vitamin-A deficiency, for example, iron-deficiency anemia, or goiter—that can be treated with vitamins and minerals added to processed staple foods, such as wheat flour, sugar, and salt, fortification should be encouraged. The technology is simple, the costs are low, and the results can be dramatic; these simple approaches can increase receptivity to costlier and less visibly dramatic efforts.

Most malnutrition is caused either by shortages of food or by the inadequate purchasing power of certain population groups. Sometimes, however, malnutrition occurs simply because food habits are inappropriate. The problem is especially pronounced among populations undergoing rapid economic and social change. It is not uncommon, for example, to find children suffering from malnutrition in households in which incomes and food are adequate. Even among the poor, much childhood malnutrition could apparently be avoided. Although there is evidence that the diets of many of the poor are remarkably well balanced, considering their small expenditures on food, the intuitive sense that makes them so seems not to extend to discerning the needs of specific members of the family, particularly children of weaning age. Education programs can help. Families need to be taught to shift the distribution of food. Nutrition education would stress the importance of breast-feeding and the introduction of supplementary foods at the appropriate age. Overcoming strongly held habits is a difficult undertaking, but given its importance and some—albeit few—successes, it should be pursued. Educational projects that encourage the planting of community and home gardens and the processing and preserving of foods should be designed to reinforce local practice. In the Philippines, for example, a substantial part of the diet of the rural population comes from homegrown foods.[3] Agricultural programs should give attention to such substantial sources of the food supply.

Access to primary health care is important for the diagnosis of malnutrition in low-income groups—regular weighing of young children, for example, can identify those at risk, alert mothers to the problem, and serve as an entry point for nutrition supplementation. Distribution of iron, folic acid, or vitamin-A capsules, and vaccination against diseases such as measles that in combination with malnutrition cause serious illness or death are important to good nutrition, as are means of controlling the sources of infection and the high worm loads that increase requirements for nutrients. Improving environmental sanitation—especially upgrading the water

supply—is particularly significant. Health programs and food programs undertaken in the same area generally magnify each other's effects.

Whose Basic Needs?

Malnutrition affects all age groups among the very poor and contributes to suffering, low resistance to disease, and low productivity. Yet nutrition programs are customarily directed toward children less than three years old and pregnant and lactating women. The damage done by malnutrition in the early years of life and the critical role of pregnant and lactating women in the health of their children make these vulnerable groups a logical choice for concentration of limited resources. But the costs, the common family decisions to share the food with others in the family, and other difficulties of age-specific feeding programs will often make them an inefficient way of addressing basic needs.[4]

Clearly, young children and their mothers will continue to be the group given the highest priority. But in planning a program, it is preferable to start, not with a decision to assist a given group, but with the total malnourished population as a target. Priorities within the target group should be established by weighting, not by excluding all those outside a selected age group. Particular nutrition programs can be aimed at particular subgroups, as part of a package that offers the highest weighted benefits to the overall target group and satisfies benefit-cost, fiscal, balance-of-payments, socio-cultural, political, institutional, and other relevant concerns. The point of such a package is to be sure that good opportunities for addressing nutrition problems are not missed because of mistaken assumptions about target groups, limited budgets, and so on.

Even efforts undertaken to reach children might in some cases be more efficient if their target were malnourished households as a whole; in many countries a large percentage of malnourished children cannot be reached effectively in any other way.*

Costs

The costs of individual nutrition actions—and even more of overall nutrition strategies—will vary widely from country to country, depending on the nature and causes of the nutrition problem, institutional capabilities, per capita income, and the funds that are available.† The higher a country's income, the higher its minimum nutritional standards and hence the costs per capita of food and administration tend to be. Measuring costs raises

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**The additional costs of broader programs are smaller than they at first seem to be. The cost per calorie of programs to feed children may be twice that of a broader subsidy program, partly because processed foods are used that are generally more expensive and partly because the costs of administration and delivery are high. In any event, part of the food distributed in programs for children is diverted in the home to other members of the family, but at a cost much higher than that of feeding these same persons through a broader program.*

†*Cost issues are discussed in greater detail in Appendix D.*

difficult questions. In many supplementary feeding programs, for example, the cost per person demonstrably helped has been several times the cost per person enrolled in the program.

Although certain nutritional efforts—such as closer scrutiny of the nutritional consequences of agricultural policies—could be undertaken without substantial budgetary costs, many of the principal actions suggested in this study would be costly. The costs of large-scale food-ration and subsidy programs, for example, tend to be high.

Opportunities to mobilize resources for nutrition will also vary substantially from country to country, depending on the overall fiscal situation and the balance of payments, the persuasiveness of the analytical and political case for expenditures on nutrition as opposed to other needs, how appealing the possibility of avoiding malnutrition is, and the ability to mobilize additional resources from external sources, domestic voluntary agencies, and community institutions.

Because combatting malnutrition has political appeal, it may be possible to raise funds to cover nutrition programs by means of special taxes. It may also be feasible to reduce expensive consumer subsidies not focused on the poor and earmark the proceeds for nutrition programs. Food and beverages with little or no nutritional value could be taxed, as could consumer luxuries in general. Taxing high-grade rice or asking consumers to pay world market prices for it might help finance the subsidy of rice of a lower grade. Although nutrition programs should not have to bear the burden of financing themselves any more than should education, for example, those possibilities for generating revenue exist, and they might in some instances be helpful in providing a political context for important nutrition initiatives.

Recurrent costs might be reduced substantially if community groups and local voluntary agencies could be engaged in the nutritional effort. This generally involves much wider local institutional and political interests than nutrition per se, but nutrition could in some cases provide the impetus for broader efforts to mobilize local resources. The potential for mobilizing community groups—a subject about which too little is known—is probably culture-specific.

Other things being equal, the higher the income of a country, the more likely it is that the basic nutritional needs can be met. The extent of the problem will generally be less and the required financial and human resources will be easier to mobilize. For middle-income countries, a reasonable target might be, for example, to bring 95 percent of all families within 10 percent of the energy and protein requirements established by the FAO and the WHO, adjusted for composition of the family and other relevant factors, within the next decade. Lower-income countries generally would have to set less ambitious targets. In either case, the initial aim should be to raise the levels of consumption among the most-deprived groups—those whose diets are deficient by more than 400 calories, for example.

Chapter 5
Promising New Avenues of Intervention: Nutrition-oriented Food Policies

The deliberate use of public policy to influence the character of production, processing, and distribution of food within a country has been generally neglected as a means of increasing the amount of food consumed by the poor. Agricultural production strategies can be adapted to put more emphasis on the nutritional needs of the poor. And food distribution and subsidy programs can be better used to reach the poor; in some countries, subsidies already serve as the largest nutrition programs, though they are not usually regarded as such.

Fresh policy approaches to large-scale food subsidies for consumers may be highly productive in addressing nutritional needs. But there are formidable constraints on their use: the degree of government interest in basic needs, the magnitude of the costs in relation to the financial capacity of the government, objections from the economic and political constituencies affected, and considerable administrative difficulties in connection with some programs, particularly national ration programs that would be aimed at reaching significant numbers of the rural malnourished. Nevertheless, the enormity of the need for improved nutrition and the thus far limited effects of nutrition efforts demand that opportunities for intervention that go substantially beyond standard approaches be considered. Food policy measures may be a productive complement to more commonly employed efforts to aid vulnerable groups.

Every government now influences, in a variety of ways, the quantities and kinds of foods being produced, traded, and consumed. Yet the nutritional effects of agricultural and food policies are seldom adequately planned or anticipated. Few countries have systematically collected data on the nutritional consequences of changes in incomes and in food prices—evidence that the nutritional implications of food-consumption patterns are given little consideration in agricultural planning or in development planning in general. Overall trends in food production and trade do not describe the nutritional well-being of a population or provide a basis for discussing policies. Fortunately, several countries—India, Indonesia, and the Philippines, for example—have begun disaggregating data concerning food consumption by income group. Analyses of these data and experience gained from certain nutrition projects have suggested several important considerations for the design of food policies with the aim of improving nutrition.

Primary Considerations for Nutrition-oriented Food Policies

Although families with very low incomes spend most of their incomes on food, many of them still do not consume nutritionally adequate amounts of food. The diets of more than 40 percent of the population in the five countries examined in Tables 2 and 3 are deficient in energy, and the diets of 15 percent or more are deficient by more than 400 calories.

The foods bought by poor families differ markedly from those bought by the rest of the population; in Indonesia, for example, the three lowest deciles of the population in income obtain about 40 percent of their food energy, or calories, from cassava and corn and 46 percent from rice, while the three highest deciles obtain about 14 percent of their food energy from cassava and corn and 59 percent from rice. In Cali, Colombia, an increase of 10 percent in the supply of beef would add three times as many calories to the daily diets of the already adequately nourished group as to the diets of the energy-deficient group. In contrast, the benefits of an increase of 10 percent in the production of cassava would be received entirely by the energy-deficient group.[1] In every country, increases in the supply of some foods would bring nutritional benefits to the poor, while increases in the supply of others would not.

The balance between protein and calories in the diets of poor people tends to be adequate—that is, the diets provide enough protein when energy intakes are adequate—even when an important share of the energy comes from such low-protein, starchy staples as cassava.* In general, people appear to be more rational in their food-consumption practices than has usually been assumed, just as has proved to be true of their agricultural production practices.†

Many of the malnourished are the families of small farmers who earn

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**The impression is widespread that diets based heavily on cassava almost always tend to be deficient in protein, with particularly adverse results for children—hence its reputation among some nutritionists as "the root of all evil." Indeed, if a child eats mainly cassava or other high-energy, low-protein food, he is almost certain to suffer from protein deficiency. There appears to be a natural upper limit to consumption of cassava, however; studies in low-income regions of India, Brazil, Zambia, and Indonesia show that more than half of all food energy comes from other sources.[2] Some persons need more protein as well as more energy, but in areas where protein intake already meets requirements—or is much closer to requirements than is the intake of calories—emphasis should be on energy. In any event, analysis of age-specific patterns of consumption should be carried out before steps are taken to encourage increased consumption of low-protein staples. Where problems are likely to emerge, adjustments can be made—in cropping patterns, for example, or in including legumes in ration programs, or in the nature and intensity of nutrition education.*

†*As noted in Chapter 4, the diets of small children—and, in some societies, of women—are less rational, particularly during periods of modernization and increased commercialization of foods. Similarly, the incidence of malnutrition is not distributed equally throughout the population. Women and children suffer disproportionately because of problems of food distribution within the family and inadequate recognition of the special needs of small children and pregnant and nursing women. Also, the demographics of poverty show a disproportionate number of women and children among income groups too poor to afford adequate diets.*

their incomes primarily from cultivation of their own or leased land. The majority, though, are landless or nearly landless agricultural laborers, those who work in other poorly paid rural or urban jobs, or the unemployed. Thus, they benefit only indirectly from production programs for the small farmer. In the state of Maharashtra in India, for example, 40 percent of those whose incomes are too low for them to be able to afford adequate nutrition are small farmers, 40 percent are agricultural laborers, and the balance are either unemployed or are in poorly paid jobs. To those who are not small farmers what matters most is the relation between their incomes, which are determined by the demand for labor on and off farms, and the cost of food. For them, the nutritionally important programs are those that provide jobs for unskilled labor, including public works or food-for-work programs.

In most countries patterns of food consumption and the nutritional adequacy of diets vary greatly among regions and between rural and urban areas. The variations are in part reflections of differences in incomes and tastes. They also reflect differences in prices that are attributable to differences in the costs of transport, production, and storage, to marketing margins, and to government pricing policies. Despite these constraints, governments can take important steps to mitigate nutrition problems in backward or isolated regions.

The nutritional adequacy of diets often varies a great deal also with the seasons. In many countries in which there is only one main harvest period, there are substantial seasonal variations in food prices. A few months after the harvest, prices begin to rise; unfortunately, this rise may well coincide with seasonally low earnings of agricultural laborers. When the peak in prices comes—generally just before the main harvest—workers require extra energy for weeding and harvesting; this is often the time of the highest incidence of malnutrition.[3] Any food policy for improving nutrition should aim at reducing seasonal fluctuations in food prices and incomes.

The nutritional adequacy of diets varies even more from year to year than with the seasons. In most poor countries, agricultural production is dependent on rainfall that is highly variable. Periodically, there are serious problems caused by droughts, infestations of pests, floods, or other natural calamities or by shortages of key agricultural inputs. Prices of food rise and incomes of farm operators and laborers decline. The result can be famine or, if relief averts large-scale death from starvation, a significant increase in malnutrition and in malnutrition-related mortality. Variations in the availability of food from year to year can be reduced if steps toward ensuring food security are taken to alter supply and demand.[4]

Agricultural Production and Nutrition

In introducing a nutrition orientation into food policy, governments must review their agricultural production plans to determine what effect agricultural policies have on the access of the nutritionally vulnerable population to food and on their incomes; they must also work out changes that emphasize achievement of nutritional objectives.

Nutritional well-being should be a prime objective of agricultural research, and production of low-cost foods that are consumed primarily by the poor needs to be emphasized. Without improved technology, for example, producers of millet and sorghum in semiarid regions can be expected to remain poor and malnourished. Agricultural research institutions have begun to devote substantial attention to the root crops and coarse grains and legumes that are the cheapest sources of food energy and protein and that are often the dietary staples of the poor. Among the root crops that seem to offer improved yields is cassava, the basic source of food energy for some 300 million people, most of whom are poor. Nobel laureate Theodore Schultz complains that agricultural research institutes have neglected farm household production research, potentially of considerable importance to nutrition.[5] Research has generally been undertaken in response to market forces that reflect purchasing power more than nutritional need and has been built on the research work of developed countries. Emphasis should be on crops favored and conditions faced by the poor and should extend to every aspect of agricultural strategy—extension services, supply of inputs, credit, and marketing—taking social as well as technical and financial viability of the poor into account. In many countries, such a reorientation would require a substantial change in the views of agricultural planners.*

When choices are to be made in the allocation of funds and manpower for increasing production of crops—of rice, for example, or of cassava—emphasis should be placed on their nutritional effect. In Indonesia, analysis of the importance of the nutritional value of specific agricultural commodities offers an example of how food policy can be examined for nutrition objectives.† Government production programs can also do much to reduce seasonal and annual variability. Research and extension efforts should be directed at improving cropping patterns with an eye toward meeting seasonal nutrition needs. In food planning, the resistance of various crops to drought, disease, and insects must be taken into account. Cassava and certain other low-cost root crops tend to be resistant to drought and to require smaller investments in irrigation and drainage than other crops; they can be left unharvested—fresh, unprocessed cassava is perishable once it has been harvested—and can be planted and harvested throughout most of the year, thereby reducing seasonal variation. Millet and sorghum also tend to be more resistant to drought than other grains. Farmers often choose lower-yielding varieties over higher-yielding but risky alternatives. Crop diversity is another common practice of low-income farmers to limit risk. While

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Planning wings of agriculture ministries in some countries, Indonesia and the Philippines, for example, have recently established units to plan and monitor the nutrition aspects and consequences of agriculture policies and programs.

†*C. Peter Timmer's country-specific analysis prepared for this study is summarized as Appendix A.*

taking formal account of these factors would make benefit-cost analysis even more complicated than it already is, these substantial benefits should not be ignored.

To help reduce seasonal, annual, and regional variability, active intervention by governments in wholesale grain trading may be required to address imperfections of the market or to improve the efficiency of private grain markets. In some cases the intervention might consist of buying large quantities of grain during seasonal lows and selling during seasonal highs, building stocks in good years and drawing them down in bad years, or buying in areas where there are surpluses and selling in areas where there are deficits. In considering possible government interventions in marketing, it is important to be aware that some such efforts in the past—in India and in some Western African countries, for example—have contributed to deterioration of the situation and have had the net effect of raising food prices. Such nutrition-oriented interventions should be undertaken only when they appear to be nutritionally required and when a government has the capacity for effective implementation of the intervention.

Between the production and consumption ends of the food chain, governments can make other important adjustments in the market that will bring about nutritional gains. At every stage in the marketing system, the nutritional quality of food may be affected. Grains that are inadequately dried at harvest or improperly stored, especially after milling, deteriorate rapidly because of the growth of microbes and funguses and infestation by insects. Investments in proper storage, at the farm and village levels as well as in larger, central locations, can reduce the loss of nutrients substantially, cutting the loss in half in fruits and vegetables. Processing methods dramatically affect the retention of nutrients—parboiled rice, for example, can retain most of the micronutrients lost when rice is polished. Government policies should be used to influence the choice of processing techniques. In other instances much might be accomplished by taking steps to make better market information available or improve farm-to-market roads. A number of governments are already active in one or more of these areas. Yet neither individual countries nor international assistance agencies have adequately explored the possibilities of intervening at the market level to improve nutrition. They should consider any economically justified marketing step that will increase the available food supply, reduce consumer prices, or help the poor in the purchase, selection, or preparation of adequate diets.

Planners must take care that changes in agricultural technology or policies do not have detrimental nutritional effects. Sometimes when food prices are falling, governments choose to export food or encourage a shift from food to nonfood crops. Although during nearly twenty years of a rural-development project in Tabasco, Mexico, agricultural production increased sixfold—while the population doubled—the nutritional status of the poorest 30 percent of the population of the project area dropped. Goals of maximiz-

ing exports and returns on investment were achieved at a cost of reducing crop diversity and stunting the growth of local food supplies.

In a shift to cash crops, even though total income may increase, heads of households may not spend enough on food to provide as much food as their families had when subsistence foods were grown.[6] In a successful coffee-growing area of Papua New Guinea overall food intake fell 22 percent below the level fifteen years earlier, before coffee was introduced.[7] Farm families also suffer in the switch to cash crops because their increased incomes cannot buy as much food at retail maket prices as the families could previously have sold at farmgate prices. If increases in income are expected to be quite large, this problem is not likely to occur, once there is an effective private or public system for marketing foods. But if increases in income are expected to be only moderate, projects that are intended to encourage the growing of cash crops must include measures to guard against a deterioration in nutrition—intensive nutrition education, for example, through extension services and plans for continued use of a portion of family lands for subsistence production.

In a recent extensive survey of studies of the relation between nutritional status and agricultural change, it was concluded that "there is reason to suspect that unless extraordinary precautions are taken to develop a distributive network and a pricing mechanism that will provide modernizing peasants with both the chance and the incentive to exchange newfound cash for nutritious food, absolute declines in nutritional status among some or all of the population can be expected."[8]

When agricultural prices are increased to improve production incentives for farmers, unskilled laborers may suffer. Their wage levels are likely to be geared largely to the cost of the prevailing least expensive diets and may adjust slowly to the sharp rise in food prices. Although increased food production could bring future food prices down, the transitional nutritional problems of those caught in between can be severe. The government must take direct steps, through wage policy and perhaps also through short-term subsidies for the benefit of these groups.

Food Distribution and Subsidy Programs

Until nutrition-oriented programs for food production and steps taken to increase the incomes of the poor begin to make the necessary contribution to meeting nutritional needs, special steps must be taken to reduce the cost to the malnourished of the food they require. The principal ways are programs that provide supplementary food free or at a nominal charge or in exchange for work, direct or indirect subsidies that reduce the cost of basic foods to consumers, and rationing that provides limited quantities of subsidized foods to eligible consumers. In certain ways, these categories may not differ sharply from one another. A large-scale take-home supplementary feeding program, for example, is little different in concept from a ration program directed to specific portions of the population.

Supplementary Feeding Programs. Virtually every country has supplementary feeding programs. These are generally the largest activities undertaken explicitly to improve nutrition. The total costs of these programs in developing countries are more than half a billion dollars a year, and much of the support is in the form of institutional and financial resources or food that would not otherwise be available. Many programs draw on nongovernment agencies that are staffed by highly committed, often unpaid volunteers. The programs are seldom broad enough to reach target groups throughout a country, although many have the potential for a substantial expansion of coverage.

Only recently have the benefits and costs of the supplementary feeding programs that have been widespread in developing countries for decades been systematically evaluated. The results are mixed.[9] Except in cases of severe food shortage, their effect on nutrition as measured by physical growth has been less than would be expected from the quantities of food energy and protein provided.* In recent reviews of programs operated for young children, however, the conclusion has been reached that physical growth may not be the most important benefit. The energy investment that does not show up in growth may be expended for increased physical activity, improvement in body composition, and restoration of normal basal metabolic rates.[10] Such programs may also have indirect and even nonnutritional benefits. To the extent that feeding of pre-school-age children leads to better performance in school and reduced rates of scholastic failure and dropout there is a greater return on the investment in education. Preliminary results of a feeding program combined with organized play and other stimulation for 24,000 pre-school-age children in the state of Pernambuco in northeast Brazil show that the rate of scholastic failure of these children is less than half that of children outside the program.[11]

Feeding programs directed to more than 100 million school children account for by far the greatest part of the supplemental feeding effort throughout the world. Their effect on nutrition is apparently diminished by problems connected with distribution of supplies, by the reduction of the children's food at home, and by concentration on children who are easy to reach. But well-run school food programs do have positive effects, both nutritionally and educationally. School attendance improves and students are reported to be more attentive and receptive to learning. For poor parents who feel that they cannot afford the modest direct costs and the earnings forgone from having their children in school, school lunches make school attendance more profitable. Because nutritional status is closely correlated with levels of parental education, helping to maintain a child in school can be expected to have subsequent nutritional benefits for him and

**A current supplementary-feeding program for women, infants, and children (WIC) from low-income groups in the United States, on the other hand, has been responsible for reducing the incidence of babies of low birth weight 40 percent. For every dollar spent on the program, three dollars has been saved in hospital costs.*

his children. Though the benefits of school food programs may not be concentrated among the age groups of highest priority, and though the programs may act indirectly as transfers of income to the children's families, the programs do help to meet basic needs.

Nevertheless, they are relatively expensive, if physical growth is used as the measure of their accomplishments. Support of the programs by educators might not be so strong if school-lunch funds could be used for other educational or nutritional purposes. School food programs have an extraordinary political appeal, however, in rich countries and poor. The support they receive in the form of international food aid, from national and local budgets, and through voluntary activities would not be readily transferable to other programs in nutrition or education. But when options exist—as when national nutrition strategies or food aid programs are being planned—the cost effectiveness of other feasible programs should be examined.

Adults, and through them their families, have been reached through food-for-work activities, which often have the added effect of creating roads, schools, storage, and other capital assets. They can be particularly useful in improving nutrition during the season when food prices are highest. The high costs of the projects—beyond the costs of wages—and the scarcity of managerial resources to plan and supervise their implementation are the main drawbacks of such programs. But where food and funds are available and other programs can provide the needed management, the use of food-for-work programs should be expanded. They are particularly attractive when nonfungible food resources are available. Cash for work is generally preferable to food for work as a means of providing local incentives to production of food, incorporating employment-generating activity into government budgets, and, in some instances, monetizing the economy. Food-for-work programs create problems similar to those of other public works programs.[12]

Supplementary feeding programs are generally worthy of encouragement, but they should be carefully evaluated for the nutritional and other benefits that they offer. They should be focused upon the neediest groups not likely to benefit from other government efforts.

Food Ration and Subsidy Programs. Food ration and subsidy programs —or food-demand programs—are expensive, both in budgeted costs and in the balance of payments. Their high aggregate costs tempt governments to depress agricultural incentives by setting domestic procurement prices at low levels or by encouraging excessive imports of food. Ration programs are difficult to administer, and they build up political constituencies that make them difficult to cut back. In South Asia they have reached more of the urban lower-middle classes than of the rural poor. It is not surprising then that many development analysts believe that ration and subsidy programs are much more part of the problem of development than of the answer to it.

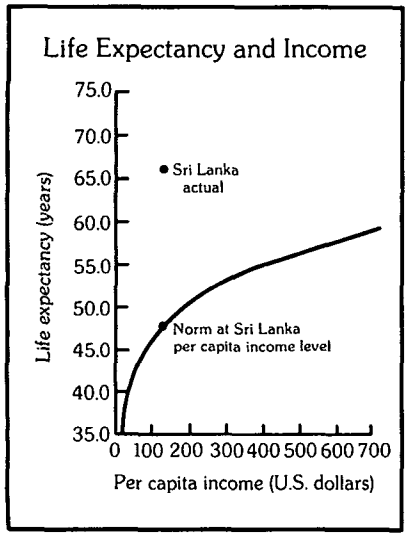
But few other nutrition actions offer the possibility of alleviating, in a reasonable length of time, any substantial part of the widespread malnutrition or preventing sizable numbers of nutrition-related deaths among poor people in developing countries. In several countries, food-demand programs have effectively reached the poor and have helped substantially to reduce severe malnutrition and deaths related to it.

The most successful food-demand programs—and among the most expensive—have been undertaken in Sri Lanka. A 1970 survey shows that the rice-ration program, which at that time included nearly the whole population, provided about 20 percent of the total calorie, or energy, intake of the participants and was equivalent in value to 14 percent of the income of the lowest-income groups. Only 5 percent of the adult-equivalent population consumed less than 1,900 calories a day. In 1975, life expectancy in Sri Lanka was sixty-six years, higher than in richer countries such as Brazil, Korea, and Malaysia and the highest recorded in the world in relation to income level; infant mortality was the lowest in relation to income. In 1975, life expectancy was 39 percent higher than would have been predicted for a country at Sri Lanka's income level, and infant mortality was 67 percent lower (see Figure 1).

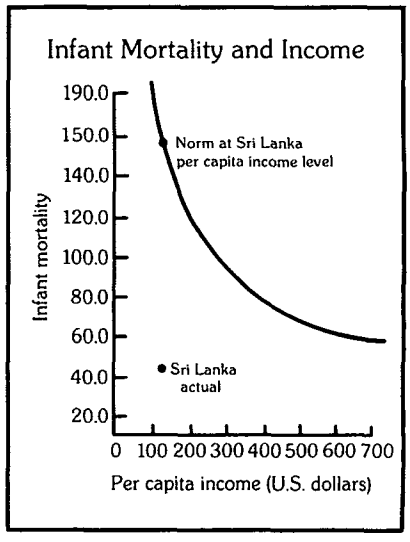
How far is nutrition responsible for Sri Lanka's long life expectancy and

Figure 1

Rates of Life Expectancy and Infant Mortality in Sri Lanka Compared to World Norms, by per Capita Income, 1975[a]



Sri Lanka was 39 percent (3.1 standard errors) above its expected value.



Sri Lanka was 67 percent (2.4 standard errors) below its expected value.

[a] *Regression equations appear in Appendix F.*

low infant mortality? Sri Lanka also has a tradition of assisting the poor in meeting other basic needs: its literacy rate is 78 percent, its health services are good, and its water supply is better than that of most other poor countries. Clearly such achievements in meeting basic needs complement one another. But the direct relation between food supply, nutritional adequacy, and the low death rate in Sri Lanka was dramatically illustrated in 1974. Ration supplies were sharply reduced and food prices on the open market sharply increased when the cost of imported food grains more than doubled. In that year the death rate increased significantly. The literacy rate had not changed, nor had the accessibility of health services or the quality of the water supply. There was no plausible reason for the increases in the death rate other than the shortage of food. The experience of Sri Lanka suggests the importance of food supplies for the poor in reducing death rates.[13]

Programs in Kerala, India, and in Pakistan also appear to have had a positive effect on nutritional status. Pakistan's wheat subsidy program is estimated to have provided half the total calories and two thirds of the protein consumed by low-income recipients.[14] In Kerala the state-financed rice ration program provided 20 percent of the calories of poor households, according to one survey; the program appears to have had a strong positive effect on nutrition.[15] Egypt is another country with very low levels of severe malnutrition, even though its income per capita is less than $400. The average diet of 3,000 or more calories a day, made possible by the extensive food-subsidy program of the government, has clearly contributed to this condition.

In Sri Lanka, food rationing, along with health and education services, served for many years as the main mechanism for improving the welfare of the poor. Not only in Sri Lanka, but in most other countries, developed or developing, food is, politically and economically, a special commodity. Thus important distinctions must be made in weighing the question whether resources used to underwrite consumer food subsidies might have better development uses. There is ample evidence, for example, that redistribution of income is politically difficult.[16] Many countries, rich and poor, that are unwilling to transfer income to the needy are willing to transfer large sums to subsidize staple foods.[17] Feeding the hungry is considered not only humanitarian and virtuous but also as contributing to political stability.

And among donor countries there is more political support for providing foreign aid in the form of food, particularly that going to the poor and malnourished, than for other forms of aid. Food aid may in some cases be the most effective means of benefiting the very poor; the record of reaching the neediest segments of society with other forms of foreign aid is not strong. Sizable portions of many countries' subsidy programs are supported through international food aid, either donated or provided on concessional terms. This food is generally made available as a result of agricultural policies of the donor countries and is not grown specifically to

assist poor countries. Thus, for reasons that range from humanitarianism to increased prices for farmers who profit from and therefore support such programs to the furtherance of foreign policy objectives, there tends to be strong support in donor countries for food aid. A reduction in that aid—and hence in the food-subsidy, child-feeding, and food-for-work programs—is unlikely to be reflected in comparable increases in other forms of aid.

The issue of fungibility, or the interchangeability of aid, is not just whether cash assistance would be available in lieu of food aid but whether there are more productive development programs that additional money can be spent on. Some countries are probably unable to absorb more investment at good rates of return. In short, it does not necessarily follow that if consumer food subsidies were cut, other, more efficient, forms of development investment would be made. Where administrative capacities are strained and rates of return on other development programs are negative, the benefits of better nutrition may make food subsidies a very good use of the available external assistance.

Concentrating on the Nutritionally Needy. The costs of food subsidies can be high: In 1975 they accounted for 21 percent of Egypt's total budgeted expenditure, 19 percent of Korea's, 16 percent of Sri Lanka's, and 12 percent of Morocco's. What a country can afford depends in part on its fiscal circumstances, its balance of payments, and its domestic food supply. It also depends on the political importance attached to the task and on the cuts the government is willing to make in other expenditures to offset food subsidies.

To keep costs down, some form of concentration on the nutritionally needy is essential. Although in Sri Lanka the expenditures in most years were less than $10 per capita, the costs of the nearly universal ration and subsidy programs became unsustainably high in the first half of the 1970s; thus in 1979 the ration program was restricted to cover only the poorest half of the population, and most of the nationwide subsidy on wheat began gradually to be eliminated. The fact that programs without targets are likely to run short of funds and supplies just when they are needed most was amply demonstrated in Sri Lanka in 1974. Had targets been introduced earlier, the increase in the country's mortality rate could have been stemmed.

Concentrating on the nutritionally needy can be accomplished in a number of ways, most of them requiring some form of rationing to prevent serious leakage outside target groups. Income is probably the best means of indicating on a large scale where nutrition problems are concentrated. Imposition of a means test, however, is difficult both politically and administratively. As income data generally are not readily available or easy to collect, assessment of eligibility is extremely difficult except among those employed in the formal sector and among farmers, whose known landholdings often put them above the eligibility level.

Some countries may be able to make use of food stamps, a variant of subsidy by income. The low-income consumer generally buys the stamps at a discount and then can use them, with no further cash payment, to buy specified foods.* Ideally consumers should have to pay as much for food stamps as they had earlier spent for the foods covered by the stamp program; the stamps they received could be used to obtain a larger amount of food, thus assuring an increase in consumption. Also, the poorer the recipient of food stamps, the greater the subsidy would be. If consumers paid less than they had formerly paid for food—or bought stamps in one period and used them in another, or sold the stamps they bought—the expected nutritional benefits would be lessened. But to the extent that these problems can be avoided and that some rough distinctions can be made among eligible households according to income, the benefits of a food-stamp program can be concentrated among the poorest groups and its nutritional effects can be increased.

Targets for nutrition programs—although generally not for consumer-demand programs—are most often set by age group, usually focusing on young children and, consequently, on pregnant and lactating women as well. Age-specific targets can be focused more sharply if income or anthropometric measurements are used as criteria. Or programs can be focused by geographic area—concentrating on drought-prone areas, for example, or other areas of concentrated poverty. A part of Colombia's nutrition program provides food to all persons in specific age groups, regardless of income level, who live in specified geographic regions where there is need. In Recife, Brazil, a city of both high-income and low-income groups, the subsidy program operates only in the poorest neighborhoods.† Establishing targets by season is a promising but generally unexplored means of efficiently providing consumer food subsidies. With subsidies that run during months when food prices are normally highest, governments

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In some circumstances the food stamp is not sold at a discount but assures access to scarce foods.

†*The neighborhood concentration is an outgrowth of lessons learned from an earlier Recife program in which those families identified through the health system as nutritionally needy were given discounts on selected foods at government supermarkets. Nutrition was improved in many cases, but the neediest group showed little change. They apparently could not pull together the minimum funds required to buy the coupons biweekly that made the discount possible. For a variety of reasons, from cash flow to limited food-storage capacity, the poorest generally buy their food daily. The supermarkets could not handle the paper work that this implied and therefore set a twice-a-month limitation on discount purchases. These problems were addressed by the neighborhood approach, which made discounts available at all times, without coupons, to everyone in the very poor areas who shopped at small commercial retail stores. Nearly everyone in these areas is in need. Estimates were made that the program costs of any "leakage" (discounted sales to those who did not need the nutritional assistance) would be considerably less than the administrative costs of establishing elaborate machinery for determining eligibility and handling coupons. The foods used in this consumer subsidy program were purchased from cooperatives of small farmers in ways that would increase their production, incomes, and nutrition.*

can cover the periods of severest nutritional vulnerability and of highest demand for the expenditure of human energy.

Such programs designed to concentrate on the nutritionally needy generally require rationing if large-scale leakages in their benefits are to be avoided. But when poor households are the target group, a careful choice of a small number of commodities to be subsidized could reduce—or even eliminate—the need for rationing and the extensive administrative machinery it requires. The best foods to subsidize are those whose cost per calorie or gram of protein is low and that have a positive income appeal for the poor and little appeal for others. Coarse grains, such as sorghum and millet, processed cassava flour, and certain legumes favored by the poor—macassar beans in Brazil, for example, whole wheat flour in rural Sri Lanka, lentils in central India, and black gram in south India—meet these criteria. These foods are generally consumed in small quantities, if at all, by persons at middle and upper income levels, so a subsidy would benefit the poor primarily.* Such subsidies on lower-status foods have rarely been tried, although Bangladesh recently conducted a large-scale test of subsidizing sorghum through its ration program. Sixty-three percent of the poorest users of the ration shop purchased the sorghum, thereby increasing their energy intake as much as 33 percent for the same expenditure.[18] In India also, sorghum was sold through government channels during the mid 1960s, when the food supply was limited.

Most subsidy programs for staples have been for high-status grains, such as wheat and rice, that the urban lower-middle and middle classes prefer and that have been widely available at concessional prices through food-aid programs. Staples such as cassava have been rejected as nutritionally inferior. With nutritional emphasis on energy intake, subsidies should now be aimed at grains or root staples with low costs per calorie and at edible oil products. For programs subsidizing cassava or other low-protein staples it must of course be ascertained that the composition of the diet is adequate to maintain correct energy-protein ratios, and care must be taken to ensure that the low-protein staple supplements are not substituted for other foods in the diet to the extent that the ratio would be altered unfavorably. Governments should not encourage intake of low-protein food alone if the total protein content of the diets of vulnerable groups would be less than 8–10 percent. Foods richer in protein should, in such instances, be added simultaneously. Subsidies on low-cost sources of protein, such as legumes, along with low-cost sources of energy, can be cheaper and can be better concentrated on the poor than can subsidies on such expensive foods as rice. Similar additional steps should be taken to increase protein con-

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*The subsidized price should not be set so low that there is danger of diversion to animal feed or exports. Commodities that are or would be used substantially as animal feed obviously should not be subsidized without rationing. Cassava, for example, should not be subsidized in Thailand, where it is fed almost exclusively to livestock, but subsidizing it could be considered in appropriate parts of Western Africa, where virtually all cassava is consumed by people.

sumption in areas and among age groups where protein deficiencies are prevalent even when intake of energy is adequate. When malnutrition in small children is a particularly serious problem, subsidies for nutritionally balanced, processed weaning foods can in some instances be helpful, and special foods for pregnant and nursing women, such as those developed in Brazil and Chile, have a place in these programs.

Aversion to switching from traditional foods is an argument sometimes raised against introducing different staples. But in many countries tastes have changed substantially among poor, malnourished people in the course of time, and when shortages were severe, quite rapidly in response to opportunities to improve nutritional status. The Indian Tamil workers on tea estates in Sri Lanka, for example, have switched from rice, their traditional staple, to wheat because it is a much cheaper source of energy. Similarly, consumption of wheat in Bangladesh and West Bengal has increased substantially since the 1960s. In the last fifteen years eating bread has become commonplace in India.

Target groups can be reached by subsidizing esthetically inferior qualities of a given staple as well as chosen staples. A subsidy on low-quality rice, for example—short-grain rice having a high percentage of broken grains—will reach more of those who are in poverty than will a subsidy on rice of a higher consumer-preference quality. In the People's Republic of China, officials are reported to have varied the value of rice coupons to encourage consumers to choose the less highly refined rices that are of greatest nutritional value.[19] Subsidies on so-called composite flours—mixtures of such low-cost foods as cassava with wheat flours—can also offer nutritional benefits. Encouraging consumption of these lower-valued foods is not, of course, to condemn poor people to consumption of poor foods but to help the needy to increase their energy intake and to save money on energy that can be used for other foods.

In short, a government can concentrate its subsidy programs on the poorest groups—and even on the most nutritionally vulnerable within these groups—in the neediest regions or neediest neighborhoods, in particularly difficult months of the year. Through such concentration, the costs of subsidy programs can be curtailed dramatically. The highly concentrated coupon program of Colombia, once it is in operation nationally, is expected to account for about 1 percent of the national budget.

Inevitably the benefits of food-demand programs leak to those outside the target groups, and resources of those within the group are diverted to purposes other than food purchases. Most nutrition programs and many other poverty-alleviation programs as well suffer such consequences. When intended beneficiaries of a food-demand program reduce their other food expenditures or sell rationed food, the program becomes at least partly a disguised transfer of income. The nutritional losses caused by substitution could, according to economic theory, be considerable, though decreasingly so as incomes declined and the percentage spent on foods increased.[20] A

rigorous comparison of the nutritional effects of a ration program on energy intake and an equivalent transfer of income on energy intake in Kerala found the ration program to be substantially more beneficial.[21] But even a program that turns out to be primarily a disguised transfer of income to the poor cannot be assumed to be a waste of funds. People whose poverty forces their families to have serious nutrition problems tend to spend more than half their incomes for food, and most of the rest is spent for other basic needs, such as shelter and clothing. Consumer food subsidies and other public feeding programs appear to be one of the best ways—and for some countries the only politically acceptable way—of dealing with the otherwise very difficult issue of income redistribution that is fundamental to breaking the cycle of poverty.

Problems of Ration Programs. The institutional problems that ration or food-stamp programs give rise to are formidable: bureaucratic inefficiency, cheating by those who should not receive the ration, unintentional exclusion of those who should receive it, the invitation to corruption inherent in the power of officials to grant ration cards. But ration and food-stamp programs whose administrative costs do not wipe out savings on food and appear to be proportionately lower than the costs of other efforts to improve nutrition or alleviate poverty will be better than programs that are without targets. In every ration program there is some helpful self-selection at work. The lengthy queues, long waits, and sometimes uncertain availability that obtaining ration supplies often involves generally prompts those who can afford to avoid these inconveniences to do so.

To improve efficiency and ease the administrative burden on government, the normal commercial market system can be used for distribution of subsidized or rationed foods. Traders in the private sector probably should be encouraged to procure, store, transport, and distribute the foods, though governments would still have to determine eligibility and issue ration books for food stamps. In bad years, when rationed supplies were scarce and private traders had a strong financial incentive to charge poor consumers more than the rationed price, the government would probably have to play a stronger role.

Risks of Disincentive Effects. The adverse effects of ration and subsidy programs on agricultural production and the prices that farmers receive for their output are matters of widespread concern. Other things being equal, subsidy programs should cause increases in demand and thus raise agricultural prices and incomes. They would only act as a disincentive to farm production if they caused imports to increase by more than the net increase they brought about in demand. If the government had to pay more for the domestic product than for the imported product, it might import the gross amount of food to be distributed, ignoring the losses to local farmers from what they previously sold to people now under the program. If the favorable cost of imports is due to an overvalued rate of exchange, the government

must respond either by devaluing the currency or by taking action to compensate for the artificial cost of imports. Donors of food aid must be alert to the possibility that excessive imports caused by incremental concessional loans can reduce and defer the budgetary cost of food imports and thus act as a disincentive to local farmers. They should either gain the agreement of recipient countries to increase demand outside the ration program to absorb the excess supplied for the ration or reduce the volume of food they supply.* Large annual variations in donor countries' surpluses that cause food aid to fluctuate are likely to cause low agricultural production in recipient countries in years of high food aid and severe economic and nutritional problems in years in which levels of food aid are low.

The bulk of the evidence, however, indicates that concern for the disincentive effects of food aid is exaggerated.[22] Properly used, food aid can help local agriculture, and it may be entirely compatible with and even necessary for providing incentives to increased production in rural development programs.[23] From a recent study of Brazil it was found that 1,000 tons of wheat under food aid would bring about an increase of more than 1,000 tons in domestic production of grain.[24] Foreign food assistance enabled the government of Pakistan to conduct ration programs in the late 1960s without depressing farm prices, something that would otherwise have been necessary as part of an effort to reduce costs. Tunisia has used food aid to maintain a dual system with higher prices to producers than are considered politically acceptable for consumers. Recent studies of Botswana, Lesotho, and Upper Volta also showed no evidence that food aid caused a significant depression of producer prices.[25] A recent survey of twenty empirical studies of possible disincentives concluded that it does seem likely that a price disincentive effect on production can be avoided—and generally has been avoided—by an appropriate combination of policy tools.[26] According to a recent analysis of country case studies, food aid "is unlikely to have a negative effect and may well have a positive impact if it is supplied in good time and in the form of locally acceptable commodities to a food-deficit country with energetic agricultural development policies and as part of a broader package of measures designed to assist a poverty-oriented development strategy. It is likely to have a negative impact if supplied under the opposite circumstances."[27]†

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*Another effect of food aid that merits watching is the lessening of pressure on governments to mobilize local resources. When food aid is sold by assisted governments in domestic markets, the resultant budgetary support reduces the need for adequate local taxation.

†The nutrition of low-income people in low-income countries can, in principle, be improved substantially by food aid. Calorie deficiencies are large, the poor spend a high proportion of their incomes on food and have high marginal propensities to spend money on food, and total quantities of food aid have been significant in relation to nutrition gaps in poor countries. In practice, most food aid has not been noticeably related to nutritional need or per capita income.[28]

Government efforts to puch down farm prices to reduce the procurement costs of food programs may also have disincentive effects. In Mali, for example, where the government held down the price of sorghum to be able to buy grain more cheaply for its urban subsidy program, domestic production of sorghum was probably inhibited. In India, the desire of the government to obtain domestic grain at low prices for distribution through "fair price" shops led to a ban in some years on trade between "food zones," which probably caused production to fall in surplus areas.* The remarkable achievements of India in grain production during the last fifteen years, however, make it clear that consumer subsidies need not be a disincentive to producers. And the long-standing consumer food-subsidy program of Sri Lanka was accompanied by a variety of incentives to farmers; in two decades, rice production tripled. Farm employment and rural incomes increased substantially.[29] Nonetheless, the need to provide incentives for domestic agricultural production is a serious one in developing countries, and attention must be given to assuring that food-demand programs are not allowed to aggravate it by depressing producer prices.

Many of the problems that have made food-demand programs unattractive—the fiscal problems and food riots in Egypt, for example—have arisen in programs whose primary goals were to keep down the urban cost of living and urban unrest—and in some instances, as in Zambia, to attract labor to urban industrial jobs—rather than the narrower goal of alleviating malnutrition. This explains why ration programs in such countries as India and Bangladesh fail to reach most of the poor: Most of the poor in the Indian subcontinent, as in Africa, live in rural areas. The ration and subsidy programs of Sri Lanka covered the poor unusually well, but a large part of the sizable expenditures made before income was made a condition of participation in the ration program in 1978 were for families not dependent on the program for adequate nutrition. Poverty-oriented food-demand programs have hardly ever been tried. Rural-development, credit, water-supply, and housing programs focused on the very poor are all relatively new instruments derived from earlier programs that were not poverty-oriented. The kind of persuasive arguments that were made to direct these programs toward the poor apply as well to food-demand programs.

Food-demand programs with the poor as targets can be a significant part of national programs for the improvement of nutrition and the alleviation of

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**The food-zone restrictions had an apparent depressing effect on incentives to farmers in surplus areas, although it was mitigated by the reductions in cost brought about by introduction of high-yielding varieties of grain. The restrictions also drove up the price of grains on the open market in deficit areas. Yet Sri Lanka had a comparatively favorable pricing situation for rice farmers, in spite of its ration program, throughout the 1950s and 1960s. The high foreign-exchange cost of food imports, very little of which was financed through foreign aid, put pressure on the government to keep the price of rice up in order to encourage domestic agricultural production. In the 1970s, as the rupee depreciated, there was a disincentive effect on production of rice and, to a greater extent, of cassava and coarse grains, for which there was no support price.*

poverty. This is particularly true of programs intended to help the urban poor, although in some countries, such as Pakistan, most people in rural areas also have access to ration shops. These programs should not be dismissed out of hand because of failures of past programs generally designed for other purposes. On the other hand, they are not without potentially serious problems. Governments should not lightly become involved in food-demand programs. Those that they undertake should be carefully directed toward specific groups. Those that are not well planned are likely to run short of funds and supplies precisely when they are needed most—at times of shortage and high prices.

When food-demand programs appear to be needed and seem likely to be politically and economically feasible, governments should examine the whole range of issues that they may raise. Initially food-demand programs should be experimental and carefully monitored; as experience is gained, planning and implementation can be improved, so as to keep both direct and indirect costs at a minimum in relation to the benefits realized.

Chapter 6
Putting New Approaches to Work

It may be fair at this point to offer the following conclusions about the nutrition problem:

- Malnutrition is a problem of major proportions.
- The nutritional condition of the poor is no better than it was a decade ago. In many countries it is worse.
- The nutrition problem is not likely to be resolved in most countries within a generation by increasing incomes and agricultural production.
- The basic problem is food-energy insufficiency, sometimes complicated by deficiencies of specific nutrients.
- The principal victims are the very poor, especially the rural poor. Most governments are not reaching them with the benefits of nutrition; few have central ministries with the outreach to do so.

Commonly expressed goals to eradicate malnutrition in the near future are unrealistic. The aim should be to overcome malnutrition in those areas, forms, and population groups in which it exerts the greatest drag on development. The problem exists in almost all countries, but within countries it differs significantly among various income groups, occupations, and regions. Malnutrition in Northeast Brazil, for example, is as severe as it is in parts of South Asia. The largest problem in sheer numbers is in the Indian subcontinent. The largest problem by proportion of population in need is in Sahelian Africa, Bangladesh, and parts of Central America.* In most parts of the world, supply of food has kept ahead of population growth. In sub-Saharan Africa, however, food production per capita has been declining for a decade. Life expectancy is fifteen years less than in Asia and may well become worse.

The need for nutritional help exists among people of all ages and both sexes, not just small children and pregnant and lactating women. The problem is particularly serious among families of landless agricultural laborers, farmers with small landholdings that rural development programs do not reach, small-scale fishermen, and the urban unemployed. Together

Disasters, both natural and man-made, would add different countries to this list in any given year; Kampuchea and parts of Eastern Africa, for example, would have to be added in 1980–81. Needs for food that arise as a result of disasters are not addressed here.

they constitute more than half the malnourished in most countries. Their nutritional condition reflects inadequacies in the availability of food, in economic and sometimes physical access to the food that is available, in knowledge of the best way to use the available resources, and in health practices that affect biological use of the food that is consumed.

Accordingly, nutrition efforts should be designed to expand food supplies—increasing production and reducing food losses—in ways that will benefit the poor, with attention focused on what is grown, who grows it, and what is stored; to increase the incomes of the poor, to improve their access to food by improving the marketing system and adjusting price policies in ways that benefit consumers without creating a disincentive to producers and by setting up special feeding programs; to try through education to bring about changes in food preferences, in the distribution of food within families, and in hygiene; to improve health and environmental conditions—water, sanitation, immunization, and management of diarrhea—and to attack specific problems of micronutrient deficiencies with mass-dose capsules or through fortification of food staples. Some changes can best—or perhaps only—be brought about through changes in government policies; others can be attacked directly through nutrition projects.

The effectiveness of different nutrition efforts and the relative importance of various determinants of malnutrition under differing conditions are now better understood than they were five years ago. Although increasing income is fundamental to increasing food consumption, for example, it is now seen to be less efficient than lowering food prices. From tightly controlled field studies it has been learned that, in addition to equity benefits, increasing the amount of food consumed and improving nutrition in other ways can significantly increase the weights and heights of total populations of children and improve their nutritional status—or at least prevent or retard its rate of deterioration. It is possible to suggest what it costs through nutrition services to avert death at an early age, to avert a day of illness, to gain an extra centimeter in growth, and to increase psychomotor development scores by a percentage point. Even some general effects of broad nutrition programs can be predicted.

Priorities

Despite the high degree of variability in nutritional needs among countries and in the causes of and appropriate responses to those needs, there are certain strategies that merit high priority in most countries. Accelerated growth in the incomes of the poor and—with few exceptions—in food production continue to be of primary importance. Attention needs to be given to the development of nutrition-oriented agricultural production policies and programs. And to ensure that food reaches those in need, food-demand programs, including the strong possibility in many instances of food sub-

sidies, are required. Broad programs, such as general consumer food subsidies, may under some circumstances be as effective in reaching target groups as narrow efforts, such as institutional feeding programs designed to reach children of preschool age.[1] Clearly, however, subsidy programs should concentrate on low-income groups instead of all income groups, on regional rather than countrywide programs, and on seasonal rather than year-round aid. Most of the larger developing countries already have sizable subsidy programs. Concentration should be on increasing their effect on nutrition, improving their efficiency in the process.

These are new areas of emphasis that can complement the well-known direct programs—nutrition education, fortification of staples with micronutrients, incorporation of nutrition-related actions into health services. The priorities that public officials assign to these various actions will depend on their countries' nutrition problems and the causes of them, the distribution of malnutrition between rural and urban areas, the extent to which the rural malnourished are small-farm families, the probable cost-effectiveness of possible programs, the institutional strength and funding capacity to mount programs, and political constraints.

The actions selected should have the aim of causing a specific improvement in specific nutritional deficiencies of a specific population within a stated period. They should be well defined as to content, costs, timing, location, and means of execution. When information to determine all this is not sufficient, projects can be developed for laying the groundwork. Action should not be limited to the gathering of data, but every operational program should include a track for evaluation and for learning from experience. Nutrition work in a country with an information base and experience in nutrition programs, such as Costa Rica, India, or the Philippines, would be very different from work in a country that had previously given little attention to nutrition.

The complexity of the nutrition problem and the multiplicity of potential nutrition actions should not be allowed to dictate complex projects. Projects should be broadly conceived with regard to content, but they should not be expected to address the many factors that affect nutritional status. Complex projects have generally been found difficult to implement effectively. Whenever it is feasible, there should be a sharp focus on a small number of critically needed actions.

Nutrition actions should be designed in ways that limit the need for managerial skills, of which many countries have a shortage. Similarly, there needs to be a clear focal point for administration of projects—multiministerial coordinating mechanisms have not proved to be particularly promising in accelerating actions. Generally a single agency should be made responsible for nutrition projects—whether an agriculture, health, or social welfare ministry, or a planning agency will depend on the nature of the project and the practices and preferences of government.

Nutrition in Agriculture

In countries where actions involving agriculture can make a significant contribution to meeting chronic needs in nutrition—urban as well as rural—specific agriculture projects designed to have an effect on nutrition should be considered. Nutrition should also be inserted as an explicit objective in agricultural and rural development projects aimed at improving the well-being of low-income groups whenever it is feasible. Malnutrition sometimes is used as a justification for such projects, but nutrition goals are not explicitly included in project objectives, and any nutritional gains occur largely by coincidence. Improvements in nutrition must be accepted as an important objective of these projects and the costs of possible actions must be taken into account. Nutrition actions should not be undertaken if their negative effects on other project goals would more than offset the gains from other actions. But modest reorientation of project designs can sometimes have significant nutritional effects without causing unacceptable changes in the achievement of other goals. When benefits of various goals are conflicting, the tradeoffs among the various goals should be weighed.

In certain agricultural and urban projects the addition of nutrition objectives might improve project design. The importance of nutrition to objectives and design will differ among projects. In Nepal, for example, a rural development project was based on an understanding of the way food consumption in the region was related to need; designation of project components, including the selection of crops, flowed from this understanding. A project in the Southern Highlands in Papua New Guinea, involving a shift from subsistence crops to cash crops, was modified to provide extension services that would help increase production in family food gardens and to include other assurances that the modernization effort would not be nutritionally negative. In Malaysia the design for a resettlement project in south Kelantan provided means for settlers to meet their nutritional needs during the first seven years, before rubber trees could be tapped. The government thus withheld a portion of the land for food crops, helped to build and stock community fish ponds, and provided nutrition education.

Often the steps required to incorporate nutritional goals are relatively easy to plan and implement—as, for example, in the choice of crops to emphasize in agricultural research projects—and need not be administratively or analytically complex. The World Bank in a 1981 research policy paper supported the goal of increased attention to nutritional implications of food production systems and a focus on foods of major importance to the diets of the poor.[2] Its object is to encourage analysis and broaden horizons in agricultural planning to include consideration of nutrition.

Projects in agriculture and rural development must not be allowed to cause a deterioriation of nutritional status. Quite unintentionally they could have harmful effects on food supply, food prices, or incomes. Both policies

and projects should be routinely examined for their nutritional effects, including, if possible, their effect on groups that are not their direct beneficiaries. Where potentially deleterious effects are discerned, the offending portions of the projects should be reoriented or nutritional components should be added to offset the negative effects.

In agriculture and rural development projects that call for evaluation, nutritional status should, whenever it is feasible, be a key measure of project performance.

Nutrition in Health

The interaction of malnutrition and infection has a far more serious effect on individuals than the combined effect of the two working independently. Consequently, the effects of nutrition actions and health programs undertaken simultaneously are greater than the sum of their effects on the same populations would be if the actions were undertaken separately. Since integration of nutrition with health services is a particularly efficient way of using limited resources, improved nutrition should be considered an explicit objective in all relevant health work.[3] Problems associated with acute forms of malnutrition and vitamin and mineral deficiencies can be much more productively attacked through health services than can the low levels of performance associated with chronic food deprivation.

Implications for Development-Assistance Agencies

Malnutrition is a major development problem that calls for development-assistance agencies to broaden both their perspective on their nutrition work and their view of their policies and lending in other sectors, particularly in agriculture. Especially within agencies involved in general development work, improved nutrition, like reductions in poverty levels, needs to be seen as an overall objective. Much of the policy and project work of development institutions affects the nutrition of low-income groups, but these agencies are not always aware of the extent and sometimes even the direction of that effect. Furthermore, they sometimes miss cost-free or low-cost opportunities for strengthening positive nutrition effects in their work in other sectors. External agencies can only make a substantial contribution to improved nutrition if they adopt it as an explicit and sustained objective. This does not demand massive budgets for nutrition projects, though identifiable nutrition projects may be the best response to the nutrition problem in some countries. What is needed primarily is a nutrition dimension in development-assistance programs, particularly in agriculture, and the systematic incorporation of food consumption issues in economic dialogues and sector work.

Development institutions and the governments of developing countries can work together to do this by:

- making a substantial effort to improve understanding of the nature and extent of the problem, of where in the chain of nutrition events the

weakest links are, and of ways in which nutrition issues can be better integrated into operations;

- incorporating nutrition concerns explicitly in agricultural and rural development project work by
  - developing projects that respond to the nutrition findings of economic and sector work,
  - analyzing the nutritional consequences of projects in agriculture and rural development, and
  - adding nutrition components to increase the benefits of projects or neutralize their possible negative effects;
- including improvement of nutritional status as an objective and part of the design of appropriate health projects; and
- setting up free-standing nutrition projects when they are the most appropriate mechanisms for achieving stated nutrition objectives.

External-assistance agencies should continue to emphasize food production, but with increased attention to those foods consumed by low-income groups and further support to projects that help to strengthen the purchasing power of the poor. They can also help government bodies fill gaps in their knowledge. Unknowns abound in this complex field. Much remains to be learned about the precise nature of nutritional deprivation, the relative importance of its causes, its consequences, and the cost-effectiveness of remedial action. A sizable gap in knowledge that the agencies should fill is on the nutritional effects of their projects, especially in agriculture and rural development. They need particularly to work on the design and implementation of simple, low-cost monitoring and evaluation systems.* Increased emphasis on nutrition is a logical extension of the effort to increase production of food, to assure consumption by those who need it. The food-policy approach can complement and broaden other work of develop-assistance agencies.

Nutrition progress will vary substantially from country to country, depending on income levels and institutional and managerial capabilities and on the priorities of governments and of the external agencies that provide assistance.[5] The extent of a country's ability to deal with malnutrition depends largely on its political determination to address the problem. An important ingredient of nutrition-oriented policies is their relation to the mainstream concerns of government planners. Policymakers must be made to realize the importance of nutrition in the formation of human capital and as a basic need—that it is both a trigger and a stop-gap in the process of national growth.

**A useful broad agenda for food and nutrition research and its potential contribution, prepared by the U.S. National Academy of Sciences, identifies four areas of priority for nutrition: determination of the functional consequences of various kinds and levels of malnutrition, determination of the specific foods that best meet nutritional needs under various circumstances, evaluation of the effectiveness of current nutrition programs, and analysis of the actual and potential effects of food policies on nutrition.*[4]

Works on Nutrition and Related Subjects by Members of the World Bank Staff and Consultants

Austin, James E. *Confronting Urban Malnutrition: The Design of Nutrition Programs.* World Bank Staff Occasional Papers no. 28. Baltimore and London: The Johns Hopkins University Press, 1980.

Basta, Samir S., Soekirman, Darwin Karyadi, and Nevin S. Scrimshaw. "Iron Deficiency Anemia and the Productivity of Adult Males in Indonesia." *American Journal of Clinical Nutrition* 32 (April 1979), pp. 916–25.

——. "Iron Deficiency Anemia and Labor Productivity." *Food and Nutrition* 3(4) (1977), pp. 15–17.

——. "Nutrition and Health in Low Income Urban Areas of the Third World." *Ecology of Food and Nutrition* 6 (1977), pp. 113–24.

Berg, Alan. *The Nutrition Factor: Its Role in National Development.* Washington, D.C.: The Brookings Institution, 1973.

——, Nevin S. Scrimshaw, and David L. Call, eds. *Nutrition, National Development, and Planning.* Cambridge, Mass.: MIT Press, 1973.

——, C. Peter Timmer, Doris Calloway, Sol Chafkin, and others. "Nutrition." Report of Study Team 9. In National Research Council, Commission on International Relations, *World Food and Nutrition Study: Supporting Papers,* vol. 4. Washington, D.C.: National Academy of Sciences, 1977. Also published by the U.S. Senate Select Committee on Nutrition, 95th Cong., 1st sess. Washington, D.C.: U.S. Government Printing Office, 1977.

Brown, Gilbert T. "Agricultural Pricing Policies in Developing Countries." In *Distortions of Agricultural Incentives,* ed. by Theodore W. Schultz Bloomington and London: Indiana University Press, 1978, pp. 84–113.

Burki, Shahid Javed, and T. James Goering. "A Perspective on the Foodgrain Situation in the Poorest Countries." Staff Working Paper no. 251. Washington, D.C.: World Bank, April 1977.

Candler, Wilfred V., and Uma Lele. "Food Security: Some East African Considerations." In *Food Security for Developing Countries,* ed. by Alberto Valdes. Boulder, Colorado: Westview Press, 1981.

Cassen, Robert. "Human Resources." In *India: Occasional Papers,* prepared by Montek S. Ahluwalia, John Wall, Shlomo Reutlinger, Robert Cassen, and Martin Wolf. Staff Working Paper no. 279. Washington, D.C.: World Bank, May 1978.

Chernichovsky, Dov. "The Economic Theory of the Household and Impact Measurement of Nutrition and Related Health Programs." In *Evaluating the Impact of Nutrition and Health Programs,* ed. by Robert E. Klein and others. New York: Plenum Publishing Corporation, 1979.

—— and Douglas Coate. "The Choice of Diet for Young Children and Its Relation to Children's Growth." *Journal of Human Resources* 15(2) (Spring 1980), pp. 255–63.

——. "An Economic Analysis of Diet, Growth, and Health of Young Children in the United States." Working Paper no. 416. Cambridge, Mass.: National Bureau of Economic Research, December 1979.

Goering, T. James. "Tropical Root Crops and Rural Development." Staff Working Paper no. 324. Washington, D.C.: World Bank, April 1979.

Harbert, Lloyd, and Pasquale L. Scandizzo. "Food Distribution and Nutrition Intervention: The Case of Chile." Agriculture and Rural Development Department, Economics and Policy Division Working Paper no. 29. Washington, D.C.: World Bank, February 1980.

Isenman, Paul. "Basic Needs: The Case of Sri Lanka." *World Development* 8(3) (March 1980), pp. 237–58.

—— and Hans W. Singer. "Food Aid: Disincentive Effects and Their Policy Implications." *Economic Development and Cultural Change* 25(2) (January 1977), pp. 205–37.

Knight, Peter T., Dennis Mahar, and Ricardo Moran. "Health, Nutrition, and Education." In *Brazil: Human Resources Special Report.* A World Bank Country Study. Washington, D.C.: World Bank, October 1979.

Knudsen, Odin K. "Economics of Supplemental Feeding of Malnourished Children: A Case of Leakages, Benefits, and Costs." Agriculture and Rural Development Department, Economics and Policy Division Working Paper no. 28. Washington, D.C.: World Bank, August 1980.

—— and Pasquale L. Scandizzo. "Nutrition and Food Needs in Developing Countries." Staff Working Paper no. 328. Washington, D.C.: World Bank May 1979.

Latham, L., M. Latham, and Samir S. Basta. "The Nutritional and Economic Implications of Ascaris Infection in Kenya." Staff Working Paper no. 271. Washington, D.C.: World Bank, September 1977.

Latham, Michael C., and Lani S. Stephenson. "Kenya: Health, Nutrition, and Worker Productivity Studies." Report to the World Bank. Washington, D.C., January 1981.

Lele, Uma. "Marketing and Pricing of Foodgrains." In *Agricultural Development in India: Policy and Problems,* ed. by C. H. Shah. New Delhi: Orient Longman, 1979.

——. "The Green Revolution: Income Distribution and Nutrition." Paper presented at the Western Hemisphere Nutrition Congress III, organized by the American Medical Association and the Canadian Medical Association, Bal Harbor, Florida, 30 August–2 September 1971.

Martorell, Reynaldo. "Nutrition and Health Status Indicators: Suggestions for Surveys of the Standard of Living in Developing Countries." Development Economics Department, Population and Human Resources Division Discussion Paper 81-32. Washington, D.C.: World Bank, June 1981.

Mohan, Rakesh, Jorge Garcia, and M. Wilhelm Wagner. "Measuring Urban Malnutrition and Poverty: A Case Study of Bogota and Cali, Colombia." Development Policy Staff, Urban and Regional Report no. 80-11. Washington, D.C.: World Bank, September 1980.

Pinstrup-Andersen, Per. "Nutritional Consequences of Agricultural Projects: Conceptual Relationships and Assessment Approaches." Staff Working Paper. Washington, D.C.: World Bank, forthcoming.

Reutlinger, Shlomo. "Food Insecurity: Magnitude and Remedies." Staff Working Paper no. 267. Washington, D.C.: World Bank, July 1977. Reprinted in *World Development* 6 (9/10) (October–November 1978), pp. 797–811. World Bank Reprint Series no. 71.

——. "Malnutrition: A Poverty or a Food Problem?" *World Development* 5(8) (August 1977), pp. 715–24. World Bank Reprint Series no. 47.

—— and Harold Alderman. "The Prevalence of Calorie-deficient Diets in Developing Countries." Staff Working Paper no. 374. Washington, D.C.: World Bank, March 1980. Reprinted in *World Development* 8(5/6) (May/June 1980), pp. 399–411.

—— and Marcelo Selowsky. *Malnutrition and Poverty: Magnitude and Policy Options.* World Bank Staff Occasional Papers no. 23. Baltimore and London: The Johns Hopkins University Press, 1976.

Scandizzo, Pasquale L., and Odin K. Knudsen. "The Evaluation of the Benefits of Basic Need Policies." *American Journal of Agricultural Economics* 62(1) (February 1980), pp. 46–57.

Scandizzo, Pasquale L., and Colin Bruce. "Methodologies for Measuring Agricultural Price Intervention Effects." Staff Working Paper no. 394. Washington, D.C.: World Bank, June 1980.

Scandizzo, Pasquale L., and Judith Graves. "The Alleviation of Malnutrition: Impact and Cost Effectiveness of Official Programs." Agriculture and Rural Development Department, Economics and Policy Division Working Paper no. 19. Washington, D.C.: World Bank, September 1979.

Selowsky, Marcelo. "The Economic Dimensions of Malnutrition in Young Children." Staff Working Paper no. 294. Washington, D.C.: World Bank, October 1978.

——. "Balancing Trickle Down and Basic Needs Strategies: Income Distribution Issues in Large Middle-Income Countries, with Special Reference to Latin America." Staff Working Paper no. 335. Washington, D.C.: World Bank, June 1979.

——. "Nutrition, Health, and Education: The Economic Significance of Complementarities at Early Ages." Paper presented at the Sixth World Congress of Economists, "Human Resources, Employment, and Development," Mexico City, 4–9 August 1980.

Srinivasan, T. N. "Malnutrition: Some Measurement and Policy Issues." Staff Working Paper no. 373. Washington, D.C.: World Bank, February 1980.

Taylor, Carl E., Arnfried A. Kielmann, Cecile de Sweemer, Robert L. Parker, Dov Chernichovsky, Inder S. Uberoi, Norah Masih, D. N. Kakar, R. S. S. Sarma, and William A. Reinke. "Malnutrition, Infection, Growth, and Development: The Narangwal Experience." Washington, D.C.: World Bank, forthcoming.

World Bank. "Nutrition." In *World Development Report, 1980,* Chapter 5: "Human Development Issues and Policies." New York: Oxford University Press, 1980.

Appendix A
Commodity-specific Orientation to a Nutrition-related Food Policy

Although manipulation of food prices has long been a favorite device for winning political favor in rich and poor countries alike, it has seldom been used specifically for improving the nutritional status of the poor. It has been used even less frequently as an intervention intended to affect the nutrition of the rural poor through the dual course of generating income by increasing food production and reducing the prices of the foods actually being consumed.

The Policy Dilemma

The apparent contradiction between these two ways of improving nutritional status is just one manifestation of the broader, fundamental problem of political economy faced by most poor countries today. Many poor countries in which there are food deficits urgently need higher real food prices as an incentive to small farmers to increase their agricultural productivity through adoption of modern technology. But those same higher food-grain prices will have a disproportionately large effect on the consumption of food by the poor. Many of these people are already suffering from inadequate intake of food, and a further reduction in their consumption may mean serious malnutrition or death.

Historically this food-policy dilemma has been resolved in two ways. First, imports of food grains are used to fill the gap between inadequate domestic production and consumption levels made possible by low food prices. Second, in some countries prices of the preferred food grain have been raised as an incentive to domestic farmers while prices of secondary grain and root crops have been kept low to protect the poor. In other countries the prices of preferred crops have been kept low to favor urban consumers, while prices for secondary grain and root crops have been set by the market.*

A number of countries that have large populations now seem to be facing

*Policy analysis in multi-staple-food economies is obviously much more complicated than that in single-food-grain economies. The consumption picture becomes more complicated because of the need to know the effect of an action concerning one food on prices of other foods by income class as well as on the price of that food. The restrictive assumptions concerning consumer behavior that are required if consumer theory is to offer significant assistance

the prospect of inadequate resources, internal or external, to increase the availability of the favored food grain rapidly enough to meet market demand at constant prices, not to mention the latent nutritional demand that would be forthcoming if prices were significantly lower. Bangladesh, Indonesia, parts of India, perhaps Pakistan, and ultimately even countries such as Nigeria and Brazil may have to face the policy dilemma of declining availability of food grains for the poorest thirds or quarters of their populations.

In the absence of massive transfers of food aid these countries will have to seek food-grain substitutes for the poorest parts of their populations while long-term investment in agricultural infrastructure, made profitable by higher prices set as incentives to production of the preferred food grain, begins to transform the outlook for domestic production.

The Experience of Indonesia

Indonesia is further along in this new approach to food policy than any other country because internal and external factors forced the issues to the surface sooner. The country is the largest importer of rice in the world, now buying between a fourth and a third of total world exports of rice. Consequently, Indonesian demand is a major factor in the determination of world rice prices. Although this position is useful to Indonesia in periods of surplus rice stocks and relatively small Indonesian needs, when rice stocks are low and Indonesia's import needs are large, how high world rice prices go is

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are so severe at the level of substitution of individual foods that little confidence can be placed in the results. Direct estimation coupled with sensible interpretation and interpolation of results is probably the only useful approach at the moment.

The production picture is also made more complicated by the possibilities for substitution if the foods to be substituted are produced domestically. Planning intensification programs for rice, for example, when maize, wheat, and barley are alternatives requires a complex balancing of output price incentives, input subsidies, credit programs, and the development of suitable seed and production technology. Attempts to raise the price of rice to increase production while keeping the price of maize low to protect the poor may simply be frustrated by the production-substitution options and the level of alternative technologies.

The complications extend to the import and domestic marketing arenas. Planning imports of food grains, especially if much of the grain will be available under the terms of food-aid programs, is far more complicated if several grains are being imported—or some are being exported—and changes in their rate of substitution are being attempted at the margin. On the domestic side, the marketing structure for the preferred grain, typically rice or wheat, is usually much more fully developed than that for secondary grains and root crops. The latter are usually regarded by government planners as inferior foods, produced primarily for subsistence, the production, marketing, and consumption of which deserve little attention from the government.

The concentration of attention in policymaking on a single preferred food grain has the advantages of simplicity, which increases the effectiveness of government programs, and of focus, which may mean that extremely scarce financial and bureaucratic resources do not become too much diluted to have any effect at all. If the resource base is adequate and the growth in the output of grain is sufficiently rapid that significant increases can be made in consumption of the food grain among the income classes that are most in need of greater intake of food, the focus on a single commodity can be quite successful in serving simultaneously as an important source of growth for the whole economy and as a means of reducing malnutrition.

largely a function of the availability of Indonesian foreign exchange and the willingness of Indonesia to consume in the present by spending proceeds from a nonrenewable natural resource, namely oil.

Domestic production of rice in Indonesia seems unlikely to increase rapidly enough in the next decade to keep up with growth in demand, much less to cut into the current need to import, unless significantly higher farm prices alter the incentives to investment at the farm level in small-scale irrigation facilities—that is, tertiary and quaternary irrigation canals. Even with the increased output brought about by irrigation it is difficult to find sources of growth that will cause rice production to grow faster than 2–3 percent a year during the next decade or so. And the higher real rice prices that would call forth even this performance would have a devastating effect on the food intake of both the urban and the rural poor if no compensating steps were taken.

It is precisely at this point that a comprehensive, nutrition-oriented food policy is needed to be sure that all possibilities are investigated. Analysis of Indonesian food-consumption patterns shows significant variation in proportions and amounts of food energy derived from rice, corn, and cassava by income class and by geographic region. Total energy derived from rice rises uniformly with income in all regions and for all but the very highest urban income groups, where substitution by wheat, meat, eggs, and fish is important. Energy derived from corn is significant only in certain rural regions. In those regions corn is an important source of energy for the poor and a not insignificant source for middle-income groups. Cassava is more widely consumed both geographically and by income group than is commonly assumed. As income rises the proportion of total energy obtained from cassava declines but not nearly so rapidly as the proportion obtained from corn. Although the composition of energy obtained from cassava may change significantly by income group, from dried cassava chips (*gaplek*) consumed by the very poor to fresh cassava consumed by better-off households, total energy intake from cassava remains significant at surprisingly high income levels, especially in rural areas.

Such descriptive pictures of Indonesian food-consumption patterns offer a tantalizing hint that the choice of individual foodstuffs by a household may depend quite sensitively on household income and urban or rural status and on the relative prices that the household must pay for the various food commodities. Determining the extent of that sensitivity as the various factors change can contribute directly to the aim of protecting and improving the nutrient intake of the poor. As the price of rice rises, for both domestic and international reasons, what will happen to the food intake of the poor? How can policy choices, especially combinations of price policies with direct agricultural production programs, soften that impact? To answer such questions parameters of food-consumption elasticity by income class are needed to determine possible shifts in consumption. At the same time the technological possibilities for producing the alternative crops

must be examined, and they must be expanded where they are seriously inadequate by world standards, as they are for producing both corn and cassava. The institutional and market infrastructure needed if production possibilities are to be translated into actual food supplies must then be determined and must be coordinated with the price policies that are being pursued with the dual purpose of providing incentives to production and changing patterns of consumption. Obviously, in the absence of technological advances, and consequent lower costs, for commodities other than rice, the dual objective of lower prices and greater consumption cannot be achieved, unless imports are used to cover the shortfall between domestic production and consumption.

There has been considerable skepticism about the sensitivity of poor consumers to changes in incomes and prices as they make their decisions with respect to food consumption. There has almost never been time-series evidence of large price elasticities for basic foodstuffs, and small shortfalls in production typically bring about very large price swings—at least on international markets, where trade is a small residual of collective national patterns of production and consumption. Single estimates of income elasticities of basic grains have also tended to be quite small, and some consensus seems to have been reached in international food-policy circles that elasticities of both income and price for wheat and rice were unlikely to exceed 0.5 for any society as a whole—that is, consumption of rice and wheat will increase at half the rate at which incomes and prices increase—the coefficients being perhaps somewhat larger for the poorer parts of society. At the same time, income elasticities for the inferior foodstuffs such as corn, other coarse grains, and root crops have been thought to be significantly negative at all income levels, with very little price responsiveness.

The results of econometric analysis of Indonesian data on household spending contradict all this conventional wisdom.* These results show large and highly significant elasticities of income and price for the three basic foodstuffs, rice, corn, and cassava, that account for three quarters of an average Indonesian's daily energy intake. These elasticities vary systematically with income class and confirm the hypothesis that poor consumers are highly sensitive to changes in incomes and prices as they choose their sources of calories.

The range in elasticities of income or expenditure for the three basic foodstuffs is quite remarkable. Fewer than 5 percent of the Indonesian population have negative elasticities of income for rice, and 10–15 percent have an elasticity near 1. Nearly 40 percent of the population have a positive elasticity of income for corn, and that elasticity is 0.5 or higher for an eighth of the population of 140 million. Fresh cassava is not a food only of the poor but is eaten in nearly all regions and at most income levels. The income elas-

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**Based on the 1976 Survey Social Ekonomi Nasional (SUSENAS V, the National Household Expenditure Survey) of the Central Bureau of Statistics of Indonesia.*

ticity remains positive for two thirds of the population of Indonesia, and a third of the population have an elasticity of expenditure for fresh cassava that is in excess of 0.55. The overall effect of the various elasticities of income for each commodity and each income class is summarized in Table A.1. Since the income elasticity for calories from foodstuffs other than rice, corn, and cassava is likely to be at least as high as the income elasticity for rice, the weighted income elasticity for calories from these three basic foodstuffs shown in Table A.1 can be considered a lower bound to the true elasticity of income for calories. Obviously these elasticities are quite substantial for the poorer segments of the Indonesian population, the lowest third having a calorie elasticity of about 0.5 and the lowest sixth an elasticity of 0.75. The effect of prices on the pattern of consumption of these basic foods is equally dramatic. Although cross-section surveys such as the one on which the table is based are seldom used to estimate price coefficients, this particular survey was well designed to reflect the effect of variations in prices. Three separate rounds were conducted during the calendar year, and strong seasonal price effects were recorded. In addition, significant differences in price between one region and another, between urban and rural areas, and even between one income class and another permitted the estimation of reliable own-price coefficients for rice and cassava. Also, some cross-price effects were observed in the preliminary analysis. As expected, the price responsiveness varies significantly with region.

The Effects of Price Changes on Consumption

Perhaps the more interesting question is whether reliable estimates of price responsiveness can be made for a reasonable disaggregation of income classes. The preliminary evidence is quite promising for rice, with four income classes showing own-price elasticities of about r2.0, r1.8, r1.4,

Table A.1

Elasticity of Income for Starchy Staple Calories in Indonesia

Total monthly expenditures per capita (rupiah)	*Percentage of population*	*Weighted elasticity of income for calories from rice, corn, and cassava*
Less than 1,000	1.2	1.29
1,000–2,000	14.3	0.76
2,000–3,000	23.7	0.47
3,000–4,000	19.1	0.41
4,000–5,000	13.3	0.37
5,000–8,000	18.2	0.18
8,000–10,000	4.4	0.08
More than 10,000	5.9	−0.24

Source: *Republic of Indonesia, Central Bureau of Statistics, Preliminary analysis of data from the Survey Social Ekonomi Nasional (SUSENAS V, the National Household Expenditure Survey, Jakarta, 1976).*

and r0.8, respectively, for income quartiles from the poorest to the wealthiest. The cross-price substitution effects remain to be determined, but again, the preliminary evidence suggests that they will be of the appropriate sign and orders of magnitude for the major samples.

Such estimation of the parameters of consumption is interesting for its own sake—no reliable, directly estimated price elasticities by income class have ever been published—but what is more important, it provides information for determining the probable effect on consumption of changes in food prices. Higher prices for rice will obviously have severe, negative repercussions on the intake of energy and protein by the very poor. What policy actions can alleviate such an impact?

First, the very large elasticities of income for basic foods among the poor reinforce the obvious point that most malnutrition is caused by poverty. Any development policy that succeeds in increasing the incomes of the very poor will be translated quite efficiently into greater intake of energy from rice, corn, or cassava. The overall development strategy must have, as a long-run goal, substantial increases in the incomes of these poorest groups.

In the short run, substantial flexibility exists in the manner of implementing changes in food prices. For instance, gradual annual increases—that is, about 10 percent—in the real prices of rice, if they are matched by equal decreases in the real prices of corn and cassava, leave average total intake of energy little changed. But more important, the intake of energy by the urban and rural poor actually increases, and there is no diminution of protein intake. Naturally, the calculations leading to such a result are hypothetical and depend critically on the assumed levels of the elasticities of price and income. No attempt is made in the example, moreover, to say *how* such price changes could be implemented. The institutional changes needed to call forth the changes in production, in marketing, processing, and distribution, and in consumption are very large and may be beyond the financial and managerial resources of the government.

After all this has been said, however, the obvious but fascinating possibility remains of tilting the relation between income and energy intake in favor of the poor by careful selection of the commodities that have higher or lower prices. In effect, a differential price policy by commodity, even if it includes direct subsidies as a means of implementing the policy, offers the potential to establish targets for the nutritional impact without many of the associated enforcement costs of programs with targets. Such a strategy relies on self-enforcement. The desire, or necessity, of the poor to eat staple foodstuffs no longer attractive to the better off among the population presents an opportunity to deal effectively with inadequate intake among the poor without subsidizing the consumption of the entire population. Indeed, the Indonesian example presents a case in which the higher price for rice, the preferred food of the population, serves as an effective tax whose proceeds could be channeled into subsidies for the less desirable foods. Such a strate-

gy obviously calls for high political commitment to increasing the access of the poor to adequate food, but it may also be the only financially feasible way of coping with malnutrition during the next decade or so.

Appendix B
Statistical Evidence as to the Effects of Energy Deficiency

As energy intakes decline, how many more people die? This appendix is a discussion of the effect of malnutrition on that ultimate standard, as revealed in a multivariate analysis that relates energy deficiencies to life expectancy and child and infant mortality. It also assesses the effect of deficiencies on physical growth in children.

Once it has been established that the amount of food energy supplied in diets is a vital matter, it is possible to examine with greater confidence the magnitude of the malnutrition problem and the kinds of general development and specific programs that might be used to address this problem.

The following variables are used to analyze national data:

LFEX = Life expectancy (years)
CMR = Child mortality rate (per thousand)
IMR = Infant mortality rate (per thousand)
MAL = Second- and third-degree malnutrition (percent)
Y = National income (dollars per capita)
CCAP = Daily calorie consumption (per capita)
YDP = Income-deficient population (percentage of population having annual income less than $250)
YD = Per capita income deficit (the weighted sum of income deficits below $250)

Data from Thirty-nine Countries/Areas concerning Parameters Related to Nutrition, Mid 1960s

Country/ area	*Calorie deficit CD (calories)*	*Population having calorie deficits CDP (percent)*	*Income Y (U.S. dollars)*	*Calories per capita CCAP*	*Income deficit YD (U.S. dollars)*	*Population having income deficits YDP (percent)*
Honduras	617	74	286	1,930	105	69
Ecuador	n.a.	82	302	1,848	117	74
El Salvador	617	78	315	1,877	81	62
Colombia	380	62	343	2,200	78	62
Dominican Republic	497	73	360	2,004	60	54

n.a. Not available.

CDP = Calorie-deficient population (percentage of population whose daily intakes of calories are below the recommended level according to FAO/WHO standards)
CD = Calorie deficit per capita (the weighted sum of daily calorie deficits)
LIT = Adult literacy (percent)
MED = Health expenditure per capita (dollars)
URB = Rate of urbanization (percent)

The size of the population with specified calorie deficits in their diets has been directly measured in only a few countries. In order to make a cross-country analysis of energy—or calorie—deficiencies, it has been necessary to infer the distribution of energy intakes by various segments of the population indirectly. The method developed by Reutlinger and Selowsky uses data on national intakes of calories per capita and the distribution of income, combined with exogenous approximations of the relation between these two factors to infer daily intakes of calories per capita by various income groups.[1] For all countries the income elasticity at the level of calorie intake that is considered adequate by the Food and Agriculture Organization of the United Nations and the World Health Organization is assumed to be 0.3. Attempts to estimate different elasticities for different countries on the basis of a priori considerations do not yield significant results. When the size of populations that have energy deficits estimated by indirect approximation is compared with directly observed data in a few countries, the indirect method appears to be sufficiently accurate for the purpose of cross-country studies. On the basis of data on the distribution of income and aggregate food consumption, estimates of the prevalence of energy deficits were made for thirty-nine countries and areas scattered throughout the developing world. These data, and other nutrition-related data as well, are reported in Table B.1.

Table B.1

Urbanization URB (percent)	*Health expenditures MED (U.S. dollars per capita)*	*Life expectancy LFEX (years)*	*Infant mortality rate IMR (deaths per thousand)*	*Child mortality rate CMR (deaths per thousand)*	*Literacy rate LIT (percent)*	*Rate of moderate and severe malnutrition MAL (percent)*	*Country/area*
25	2	46	46	14	46	30	Honduras
34	1	54	90	20	64	11	Ecuador
39	5	50	70	17	53	26	El Salvador
51	n.a.	58	85	12	75	21	Colombia
30	7	50	82	12	47	27	Dominican Republic

(table continues on the following page)

Data from Thirty-nine Countries/Areas concerning Parameters Related to Nutrition, Mid 1960s

Country/ area	*Calorie deficit CD (calories)*	*Population having calorie deficits CDP (percent)*	*Income Y (U.S. dollars)*	*Calories per capita CCAP*	*Income deficit YD (U.S. dollars)*	*Population having income deficits YDP (percent)*
Guatemala	465	89	365	1,952	22	35
Brazil	222	40	370	2,541	77	60
Mexico	170	40	470	2,623	53	48
Jamaica	337	56	480	2,243	48	40
Peru	377	59	480	2,255	66	53
Costa Rica	315	59	482	2,234	30	36
Panama	342	54	648	2,317	37	35
Chile	178	45	721	2,523	16	23
Uruguay	64	11	760	3,037	16	16
Argentina	23	14	1,069	2,868	n.a.	n.a.
Venezuela	313	50	1,098	2,392	14	20
Indonesia	438	94	69	1,798	194	99
Sri Lanka	148	69	94	2,219	159	96
India	327	69	106	1,948	158	97
Pakistan	281	80	114	1,993	142	95
Philippines	430	73	118	1,895	115	81
Thailand	215	54	164	2,226	132	86
Korea	83	33	180	2,421	100	79
Taiwan	74	17	301	2,379	41	50
Malaysia	241	46	352	2,255	66	56
Hong Kong	167	33	663	2,324	13	17
Sudan	461	73	129	2,088	137	88
Egypt	256	59	229	2,421	85	68
Tunisia	473	66	269	2,158	89	66
Turkey	134	35	274	2,858	95	69
Iraq	605	72	328	2,055	96	67
Libya	21	5	1,050	2,031	n.a.	n.a.
Chad	193	73	93	2,259	163	98
Tanzania	304	75	96	2,170	170	96
Kenya	278	72	131	2,253	165	94
Senegal	284	59	234	2,348	112	77
Ivory Coast	148	57	271	2,433	72	21
Zambia	334	61	356	2,237	68	61
Gabon	497	66	548	2,164	72	55

n.a. Not available.

Table B.1 (continued)

Urbanization URB (percent)	*Health expenditures MED (U.S. dollars per capita)*	*Life expectancy LFEX (years)*	*Infant mortality rate IMR (deaths per thousand)*	*Child mortality rate CMR (deaths per thousand)*	*Literacy rate LIT (percent)*	*Rate of moderate and severe malnutrition MAL (percent)*	*Country/area*
33	3	47	86	28	34	32	Guatemala
51	1	57	70	n.a.	65	20	Brazil
55	2	60	66	13	73	n.a.	Mexico
33	9	66	42	12	86	11	Jamaica
48	7	54	83	16	67	12	Peru
33	7	64	60	7	86	14	Costa Rica
44	12	61	50	10	80	11	Panama
69	20	67	110	10	87	4	Chile
80	n.a.	68	47	2	90	n.a.	Uruguay
61	6	67	61	4	91	n.a.	Argentina
63	19	61	51	6	71	14	Venezuela
16	n.a.	43	87	n.a.	48	n.a.	Indonesia
15	2	62	53	7	75	n.a.	Sri Lanka
19	n.a.	46	133	44	30	n.a.	India
12	n.a.	44	132	n.a.	20	n.a.	Pakistan
30	1	53	81	10	64	n.a.	Philippines
14	1	56	42	8	68	n.a.	Thailand
34	n.a.	55	51	n.a.	80	n.a.	Korea
60	5	64	25	4	64	n.a.	Taiwan
37	5	55	58	6	68	n.a.	Malaysia
90	9	68	27	2	75	n.a.	Hong Kong
9	1	45	150	n.a.	17	n.a.	Sudan
41	3	47	106	39	30	n.a.	Egypt
40	5	49	70	20	48	n.a.	Tunisia
34	2	52	n.a.	15	48	n.a.	Turkey
44	4	49	114	n.a.	21	n.a.	Iraq
25	20	50	n.a.	n.a.	30	n.a.	Libya
6	n.a.	36	160	n.a.	6	n.a.	Chad
6	1	39	190	32	5	n.a.	Tanzania
9	1	45	n.a.	34	28	n.a.	Kenya
23	4	38	171	n.a.	8	n.a.	Senegal
2	5	38	n.a.	n.a.	15	n.a.	Ivory Coast
19	5	41	n.a.	n.a.	42	n.a.	Zambia
10	n.a.	36	n.a.	24	22	n.a.	Gabon

Life Expectancy

Table B.2 gives the simple correlation matrix of the principal variables on the basis of the data concerning these countries and areas.* (Correlations of some variables are based on fewer than thirty-nine observations because of missing data.) As has already been noted in other studies, life expectancy is closely correlated with literacy. Urbanization is also closely correlated with life expectancy. It should not be concluded from such simple correlations, however, that life expectancy would be dramatically increased merely as a result of a successful literacy campaign or a high rate of urbanization. Literacy and urbanization, in the absence of other variables analyzed simultaneously, stand, at least partly, as proxies for other variables, such as higher incomes. The same could be said for the size of the food-energy deficit or the share of the population having energy-deficient diets. To test such hypotheses, it is necessary to go to a multivariate analysis.

The basic hypothesis was that energy-deficient diets, not just low income, affect life expectancy. The statistical results of the analysis confirm this hypothesis. As the following equation shows, the income deficit, which is the weighted per capita income below $250, adds little beyond what literacy and urbanization explain about differences in life expectancy among countries (the values in brackets are the standard errors of the estimates):†

$$\begin{aligned} \text{LFEX} &= 34.9 - 0.0040\,\text{YD} + 0.2545\,\text{LIT} + 0.1331\,\text{URB} \\ &\qquad\quad (0.0149) \qquad (0.0283) \qquad (0.0426) \\ R^2 &= 0.89. \end{aligned}$$

But the calorie-deficit variable, taken together with literacy and urbanization, is statistically significant in explaining variations in life expectancy:

Each number in the table is the simple correlation coefficient found for the two variables indicated— −0.38 for CD and LFEX, for example. The simple correlation coefficient is a measure of the degree of statistical association between two variables, including any interdependence passed through relations of each of the two variables with other variables. The range of a correlation coefficient is from −1 to +1; values near −1 indicate a strong negative relation, values near zero indicate virtually no relation, and values near +1 indicate a strong positive relation. Since correlation coefficients primarily indicate the degree of linear association, they may fail to reflect fully a relation that is highly nonlinear.

†*All equations were obtained by ordinary least squares regression analysis, which gives a measure of the statistical association between the variable on the left (LFEX in the first equation) and the right-hand variables collectively (YD, LIT, and URB). Estimates of the coefficients (0.0040, 0.2545, and 0.1331) and the constant term (34.9) are produced as part of the analysis. The resultant expression on the right side is the best linear combination of the chosen variables (YD, LIT, and URB) for the purpose of accounting for (or "explaining" or predicting) variation in the variable on the left, given the data that are available. The relative individual contributions of the variables on the right are also indicated. The first equation implies, for example, that an increase of $100 in YD, the per capita income deficit, is associated with a decrease in LFEX, life expectancy, of 0.4 years, holding the other variables constant.* R^2 *is a measure of the proportion of variation in the variable on the left that is accounted for by the expression on the right.* R^2 *ranges from zero to one, values near zero signifying a weak relation and values near one a strong relation.*

Table B.2
Simple Correlation Matrix of the Principal Variables Based on Data from Thirty-nine Developing Countries/Areas

	LFEX	*CD*	*YD*	*LIT*
CD	−0.38			
YD	−0.60	0.21		
LIT	0.91	−0.30	−0.52	
URB	0.79	−0.24	−0.71	−0.60

$$\text{LFEX} = 36.75 - 0.0062\,\text{CD} + 0.245\,\text{LIT} + 0.1369\,\text{URB}$$
$$(0.0032) \quad (0.0275) \quad (0.0334)$$
$$R^2 = 0.90.$$

Similar but slightly less significant results were obtained by substituting YDP and CDP in the above equations. When both CD and YD are included in the equation, CD remains significant and YD becomes highly insignificant.

With all the usual caveats that apply to this kind of statistical analysis, all the errors in the measurement of the variables, the arbitrariness in the economic and mathematical specification of the equations, and possible biases for leaving out still other variables, the conclusion can nevertheless be reached that energy-deficient diets have some negative effect on life expectancy. Conversely, eliminating energy-deficient diets would increase life expectancy. To put this in perspective, assume that 50 percent of the population of a country consume diets that are deficient by 400 calories. If the country could achieve calorie-adequate diets for 75 percent of this population and the daily calorie deficit in the remaining 25 percent of the population could be reduced to 200, the weighted daily calorie deficit in that country would be reduced to 50. The analysis suggests that life expectancy would increase by approximately one year in that country.

Child Mortality

Earlier statistical tests suggested that the relations between child and infant mortality and the other variables in the Latin American countries are different from those in countries in other regions. Since it is postulated here that cross-country analysis has greater significance if it is confined to a single region, where there are many social and political similarities among countries and the same variables can be measured in much the same ways, the analysis of child and infant mortality was undertaken only on the basis of thirteen countries in Latin America. The simple correlation matrix is presented in Table B.3.

Again, the simple correlation between child mortality and other variables is seen to be highest with respect to literacy. But the picture changes

Table B.3

Simple Correlation Matrix of the Principal Variables Based on Data from Thirteen Countries in Latin America

	CMR	*IMR*[a]	*CDP*	*MED*	*URB*
CDP	0.79	0.33			
MED	−0.52	−0.08	−0.39		
URB	−0.49	0.04	−0.75	0.65	
YDP	0.56	0.22	0.74	−0.60	−0.68
LIT	−0.75	−0.23	−0.80	0.47	0.57

[a] *Correlations based on analysis of data from sixteen countries.*

dramatically in a multiple-variable analysis. The single best equation explaining variability in child mortality is the following:

$$\text{CMR} = -16.4 + 0.344\,\text{CDP} - 0.595\,\text{MED} + 0.310\,\text{URB}$$
$$\qquad\qquad (0.070) \qquad (0.207) \qquad (0.120)$$
$$R^2 = 0.81.$$

Literacy is no longer significant ($t < 1$). Other equations have less explanatory power and often include variables with the wrong sign. With all the caveats, which in this instance must also include the smallness of the sample of countries, the conclusion is as before: The prevalence of energy-deficient diets matters. For whatever reason, a larger proportion of the population having energy-deficient diets, given a constant rate of urbanization and constant size of public expenditures for health, means a higher rate of child mortality. And it is not just income. Taken at its face value, the equation suggests that reducing the share of the population whose diets are deficient in energy from, say, 40 percent to 30 percent would reduce the rate of child mortality by three per thousand.

Infant Mortality

As can be seen from Table B.3, infant mortality is not closely correlated with any of the other variables included. The best multiple regression, given the usual criteria of right signs and statistical significance of the coefficients, is:

$$\text{IMR} = 16.400 + 0.925\,\text{CDP} + 1.105\,\text{URB}$$
$$\qquad\qquad (0.330) \qquad (0.465)$$
$$R^2 = 0.38.$$

While most of the intercountry variability in rates of infant mortality remains unexplained, it is nevertheless noteworthy that the prevalence of energy-deficient diets does have a statistically more significant effect than any of the other variables tried.

Clearly, the equations do not suggest that income is unimportant. On the contrary, the level of food consumption has a high degree of association with income. In estimating energy deficits for the cross-country analysis

reported here, income has been an important determinant—though not the only determinant—of energy intake.*

The results of this cross-country analysis of nutrition-related statistics, while giving some support to the hypothesis that the prevalence of energy-deficient diets has indeed serious functional consequences, are by no means conclusive. It is disturbing, for example, that in some instances the weighted calorie deficit (CD)—that is, the number of persons as well as the size of the calorie deficiency in their diets—is significant, whereas the size of the affected population (CDP) is not, and in other instances, the converse is true.

Above all, the analysis presented here suggests that the same analysis should be undertaken again with better data. For instance, while to a certain extent the results give credence to the crude, indirect method by which the prevalence of energy-deficient diets was estimated, it is quite possible that data collected specifically for the purpose of estimating this variable would have made it possible to obtain stronger confirmations of the hypotheses tested. It would be desirable, moreover, to repeat this kind of analysis with data collected within a country and possibly with a combination of cross-sectional and time-series data. It would also be useful to carry out similar analyses using morbidity or a related measure of health status instead of mortality. Relevant country data, however, are not available on a comparable basis.

Definitions and Sources of Data

All data are from the sources closest to 1964–66 that are available. While food balance sheets for later periods are available, the time lag in the statistics on mortality and the distribution of income preclude the possibility of basing the analysis on more recent data. The sources are the following:

LFEX—*life expectancy at birth:* United Nations Department of Economic and Social Affairs, *World Population Prospects as Assessed in 1968,* Population Studies, no. 53 (New York, 1973).

IMR—*infant mortality rate (infants less than one year old):* Interpolated from World Bank, *World Tables 1976* (Baltimore and London: The Johns Hopkins University Press, 1976).

CMR—*child mortality rate (children between the ages of one and four):* Interpolated from World Bank, *World Development Indicators* (Washington, D.C., 1978) and *World Health Statistics Board,* vol. 30(4)(1977).

MAL—*moderate and severe malnutrition in children under the age of five:* Pan American Health Organization, *Politicas nacionales de alimentacion y nutricion,* publication no. 328 (Washington, D.C., 1976).

MED—*health expenditure per capita:* World Bank, *World Tables 1976.*

LIT—*adult literacy:* World Bank, "World Tables 1971" (Washington, D.C., January 1971), mimeographed.

URB—*rate of urbanization:* United Nations Department of Economic and

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*See Table 6, footnote a.

Social Affairs, *Statistical Yearbook 1972* (Paris, 1973).

YD—*per capita income deficit* (weighted average income deficit $\Sigma w_i(250-y_i)$, where any negative value is taken as zero): The income of the *i*th group, y_i, and the share of each group, w_i, are taken from Table B.6 in Shlomo Reutlinger and Marcelo Selowsky, *Malnutrition and Poverty,* World Bank Staff Occasional Papers no. 23 (Baltimore and London: The Johns Hopkins University Press, 1976).

YDP—*income-deficient population* (Σw_i, where w_i is the share of each income group having annual income less than $250). The source of w_i is Table B.6 in Reutlinger and Selowsky, *Malnutrition and Poverty.*

CD—*per capita calorie deficit* (the weighted average calorie deficit, $\Sigma w_i(r-c_i)$, where any negative value is taken as zero). The calorie intake of each income group is calculated according to the method described by Reutlinger and Selowsky in *Malnutrition and Poverty.* The calorie requirement, *r,* is as reported for each region by Reutlinger and Selowsky. Per capita consumption of calories by country is taken from Food and Agriculture Organization, *Agricultural Commodity Projections 1970–80* (Rome, 1971).

CDP—*the share of a population having energy deficits* (Σw_i for all income groups, with $r_i > c_i$).

Appendix C
Can Nutrition Efforts Make a Difference?

How effective have nutrition programs been? The record, unfortunately, is incomplete and difficult to interpret, especially with respect to the large-scale efforts that are of the greatest potential interest. Overall national experiences are difficult to assess because of limitations in the quality and quantity of data and because of difficulties in sorting out many interacting factors that influence nutritional trends. As a result, it is difficult to get a clear sense of what has been achieved. In few nutrition programs has the attempt been made to collect data on the outcome of the program; the data that have been collected have rarely been adequate for valid analyses. Those few evaluations that have proved useful have usually concentrated on specific aspects of nutritional status, such as physical growth, rather than providing a broader perspective on changes.[1]

Since it is difficult to confirm from experience with national or other large-scale efforts that nutrition programs make a difference, it is necessary to look for evidence in the numerous relatively well-organized and well-controlled field experiments that have provided nutrition services to limited populations during the past twenty-five years. Nearly all such efforts operated as health-delivery programs. While the broader relevance of such relatively small undertakings may be challenged, it is only among them that the kind of careful records necessary for policy-relevant evaluations are to be found.

Those well-recorded field projects that were directed toward alleviating the consequences of nutritional inadequacies and improving health provide data on rates of infant and child mortality and sometimes on physical growth. Mortality rates, apart from their merits as perhaps the most widely accepted index of health and nutritional status, are more frequently available than are clinical or other assessments that might theoretically be more desirable. The results of these projects also provide an opportunity to examine various approaches to combining nutrition and health services and to providing family-planning services.

An extensive search of the literature led to the identification of ten projects in which a systematic effort was made to reduce infant and child mortality in poor rural areas, and sufficient records were kept that conclusions could be drawn as to their accomplishments (see Table C.1). Six of the projects were also concerned with the physical growth of children, and in

Summary Results of Selected Field Projects in Nutrition and Health

Location	*Dates*	*Orientation*	*Principal inputs*	*Approximate size of treatment population*[a]
Many Farms, U.S.A.	1956–62	Research and pilot project	Medical services	2,000
Rural Guatemala I	1959–64	Research project	Food supplements and medical services	1,700
Imesi, Nigeria	c. 1960–	Service project	Nutrition surveillance and medical services	6,000
Northern Peru	1962–67	Research project	Food supplements	1,800
Etimesgut, Turkey	1965–	Pilot project	Medical services	55,000

n.a. Not available.

Table C.1

Results reported					Annual cost per capita (percentage of annual income per capita)[e]
Physical growth[b]	Infant mortality[c]		Child mortality[d]		
n.a.	Before (1957) After (1961)	116 76	n.a.		n.a.
Children given nutrition care 1 kilogram (6–7 percent) heavier and 3 centimeters (2–3 percent) taller at five years of age than control group or those given only health care.	Reduced in health-care area from 136 to 88 (35 percent). Reduced in nutrition-care area from 182 to 146 (21 percent). In control area, up from 186 to 191 (3 percent).		Reduced in health-care area from 50 to 34 (31 percent). Reduced in nutrition-care area from 56 to 24 (56 percent). Reduced in control area from 81 to 50 (38 percent).		n.a.
Children given treatment 0.3–0.4 kilograms (4–6 percent) heavier and 1.5–3.0 centimeters (2–3 percent) taller than control group after 6–12 months of age.	Control area Treatment area	91 48	Control area Treatment area	51 18	$1.50 (2 percent)
No significant difference between treatment and control areas.	Control area Treatment area	134 48	Control area Treatment area	40 22	n.a.
n.a.	Reduced in treatment area from 142 to 73 (49 percent) between 1967 and 1977. Reduced in all Turkey from 153 to 110 (28 percent) between 1967 and 1973. Reduced in treatment area from 142 to 93 (34 percent) between 1967 and 1973.		Before (1967) After (1977)	59 37	$6.50–7.50 (1.5–2.0 percent)

(table continues on the following page)

Summary Results of Selected Field Projects in Nutrition and Health

Location	*Dates*	*Orientation*	*Principal inputs*	*Approximate size of treatment population*[a]
Narangwal, India	1968–73	Research and pilot project	Medical services, nutrition supplements, and nutrition education	10,500
Rural Guatemala II	1969–77	Research	Nutrition supplements and medical services	3,000
Jamkhed, India	1971–	Service	Nutrition supplements, education, and medical services	40,000
Hanover, Jamaica	1973–	Pilot project	Nutrition surveillance and medical services	65,000

n.a. Not available.

Table C.1 (continued)

Results reported			*Annual cost per capita (percentage of annual income per capita)*[e]
Physical growth[b]	*Infant mortality*[c]	*Child mortality*[d]	
Children given treatment 0.5–0.6 kilograms (6–7 percent) heavier and 0.2–1.3 centimeters (0–2 percent) taller than others at 36 months of age.	Control area 128 Nutrition-care area 97 Medical-care area 70 Area where both nutrition care and medical care were given 81	Control area 19 Nutrition-care area 11 Medical-care area 11 Area where both nutrition care and medical care were given 13	$0.80–2.00 (0.8–2.0 percent)
Children who received high-protein supplements grew 10–15 percent more rapidly than other children.	Reduced in treatment area from about 150 before 1969 to 55 in 1970–72 (63 percent). Reduced in all Guatemala from 89 before 1969 to 85 in 1970 (4 percent).	Reduced in treatment area from 28 before 1969 to 6 in 1970–72 (79 percent). Reduced in all Guatemala from 26 before 1969 to 22 in 1970 (15 percent).	$3.50 (0.75–1.0 percent)
n.a.	Treatment area, 1971 97 Treatment area, 1976 39 Control area, 1976 90	n.a.	$1.25–1.50 (1.00–1.25 percent)
Proportion of children below 75 percent of expected weight for age fell from 11–13 percent to 6–7 percent within one year of initiation of program.	Reduced in treatment area from 36 to 11 (69 percent) between 1970–73 and 1975. Reduced in all Jamaica from 26 to 23 (12 percent) between 1973 and 1975.	Before (1972–74) 13–15 After (1973–75) 5–6	$0.40 (0.05 of 1 percent)

(table continues on the following page)

Summary Results of Selected Field Projects in Nutrition and Health

Location	*Dates*	*Orientation*	*Principal inputs*	*Approximate size of treatment population*[a]
Kavar, Iran	1973–	Pilot project	Medical services and education in health and nutrition	8,200

n.a. Not available.

[a] *Total project population—infants, children, and adults—excluding control population, if any.*

[b] *The reported results, with respect to both physical growth and mortality, are subject to the several methodological considerations discussed in Davidson R. Gwatkin, Janet R. Wilcox, and Joe D. Wray,* Can Health and Nutrition Interventions Make a Difference? *Monograph no. 13 (Washington, D.C.: Overseas Development Council, February 1980).*

[c] *Deaths of infants through the age of 12 months per 1,000 live births.*

[d] *Deaths of children between the ages of 12 months and 60 months per 1,000 population between 12 months and 60 months, except for Etimesgut, where the figures refer to deaths of children through the age of 60 months per 1,000 population through the age of 60 months.*

four an effort was made to promote acceptance of family planning and reduction of fertility.

They are not necessarily the projects in which the most was actually accomplished. Since they were chosen because of the adequacy of their data, they incorporate the concept of the scientific method and therefore presumably incorporate other Western social and political outlooks. Whether they thus embody characteristics that might reflect actual effectiveness is not clear. The possibility that they do just the opposite certainly exists, for there seem to be a large number of impressive projects that were executed without much heed to the collection of data. Basing selection on the adequacy of data, for example, precludes inclusion of all but one of several interesting community-based efforts described in *Health by the People,* a well-known publication of the World Health Organization.[2] It also excludes the Huehuetenango and La Pasion projects in Guatemala, the Savar and Brac programs in Bangladesh, Project Piaxtla in Mexico, and the Palghar and Miraj projects in India, not to mention that country's entire Gandhian village health tradition.[3] Other well-known projects omitted because final results were not yet available are those in Lampang, Thailand; Bohol, Philippines; Danfa, Ghana; and Deschapelles, Haiti; because mortality data are inadequate, an otherwise well-documented project in Candelaria, Colombia, is also excluded.

Table C.1 (continued)

Results reported				Annual cost per capita (percentage of annual income per capita)[e]
Physical growth[b]	Infant mortality[c]		Child mortality[d]	
n.a.		1975 1977–78	n.a.	$3.50–5.25 (0.4–0.5 of 1 percent)
	Control area	128 138		
	Treatment area	65 84		

Narangwal, where the figures refer to deaths of children between the ages of 12 months and 36 months per 1,000 population between 12 months and 60 months; and Hanover, where figures refer to deaths of children between the ages of 1 month and 48 months per 1,000 population between the ages of 1 month and 48 months.

[e] *Recurring costs plus capital costs, with annual capital cost estimated at 5–10 percent of total stated capital expenditures. Data for Hanover refer to its predecessor Elderslie pilot project; cost figures for the Hanover project itself are not available. The Elderslie cost figures are now being revised, and a significant upward revision is likely. The calculations of GNP are based on figures from the appropriate volumes of World Bank,* World Tables *(Baltimore: The Johns Hopkins University Press). Rural Guatemala II costs refer to the medical component only; figures for nutrition costs are not available.*

In chronological order, the ten projects covered are:*

- *Many Farms, Arizona, U.S.A.,* a Navajo reservation project begun in 1956 by the Cornell University Medical College. It was one of the first attempts to apply the technologically advanced physician-based curative medical orientation of "modern scientific" medicine to a traditional, low-income population in an environment similar to that of many areas of the developing world today.
- *Rural Guatemala I,* the first of two major village-level projects executed by the Institute of Nutrition of Central America and Panama (INCAP). Undertaken in 1959, it was the first to explore systematically the interaction between nutrition and infection, providing nutrition supplements in one village and health care in another, using a third village as a control.
- *Imesi, Nigeria,* an outreach service effort of the prominent Wesley Guild mission hospital, initiated around 1960. In it originated the "under-

More details on these projects are contained in Table C.1. For further information and a bibliography of project reports, see Davidson R. Gwatkin, Janet R. Wilcox, and Joe D. Wray, Can Health and Nutrition Interventions Make a Difference? *Monograph no. 13 (Washington, D.C.: Overseas Development Council, February 1980), an outgrowth of the background paper prepared for the present study.*

fives" clinic concept, featuring frequent comprehensive care for young children, and also the use of the regular weighing of young children as a means of monitoring nutrition and identifying cases that need special attention.

- *Northern Peru,* a 1962–67 experiment with the distribution of high-protein food supplements to entire families living in villages on a sugar plantation, conducted by the research department of the British-American Hospital in Lima.
- *Etimesgut, Turkey,* a pilot project to test the package of services, predominantly in medicine and family planning, that was to be offered by the proposed national health program for rural regions. Implementation of it by the Institute of Community Medicine of Hacettepe University began in 1965 in an agricultural area near Ankara.
- *Narangwal, Punjab, India,* a further exploration of the interaction between nutrition and infection, conducted from 1968 to 1973 by the Johns Hopkins School of Hygiene and Public Health in collaboration with the Indian Council of Medical Research. Nutrition supplements and education were provided in one area, health care in another, and both nutrition and health services in a third. In a parallel project different approaches to the delivery of family-planning services were tested.
- *Rural Guatemala II,* the second of the village intervention projects executed by INCAP. It ran from 1969 until 1977 in four Guatemalan communities—not the same ones as those included in Rural Guatemala I. Studies were made of the influence of nutrition supplements on child development and of the effect of medical services provided by health auxiliaries on health conditions.
- *Jamkhed, Maharashtra, India,* a service project established 400 kilometers southeast of Bombay in 1971 by two Indian physicians who were concerned about village problems. The program, which was designed to involve local community leaders, provided a wide range of services in nutrition, health, and family planning in an attempt to tailor the assortment of services to local needs and desires.
- *Hanover, Jamaica,* a pilot service project initiated in 1973 by the Cornell University Medical College, the University of the West Indies, and the government of Jamaica. The approach featured regular nutrition surveillance and education administered by paramedical community health aides.
- *Kavar, Iran,* a pilot health-service and nutrition-education project of the Department of Community Medicine of Pahlavi University, also begun in 1973. The objective was to test in a rural area near Shiraz the applicability of a paramedical "barefoot doctor" approach for rural Iran. Maternal-health and family-planning services were among those offered.

These projects covered populations ranging from 1,700 (Rural Guatemala I) to 65,000 (Hanover), most lying toward the lower end of the range. While the majority of the projects included both nutrition and health

components, some did not: The Northern Peru project gave only fortified food supplements; Many Farms and Etimesgut provided only medical care. Among those that did incorporate both nutrition and health services a wide variety of approaches was taken. This heterogeneity of approaches was in part the result of wide differences in the economic, social, and cultural settings and in part of differences in program objectives. The state of the art prevailing at the time that the various projects were begun is another source of diversity. The Many Farms project was started in the mid 1950s, before the importance of nutrition was widely appreciated; the project reports hardly mention the term. The Northern Peru project of the early 1960s featured the use of fish-protein concentrate to enrich the dietary staple, an idea that was of particular interest in nutrition circles at the time. Jamkhed and Kavar reflect the concern for community involvement that arose in the early 1970s out of a growing awareness of the apparent accomplishments in a number of socialist states, notably China and Cuba, through emphasis on rural development. Kavar was a conscious effort to adapt the Chinese barefoot doctor to Iranian conditions.

In brief, each project had its own distinctive characteristics, which reflected local conditions and needs, the predilections and orientation of its leaders, and the temper of the time at which it was undertaken. Yet the projects have two central characteristics in common that justify grouping them together for a common review: All moved in one way or another out of the hospital toward the villages in an effort to deal more effectively with problems of nutrition and the health of infants and children, and in all the attempt was made to measure the success of their efforts.

The Effect of the Experimental Projects on Infant and Child Mortality, Physical Growth, and Fertility

What did these projects accomplish?

- *Many Farms, U.S.A.* While the project was being implemented, the infant mortality rate declined from 116 to 76.* For a variety of reasons, however—the small size of the sample, the lack of controls, erratic year-to-year changes—the significance of the decline is unclear. The authors concluded that the project had not had a significant effect on overall conditions of mortality, a conclusion that gave rise to the idea of what Walsh McDermott calls a "technologic misfit" between the modern medical approach that they used and the complex of diseases that was found to be dominant among infants and children of the reservation.[4] Data on child mortality and physical growth are not available, nor is there information on fertility or costs.
- *Rural Guatemala I.* Physical growth was moderately more rapid in the area served with nutrition supplements than in the other areas. Infant and child mortality declined 20–50 percent in the intervention areas. Child mor-

**Infant mortality is expressed throughout as the rate per thousand live births; birth rates given are per thousand population.*

tality also declined nearly 40 percent in the control area, however. This and other complications—such as the small size of the samples and the lack of comparability among experimental areas—prevented the investigators from reaching conclusions that they considered to be unambiguous. Data on fertility and costs are not available.

- *Imesi, Nigeria.* Approximately five years after the initiation of the project the infant mortality rate was 48 in Imesi, 91 in a nearby control village; the child mortality rate was 18 in Imesi, 51 in the control village. Children in Imesi were 4–6 percent heavier and 2–3 percent taller than in the control village. The crude birth rate was 45 in Imesi, 43 in the control; the general fertility rate in Imesi, 228, was a third higher than in the control village, where it was 171. The cost per capita was $1.50 a year, about 2 percent of the yearly per capita income of Nigeria at the time.
- *Northern Peru.* During the study period, there was no significant difference in physical growth between the treatment area and the control areas. The infant mortality rate averaged 48 in the treatment areas, however, while it was 134 in the control areas; the child mortality rate averaged 22 in the treatment areas, 40 in the control areas. Data on fertility and costs are not available.
- *Etimesgut, Turkey.* The infant mortality rate fell from 142 to 73 between 1967 and 1977. The 1967–73 decline was from 142 to 93 (—34 percent), while that for Turkey as a whole was from 153 to 110 (—28 percent). Child mortality fell from 59 per thousand children between birth and the age of five in 1967 to 37 in 1977. Information about physical growth is not available. The crude birth rate, stable at about 35 before 1969, fell steadily to 27 in 1974 and has since remained at about 27–28. The annual cost per capita was about $6.50–7.50, 1.5–2 percent of the yearly income of the average Turk.
- *Narangwal, India.* Infant mortality was 25–45 percent lower in the treatment areas than in the control areas; mortality among children between the ages of one and four was 30–40 percent lower. At thirty-six months of age, children in the nutrition-care area were 6–7 percent heavier and as much as 2 percent taller than children in all other areas. The annual cost of services was on the order of $0.80–2.00 a person, equal to about 0.8–2 percent of the annual per capita income of India. In the companion family-planning project, the general fertility rate fell 4–21 percent in the areas in which various combinations of family planning, health, and welfare services were offered, while the decline in the control area was only 3 percent.
- *Rural Guatemala II.* Children who regularly received high-protein food supplements grew 10–15 percent more rapidly than children who did not. Infant mortality fell about two thirds—from a rate of about 150 to 55—and child mortality about three fourths—from a rate of 28 to 6—within two to three years after the initiation of the project. During this period, infant and child mortality in Guatemala as a whole declined some 5–15 percent.

Neither fertility data nor cost figures for the nutrition component of the program are available. The health component, believed by the project investigators to be responsible for the greater part of the decline in mortality, cost about $3.50 a year per capita. This figure is somewhat less than 1 percent of the income of the average Guatemalan in 1971.

- *Jamkhed, India.* In the relatively small sample population surveyed the infant mortality rate declined from 97 in 1971 to 39 in 1976, while it was 90 in a control area, also small, surveyed in 1976. The corresponding figures for the crude birth rate were 40, 23, and 37. The cost is roughly estimated at $1.25–1.50 a person annually, just over 1 percent of the GNP per capita of India in the mid 1970s. Data on child mortality and physical growth are not available.
- *Hanover, Jamaica.* The infant mortality rate in Hanover parish fell from an average of 36 between 1970 and 1973 to 11 in 1975, while in Jamaica as a whole the decline was from 26 to 23 between 1973 and 1975. The mortality rate among children one to forty-eight months of age fell about half, from 13–15 to 5–6, within a year of the initiation of the program. The proportion of children whose weights were less than 75 percent of expected weight for age fell from 11–13 percent to 6–7 percent within a year of the initiation of the program. The investigators have tentatively established the cost of a pilot project to be $0.40 a person, about one twentieth of 1 percent of the average annual per capita income of Jamaica. Data on fertility are not available.
- *Kavar, Iran.* Two surveys taken after the initiation of the project yielded estimates of infant mortality rates in the treatment area 50–60 percent lower than those found in the control area. In the first survey, taken fifteen months after the project had begun, an infant mortality rate of 65 was found in the treatment area, 128 in the control area. Three years later the rates recorded were 84 and 138. The crude birth rate was 40 in the treatment area and 45 in the control area according to the first survey, 37 in each area according to the second. The cost per person was estimated to be $3.50–5.25 annually in 1975, depending upon the method of calculation used—a sum equal to roughly half of 1 percent of the national per capita income of Iran. Data on physical growth and child mortality are not available.

Overall Effectiveness of the Projects. What generalizations can be drawn from these individual experiences? In all ten projects the available data suggest that there were declines in infant and child mortality. Most of the declines were large—on the order of a third to a half, sometimes more—and they were rapid, occurring within one to five years of initiation of the projects. In themselves, though, the reported declines in mortality are not necessarily significant. Infant and child mortality have been declining throughout the developing world during most of the past quarter of a century, often rapidly, and without the benefit of efforts nearly so intense as were made through these projects. It is thus necessary to show that mortality declined more rapidly in the project areas than elsewhere and that it

declined because of the actions of the projects in order to argue persuasively that the projects made a significant difference.

For methodological reasons that will be discussed later, this turns out to be extremely difficult to demonstrate conclusively. Yet there is still a persuasive, even if not conclusive, case to be made that declines in mortality were notably more rapid in a clear majority of the ten project sites than would have been expected if the projects had not been undertaken.

Some information about mortality trends outside the experimental area is available for nine of the ten projects. In six instances project assessments provide information about more or less comparable control areas; in two, comparison is made with national data. In seven of the nine instances in which some kind of comparison is possible, the data suggest that infant and child mortality fell more rapidly in the project areas than in the control areas. In four of the five projects for which fertility data were available, at least some apparent decline was reported. In all four a conscious effort had been made to decrease birth rates, and family-planning services had been provided in conjunction with nutrition and health actions. In three of these projects the decline reported was substantial; in the fourth it was modest. Similarly, in five of the six projects concerned with physical growth, at least some results appear to have been achieved.

Costs of the Projects. For seven of the ten projects, information about the cost of the undertaking and about accomplishments has been provided. While the cost estimates are often impressionistic, they are adequate to produce a picture of generally modest expenditures. The annual cost per capita varied from about $0.80 to $7.50, including both capital and recurring expenditures.* This works out to about 0.5–2.0 percent of annual GNP per capita of the countries concerned for the year to which the cost figures in each instance refer.† This level of expenditure is very close to the levels of health expenditure reported by the World Bank for most developing countries. The proportion of the total population served by the more traditional systems to which the World Bank figures refer is thought to be quite small, however, because of the concentration of facilities in urban, relatively affluent areas. Thus, the cost per person actually served by conventional national health-care systems is probably many times higher than is suggested by 0.5–3.0 percent of GNP and, consequently, also much higher than the widely accessible services provided by the projects reviewed.

**Capital costs and recurring costs are given separately in most project reports. An annual capital-cost estimation has been made by assuming a life of 10–20 years for capital items, which means adding 5–10 percent of total capital costs to the figure for annual recurring costs to arrive at total costs. The procedure used makes little difference in the outcome, since the great majority of costs, usually 90 percent or more, are recurring.*

†The ranges of annual costs of $1.50–7.50 per capita and 0.5–2.0 percent of GNP both exclude the particularly sketchy cost data available for the Hanover, Jamaica, project, which suggest an annual per capita cost of $0.40, 0.05 percent of annual GNP.

The general comparability of the cost figures cited suggests that the conventional concentrated pattern of health and nutrition services, with its inevitably limited coverage, could be replaced by the wide-coverage approaches of the projects reviewed here at little increase in total government expenditures for health. If it were possible to achieve on a larger scale a level of effectiveness in primary care comparable to that of these projects, such a reallocation of funds would seem likely to lead to considerable gains in both equity of coverage and overall conditions of infant and child mortality. Although so drastic a reorientation is rarely likely to be feasible politically, such rough calculations suggest that placing greater reliance on the kinds of nutrition and health approaches reviewed here can be attractive.

Factors Contributing to the Effectiveness of Projects

Although the projects reviewed have all been based on nutrition or health services of some kind, those that appear to have been effective seem at first glance to have had little else in common beyond their apparent effectiveness. Amid the diversity, though, several specific innovative measures or features of different projects seemed to stand out as particularly effective each time they appeared and thus to be worthy of further attention. Also, the project findings permit an exploration of the effectiveness of some of the more traditional components of nutrition and health interventions.

Nutrition for Expectant Mothers. The value of nutrition actions for expectant mothers was explored most extensively in the Rural Guatemala II project, in which the effect of food supplements given to expectant mothers on birth weights and death rates was impressively documented. Heavier weights at birth are strongly associated with lower death rates. The findings were similar at Narangwal, where supplementary iron, folic acid, and food given to expectant mothers seem to have been associated with the significant decline in mortality at very early ages. Indeed, although efforts to improve the nutrition of expectant mothers through services to provide iron, folic acid, food, and nutrition education were a relatively small part of the Narangwal project, this component seems to have been a particularly effective means of averting early deaths of infants. Increased intake of food by expectant mothers, with its possible influence on birth weight of the infant and lactation capacity of the mother, has been suggested as an explanation for the otherwise puzzling finding in the Northern Peru project that food given to entire families helped to reduce infant mortality without contributing to more rapid physical growth later.

Monitoring of Nutrition. Monitoring of nutrition was pioneered with considerable success at Imesi and later refined with equally encouraging results in the Narangwal and Hanover projects. In these situations, monitoring of growth on the basis of regular anthropometric measurements of children in the project area facilitated the early identification of infants and young children whose growth was retarded and whose risk of death was

consequently increased. Nutrition supplementation, medical treatment, and nutrition education could then be directed toward these children and their families.

The use of anthropometric measurement also served in these programs as an important means of alerting mothers to the retarded growth of their children, thereby encouraging them to improve feeding practices. Thus, in communities in which social or cultural factors are more significant than absolute inadequacy of resources in the etiology of malnutrition, monitoring of nutrition appears to have a significant effect on mortality even in the absence of more expensive components that are more difficult to implement.

Greater Reliance on Paramedical Personnel and Training. In several of the projects ways of giving more responsibility to paramedical personnel for the provision of simple curative services were explored to make possible a much broader coverage of the population than is common. In contrast to the 15–20 percent of the population in need reached by health services in most developing countries, the coverage of the projects reviewed was remarkably comprehensive. In many cases, almost all the target population were surveyed at the outset of the project and were served regularly thereafter. In Narangwal there was considerable reduction in deaths from diarrheal and respiratory diseases because family health workers were relied on to diagnose these problems, administer penicillin as necessary, and institute oral rehydration procedures that were handled principally by the mothers themselves.

Several project reports emphasized the importance of training. Although important differences existed and details are not always available, the most successful training programs—those in the Hanover, Narangwal, and Rural Guatemala II projects—had several features in common. They were developed by health professionals thoroughly familiar with local problems, having themselves dealt with such problems under field conditions. Active on-the-job training was carried out under the guidance of experienced workers who could do the tasks required within the constraints of local conditions, and continuing education involving frequent and regular meetings of field workers and supervisors was included. The effective training programs were usually linked to overall personnel systems that fostered a sense of satisfaction and motivation in field personnel.

Immunization of Expectant Mothers against Tetanus. Concerted efforts to immunize pregnant women against tetanus were included as components of the Narangwal and Rural Guatemala II studies because of the effective protection against tetanus in the newborn afforded by immunity transmitted through the placenta. In Narangwal, an early survey showed that neonatal tetanus was responsible for almost 20 percent of the neonatal deaths. Project personnel were able to immunize 87 percent of the mothers and have estimated that at least 80 percent of the deaths from neonatal

tetanus were averted. Tetanus immunizations for prospective mothers also appear to have made a significant contribution to declines in mortality in the Rural Guatemala II project. Such experiences commend immunization of mothers as a particularly promising component of projects in communities where neonatal tetanus remains a problem.

Other Nutrition and Health Measures. Not surprisingly, the experience garnered from the ten projects confirmed the importance of nutrition to the reduction of infant and child mortality. The Narangwal data, for example, showed that each 10 percent decrease in weight for age brought a disproportionate increase in the probability of death. A child less than three years old who weighed between 60 percent and 70 percent of the Harvard weight-for-age standard weight was ten times more likely to die than was a child who weighed more than 80 percent of that standard weight. Nutrition measures were incorporated in all but one of the seven more successful projects, whereas they had been incorporated in only one of three earlier, less obviously successful ones.

Also, several specific nutrition components appear to have made notable contributions. A pair of particularly promising nutrition approaches—nutrition supplements for expectant and nursing mothers and monitoring of nutritional status—have already been identified. Nutrition supplements for infants and children seem to have been effective in reducing mortality in the Northern Peru project and to have had a significant effect in the Narangwal and Rural Guatemala I and II projects.

To state that nutrition measures as a class are inherently superior to health measures as a class, though, would require much more solid evidence than can be found in these studies. As noted, a number of health measures—immunization of expectant mothers against tetanus and increased reliance on paramedical personnel—were also quite promising. Programs for the immunization of children were widely used, with apparent effectiveness. All but one of the seven more obviously successful projects included some kind of health component as well as a nutrition element, and under some circumstances, the health measures employed appear to have been more effective than the particular nutrition components that were used. The most effective projects seem to have featured a judicious mix of both nutrition and health components, a mix that differed from place to place in response to dramatically different epidemiological, social, economic, and political conditions.

The experience gained in these projects also suggests that the mix should be varied according to the relative importance attached to various aspects of performance under the program. Consider, for example, the hints from Narangwal that nutrition measures may be more effective in stimulating physical growth and reducing mortality at very early ages, particularly through programs to improve the nutrition of expectant mothers, while medical measures may in general be more effective in reducing mortality among older children. Under such circumstances, the relative importance

accorded each component would depend on the relative importance attached to saving newborn babies or, say, toddlers two to three years of age. The Narangwal data suggest that for any given amount of money more neonatal deaths can be averted than deaths at later ages. Averting deaths at earlier ages could have the further effect of promoting the kind of climate necessary for full parental commitment to the child, which would in turn improve the child's physical and mental well-being throughout the critical early years and beyond. On the other hand, toddlers might well be considered more "valuable" by both parents and economists in view of the considerable psychological and economic resources that have already been invested in them.

Or, it might perhaps be argued, emphasis should not be on efforts to reduce mortality but rather on project components that promote physical growth, in line with a general policy emphasizing the capacities and qualities, rather than the number, of the persons who constitute society. To the degree that the Narangwal findings are relevant to situations elsewhere, any policy decision of this nature would increase the importance of nutrition in relation to that of health inputs.

The absence of easy answers to these difficult questions, coupled with the situational differences noted earlier, argues against unduly strenuous efforts to "fine tune" intervention programs by identifying certain components as undeniably most effective. Better to go toward the community with an open mind.

General Considerations. Two other, more general, themes also emerge from a review of the projects. The first concerns a principal characteristic that seems to distinguish the more successful projects from the less obviously successful ones: the degree of departure from the Western tradition of hospital-based, high-technology medical services in the search for approaches more appropriate to village conditions. In the more obviously successful projects, efforts to reduce reliance on the services normally provided by highly trained physicians were noteworthy.

The second general theme concerns the effectiveness with which the project components selected, whatever they may have been, were implemented and administered. Service personnel, for example, were generally selected carefully, trained effectively, well supervised and supported, and given carefully developed and realistic job assignments to perform in populations sufficiently small to make adequate performance of the assignment possible. Support services and personnel were usually available as they were supposed to be. The clinics and meal centers were open when the schedules indicated, providing the services called for in the outline of the project. A service ethics, often inspired by dedicated leaders, provided the basis for the efficiency with which things were done. The total effectiveness of a project depends, such considerations suggest, not just on what is done, but also on how well it is done. The need is not just for an appropriate

mix of components, but rather for an appropriate mix of effectively administered components.*

Broader Aspects of Interactions between Providers and the Community. As the WHO definition says, good health—and good nutrition, which is closely related to it—is not merely the absence of disease or infirmity, but rather "a state of complete physical, mental, and social well-being." An appreciation of the contribution of these projects to nutrition and health thus also requires an assessment of their effects on aspects of village life that, while perhaps not commonly seen as being related to nutrition or health, are likely to be of considerable significance to the development of long-term self-sustaining capacities to improve nutrition, health, and physical, mental, and social well-being. Two areas are of particular concern.

First, in none of the projects was substantial thought given to the way the project might affect productive and social structures of a village.[5] Most project investigators were concerned principally with establishing working relationships with village leaders in order to be able to do what they wanted to do in the provision of nutrition and health services. To the extent that village

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*Field studies are rarely flawless, and the ten described here are no exceptions. The results from the projects should therefore be evaluated with a number of caveats in mind. While the results of the projects described above are methodologically by far the best that exist and provide considerable insight into the question of the efficacy of intervention projects and specific components of projects, a number of difficulties with the data are significant enough to require mention.

*First, in some cases—Jamkhed, Many Farms, and Rural Guatemala I—the sizes of the samples were not large enough for some of the most important findings to be significant statistically. The complexity of the relations being studied meant that certain study designs implemented to explore one set of variables proved to be inadequate when other important variables unexpectedly emerged. Second, formal controls were sometimes lacking, as they were in Many Farms, Etimesgut, Rural Guatemala II, and Hanover. Because trends in infant and child mortality have been generally downward almost everywhere in the developing world since the Second World War, the need is not simply to show a decline in any given project area, but a decline that is faster than that occurring naturally elsewhere.

*Third, even when formal control groups exist, their populations are inevitably at least somewhat different from those of the treatment areas in ways that could influence the results. Despite the care with which they were selected, the Narangwal areas, for example, had significantly different caste compositions, with all that that implies for differences in customs and intracommunity relationships. The villages of the Rural Guatemala I project showed notably different earlier trends in infant mortality. Other projects presented similar difficulties.

*Fourth, what the package of measures actually had to do with bringing about the change recorded in nutritional status or mortality was rarely established clearly and directly. This, coupled with the difficulties of establishing adequate controls, leaves room for uncertainty about the importance of the package of measures in relation to that of the numerous other extraneous factors that could be involved.

*Fifth, as is usually the case when sophisticated statistical techniques are applied to large data sets, the factors that could be quantified by the investigators—program inputs plus other physiological, social, economic, and environmental factors—proved capable of explaining less than half the total variance observed. Explaining even this portion of total variance is an impressive accomplishment; in many respected econometric studies, policy conclusions have been drawn from considerably less robust results. Clearly, though, there seems to be a great deal going on in these field study areas that affects outcomes—physical growth, birth weight, mortality, and so on—that such analyses have failed to pick up. Yet until they are resolved, the sources of uncertainty remain.

leaders could become associated with or appear to be responsible for the benefits accruing from the project, the legitimacy of their position within village society and the existing structural relationships that they represent would be enhanced. Since the inegalitarian nature of the productive and social relationships of a village often constitutes an important deterrent to total rural development, and therefore to nutrition and health, the benefit of strengthening such existing structures, even modestly and unintentionally, must be questioned. There is no easy answer, but greater awareness of such issues and conscious efforts to deal with them are vital to the formulation and implementation of intervention programs.

A corollary issue is that of the psychological impact of externally led programs. While the ideas of self-help were subscribed to in most of the projects, by and large assistance was provided principally from outside. Even in those that exhibit the greatest concern with community involvement, community mobilization was found to be considerably more difficult than straightforward provision of services. To the extent that the development of a sense of self-determination is important to the capacity of individuals or communities to achieve adequate nutritional and health status, projects that do not integrally involve the people they are designed to help may unintentionally lower the capacities of those people to improve their conditions on their own.

Implications for Future Efforts

Far more needs to be known about the total effects of such projects, about their true functioning, and about their relevance for large-scale operations beyond the carefully controlled field laboratory before their ultimate potential can be adequately assessed. To claim too much too soon would risk diversion of attention from more general social and economic development efforts or from such other promising specific approaches as nutrition-oriented agricultural production policies and improved food distribution. The projects reviewed here, moreover, address only a limited—albeit the most vulnerable—portion of the needy population.

Yet this having been said, there is also no way that the findings of these ten projects—especially the more recent of them—can be described other than as very encouraging. Taken together, they present a persuasive case that in the hands of able investigators and in populations as large as 60,000–70,000, infant and child mortality can be reduced by a third to half within one to five years, at a cost of less than the equivalent of 2 percent of per capita incomes, an amount no greater than that now being allocated to health.

Despite the many significant uncertainties, results such as these clearly merit much more than the usual "more research is needed" response. More research *is* needed and should be pursued, but what is known already is more than sufficient to justify proceeding outward beyond the initial carefully controlled field experiments of the sort described here. The next chal-

lenge is the expansion of project activities to serve significantly larger numbers of people, accepting the organizational constraints and others that inevitably accompany large-scale efforts.* Two sets of suggestions—one substantive, one procedural—to facilitate such a move emerge from this review.

The substantive suggestions that emerge from this review are straightforward, consisting of points made earlier. The almost universal importance of nutrition for physical growth and reduction of mortality, for example, argues that nutrition measures *do* make a difference and that nutritional considerations should be incorporated into the design of projects—as they were in all but one of the seven more successful projects. Also, the move from the hospital into the village emerges as promising. More specifically, improved nutrition and immunization of expectant mothers, monitoring of nutrition, and expanded functions for village health personnel seem to have worked well in many different settings. Yet the nature of successful packages of services has varied widely, suggesting that no one approach is likely to be best suited to all situations throughout the developing world. This indicates a need for considerable flexibility and a willingness to consider a wide variety of organizational and technological approaches.

The procedural suggestions that emerge from this review arise out of the recognition that many factors that may explain the accomplishments of the projects are poorly understood and that the projects may well have had effects as yet unrecognized beyond those measured. It is quite possible, for example, that the accomplishments of these projects are as much the result of the effectiveness with which they were administered as of the particular approach or set of components selected. And it is also possible that village projects designed and administered with inadequate care can have unexpected and sometimes perhaps undesirable effects on village social and productive structures. To the extent that concerns such as these are legitimate, the move from the effective pilot effort to the large-scale operating project could prove to be an uncertain one, with the degree of success ultimately achieved determined by the wisdom and sensitivity with which the field experiment experience is translated into larger-scale service activities.†

Populations of perhaps 100,000–500,000 would seem suitable for such purposes. In some instances test runs might be made of approaches that are under serious consideration for nationwide implementation; in others, where nationwide programs are already under way, the experimental efforts could test alternate approaches for incorporation into the national effort at some later time. In either case, success would be defined not simply in terms of overall outcomes for nutrition and health, but more broadly to incorporate considerations of equity and community organization.

†*Careful, continuous monitoring and evaluatiom of large-scale primary-care service projects is needed as they come into operation. The call is not for sophisticated demographic research. What is needed, rather, is simple project management information systems that can be administered by project personnel at all levels and that can provide quickly the information that they*

To wait until all questions have been answered and all uncertainties have been resolved before pushing ahead, however, would be tantamount to a decision not to push ahead, a decision obviously not justified in the light of what is now known.

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require for assessment of their own effectiveness. Also important are the evaluation studies necessary to document the effect of large-scale continuing primary-care projects on such areas as nutritional status and levels of mortality and the social and economic status of various population groups.

Appendix D
The Costs of Nutrition Programs

The beginning of rough estimates of the cost of a nutrition program can be based on the common energy, or calorie, deficiency in developing countries. In a country in which 20 percent of the population consume, on an average, 1,600 calories a day, the cost of enough wheat to increase the average by 300 calories would be about $6.25 a year per beneficiary, at a landed cost of $200 a ton, and the additional costs of administration and delivery would be in the range of $1.50. Thus the base cost would be $25 million for a country of 20 million people.

In addition, substitution of food provided by programs for food now consumed and leakage outside the target group must then be taken into account. Program leakages that are the result of damage, infestation, pilferage, or other diversion of food and the inability to consume or digest food efficiently cause further losses and thus add to the costs.

The base cost of a supplementary feeding program in the early 1970s in Tamil Nadu to provide 300 calories a day per child was $14 a year per capita. But the cost was $16 a calorie-deficient child and $24 for each child whose anthropometric measurements improved. The effects of substitution are such that it would have cost $40 a year per child to provide a net increase in consumption of 300 calories to the group on which the figure of $14 was based.[1] In a nutrition rehabilitation program in Haiti, the cost per child reported in 1972 was $72 just for the services; it rose to $103 for those showing positive weight-for-age change and to $605 for those demonstrating more improvement than the control.[2] These extreme examples are not meant to imply that all supplementary feeding or nutrition rehabilitation programs are extremely expensive in relation to their effectiveness. But care must be used in estimating and comparing costs of nutrition programs. Target groups should be defined broadly, and income as well as the nutritional effects of programs should be estimated. If, for example, nutritional benefits to poor children less than thirty-six months old are valued at three times the nutritional benefits to others in the target group and at four times the general income benefits, then priorities among programs could be substantially different from those of programs that ignored all but nutritional benefits to poor children under the age of three.

Costs of other types of nutrition actions also tend to be highly variable, particularly when measured by per capita nutritional effect rather than per

capita input cost. It was estimated, for example, that in 1974 it would have cost only $0.03 a year per capita to provide Guatemalans with three quarters of the vitamin A that they require, but the cost per person of fulfilling the needs of those suffering from vitamin-A deficiency would have been $2.20 a year. Iron fortification has been estimated to cost $0.03 per capita and $0.11 per case of anemia relieved. Some fortification measures, such as fortification of salt to prevent goiter, are, even when measured by their effects on health, quite inexpensive. Other measures, particularly protein fortification, can be very expensive, both per kilogram and in relation to their nutritional effect. Looking at the cost of output can also be useful in evaluating nutrition education programs. For example, the per capita cost of producing a favorable change in attitude toward nutrition practices through mass media in the Philippines was estimated to be $1–$3 a year, but the corresponding cost of producing a change in behavior was $15–$29.[3]

Projects that offer both nutritional and nonnutritional benefits, such as integrated health and nutrition programs, raise complex questions of cost. In the ten integrated programs analyzed in Appendix C the costs of direct inputs were about $2–$7 a year per capita in low-income countries, varying according to the country and the inputs provided. When a water-supply program is added, costs rise to $10–$15 per capita if water comes from village wells and $30–$50 if standpipes are provided. Allocating costs among the objectives in health and nutrition programs is quite difficult. The costs and benefits of school lunch programs are justified partly on nutritional grounds and partly on the grounds that they improve school attendance and achievement. There is need both to take nonnutritional benefits into account and to be sure that the benefits claimed, both nutritional and nonnutritional, are carefully scrutinized. Opportunities forgone in the effort to achieve objectives in nutrition should also be taken into account.

The problems of assessing costs are not unique to nutrition; they apply to projects for the development of infrastructure and to other aspects of human resources. Poor countries have had less experience in addressing national problems of malnutrition than in efforts to improve transportation or irrigation, for example. Though there is greater uncertainty, and perhaps greater awareness of the extent of uncertainty, in assessing nutritional needs and costs than is true with respect to other national problems, nutrition is too important for programs to be dismissed out of hand for this reason.

To put the picture into perspective, the cost of the extensive and highly successful subsidy and other nutrition programs in Sri Lanka averaged about $10 a person from 1960 to 1973. With the worldwide increase in food prices that began in 1973, the cost rose to between $15 and $20. But with the restriction in the late 1970s of the ration to the poorest half of the population, and a sharp reduction in the general subsidy on wheat, the cost was

reduced again to approximately $10 per capita. Such an expenditure would be higher than some very poor countries could afford, and the objectives of the program would have to be scaled down. For certain other countries, though, this would be well within what, with external aid, could be considered feasible.

In many countries it may be feasible to generate a sizable increase in domestic and foreign resources—food and fiscal—for programs that make a substantial contribution to the alleviation of malnutrition. Some countries, because of political, administrative, and financial incapacity, will not be able or willing to borrow or to devote additional resources to basic needs for nutrition, but in a number of countries, there may be steps that can be taken to improve nutrition at low cost. It may be feasible, for example, to develop marketing arrangements that make basic foods more widely accessible, to bring about nutritionally desirable adjustments in cropping patterns through agricultural credit and extension programs, or to open agricultural policies to review to make sure that they are consistent with nutritionally desirable objectives.

Finally, with regard to costs, governments should be encouraged to examine the consequences of *not* doing something. Failure to meet basic needs for nutrition means, among other things, higher death rates and a less productive population.

Appendix E
Dietary Measures and Standards

Generally, determinations as to who is likely to be malnourished are based on a comparison of actual intake of nutrients with recommended levels of intake or of biological measurements with normative values of a well-nourished population. Food intake has serious limitations as a measure of malnourishment. Neither the intake of individuals nor the intake of households has been measured over long periods—one to seven days is common—or at regular intervals; national data on the availability of food seldom reflect postharvest losses, subsistence consumption, animal feed, uses of crops other than for food, or the variation in consumption of food by different population groups. At best, comparison of intakes of nutrients with dietary standards can only provide an estimate of the probability that the needs of the individual are being met.

The best indicators now available of overall nutritional state, especially of children, are biological measures: height and weight. Hematologic and biochemical measurements are most valuable, if clinical signs do not exist, in determining whether needs for the micronutrients—vitamins and trace elements—are being met. Shortness of stature at a given age indicates a past history of malnutrition, and low weight in relation to height indicates current malnourishment. Encompassed in these measures, however, are all the growth-suppressing features of the life experience, including prenatal and environmental forces. The height of seven-year-old children, for example, has been shown to be closely correlated with measures of the socioeconomic development of the communities they live in. Unfortunately, it is not known how those anthropometric measures vary with different levels of nutrient intake over different time spans.[1]

The problems encountered in separating the many factors that account for nutrient deficits make it difficult to identify the functional consequences of various levels of food deprivation and the most appropriate ways of combatting malnutrition. Research on these problems is under way. At present, the effects of severe malnutrition are readily documented: Studies have been made of the most seriously affected surviving cases—of children hospitalized with severe malnutrition, for example. Few studies have been made of marginal states of malnutrition; most evidence for these cases is derived from studies in which some anthropometric measurement served as proxy for nutrient intake.

Classically, the essentiality of a nutrient is determined by detection of some pathological change when the substance is omitted from the diet accidentally—such as scurvy, beriberi, pellagra, goiter, xerophthalmia, and rickets in deprived human populations—or intentionally in the laboratory. Modern experimental techniques allow the detection of more subtle changes, such as reduced levels of the nutrient in the blood or reduction of a metabolic reaction that is dependent upon it, changes that usually occur before the appearance of frank clinical symptoms. There is a range of intakes, depending on the nutrient in question, over which a positive state of health can exist with relatively little of the body's adaptive ability being brought into play. This is illustrated in Figure E.1. The time required for detectable changes in state to occur depends upon the amount of the nutrient that can be drawn from stores in the tissues. Thus if the nutrient in question were vitamin B_{12} and the person had been well nourished previously, his liver would contain a one- to three-year supply, and anemia would not develop until this store had been exhausted, whereas changes would occur after a few days, weeks, or months for lack of some other nutrient, such as sodium or vitamin C.

Even within a single individual, nutrient requirements are not fixed. Children do not grow at a steady rate, and their needs for nutrients vary at various times, but not necessarily linearly. Not all body tissues participate equally in accelerated growth at any given time, and there may be an adaptive decrease in one function to make possible maintenance of another. Needs for nutrients are also affected by the vicissitudes of life—the need to do exceptionally heavy work, idleness, an occasional illness, exposure to a toxic substance, or intentional or unavoidable food deprivation or excess in the past.

Some nutrients are metabolically interactive, and the need for one is related to the intake of the other. Thus, more thiamin is required at high levels of energy intake, and the need for vitamin B_6 goes up with the increase of protein in the diet. The significance of a lack of vitamin D in the diet differs according to intakes of calcium and phosphorus and the ratio of these elements to one another and, more important, according to the exposure to sunlight. If intake of energy is low, dietary protein is not used efficiently for its essential function, in contrast to its nonspecific energy-yielding function.

These uncertainties have led various authorities to elaborate relatively generous standards for the intake of nutrients. When it has been possible to establish an average minimum requirement against some criterion—something that has not been attempted for all nutrients—committees have set recommended dietary intakes 30 percent higher than the average figure, which is taken to be two standard deviations above the mean. This approach has been used in setting national and international standards for protein and many of the micronutrients, on the assumption that a small excess of the essential nutrients will do no harm to those whose

Functional Deterioration **Figure E.1**

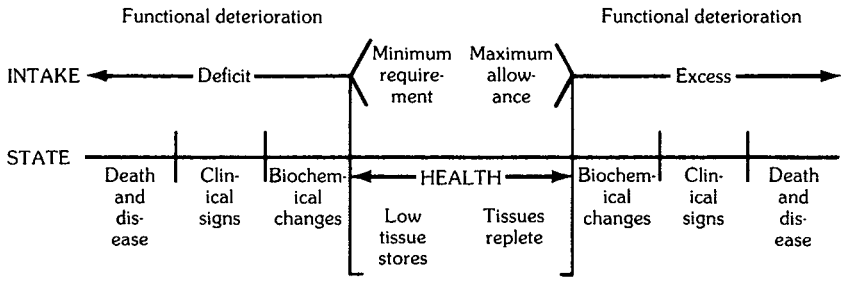
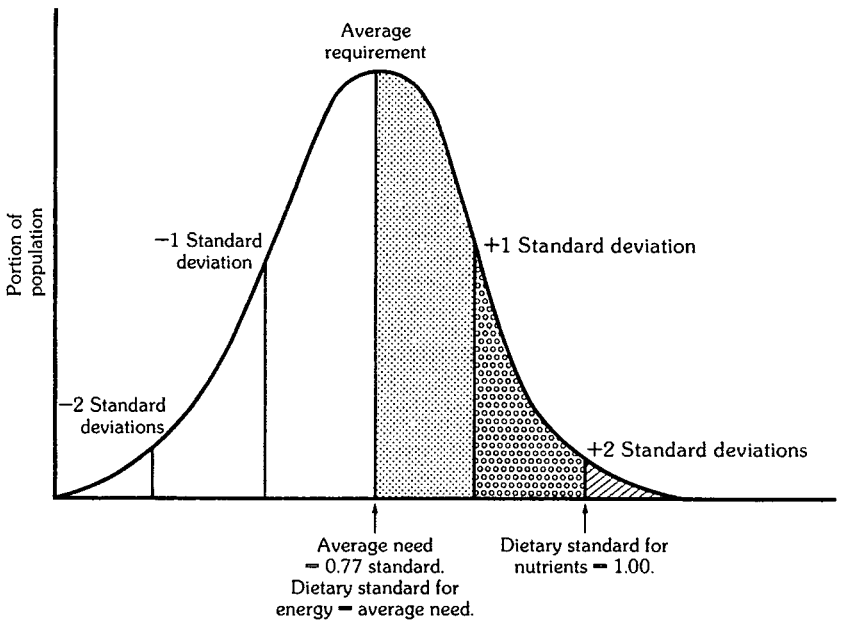


Figure E.2

Dietary Standards for Protein, Vitamins, and Minerals



Dietary standards for protein, vitamins, and minerals are intended to cover the needs of almost all healthy persons in a population; they are set at two standard deviations above the mean requirement when that is known. Thus, only 2.5 percent of a normally distributed population of requirers (▨ above) will fail to meet their needs if their diets meet the standard. The standard deviation is about 0.15 of the mean requirement in the few instances in which valid information exists. Thus, the average need is about 77 percent of the standard and the requirements of half the individuals will be met by intakes at this level. The standard for energy is set at the mean requirement, however, so the needs of half a population are not met by intakes that are equal to the standard.

requirements are low and that the standard should meet the need of nearly all healthy persons.* (See Figure E.2.)

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*There is no requirement for protein per se; the requirement is for essential amino acids and other nonspecific amino nitrogen. Protein is a practical proxy.

Appendix F
Equations

Methodology for Estimating Levels of Intake of Calories by Income Class

Most of the estimates reported by Shlomo Reutlinger and Harold Alderman in "The Prevalence of Calorie-deficient Diets in Developing Countries" of the magnitude of the malnutrition problem were calculated from equations reported by Odin K. Knudsen and Pasquale L. Scandizzo in "Nutrition and Food Needs in Developing Countries."[1] These equations provide estimates of calorie intakes by income group on the basis of functions fitted statistically to household consumption data of the form

$$C_i = a + b(\ln X_i),$$

where C_i is daily consumption of calories per capita
and X_i is the annual income of each income group.

The parameters (a, b) used were as follows: India, −1881, 1040; Pakistan, −231, 603; Bangladesh, −1779, 851; Morocco, −6246, 1343; and Brazil, −396, 664.

The level of intake of calories of each income group at time T, when prices remain unchanged, was projected by the equation

$$C_iT = C_{io} + bdT,$$

where C_{io} is the intake of calories during the base period and
d is the rate of growth in income.

If the price increased during the period, the equation used for the projections was

$$C_iT = C_{io} + bT(d - W_ig),$$

where W_i is the share of the budget of the income group that is allocated to food and
g is the growth rate of price.

Calorie deficits were measured by determining the difference between average requirements and estimated intakes per capita.

Regression Equations for Computing Values of Life Expectancy and Infant Mortality

The following equations were used to determine rates of life expectancy and infant mortality in Sri Lanka:[2]

$$\ln(\text{LIFEX}) = 3.263 + 0.123 \ln(Y)$$
$$(t) = (39.47) \quad (10.19)$$
$$R^2 = 0.65$$
$$s.e. = 0.10$$

and

$$\ln(\text{INFMOR}) = 7.896 - 0.590 \ln(Y)$$
$$(21.79) \quad (-11.14)$$
$$R^2 = 0.68$$
$$s.e. = 0.46$$

where

LIFEX = life expectancy,
INFMOR = infant mortality, and
Y = per capita income.

Notes

Chapter 1

[1]*C. H. Shah, "Food Preferences and Nutrition: A Perspective on Poverty in Less Developed Countries,"* Indian Journal of Agricultural Economics *35 (January–March 1980), pp. 1–39.*

[2]*Carl E. Taylor, in a general discussion in* Nutrition, National Development, and Planning, *ed. by Alan Berg, Nevin S. Scrimshaw, and David L. Call (Cambridge, Mass., and London: MIT Press, 1973), pp. 92–93; Cecile C. de Sweemer, "Growth and Morbidity," Ph.D. dissertation, The Johns Hopkins University, 1974.*

[3]*Frederick Golladay and Bernhard Liese, "Health Problems and Policies in the Developing Countries," Staff Working Paper no. 412 (Washington, D.C.: World Bank, August 1980);* Health, *Sector Policy Paper (Washington, D.C.: World Bank, February 1980).*

Chapter 2

[1]Energy and Protein Requirements, *Report of a Joint FAO/WHO ad Hoc Expert Committee, FAO Nutrition Meetings Report Series no. 52, WHO Technical Report Series no. 522 (Rome, 1973), p. 12.*

[2]*FAO/WHO,* Energy and Protein Requirements; *"Energy and Protein Requirements: Recommendations of a Joint FAO/WHO Informal Gathering of Experts,"* Food and Nutrition *1(2) (1975), p. 11.*

[3]*I. H. E. Rutishauser and R. G. Whitehead, "Energy Intake and Expenditure in 1–3-year-old Ugandan Children Living in a Rural Environment,"* British Journal of Nutrition *28 (1972), p. 145; J. M. Simmons, C. J. Wilson, D. E. Potter, and M. A. Holliday, "Relation of Calorie Deficiency to Growth Failure in Children on Hemodialysis and the Growth Response to Calorie Supplementation,"* New England Journal of Medicine *285(12) (1971), p. 653; Joaquin Cravioto and Beatriz Robles, "Evolution of Adaptive and Motor Behavior during Rehabilitation from Kwashiorkor,"* American Journal of Orthopsychiatry *35(3) (April 1965), pp. 449–64.*

[4]*K. Satyanarayana, A. Naclamurri Naidu, B. Chatterjee, and B. S. Narasinga Rao, "Body Size and Work Output,"* American Journal of Clinical Nutrition *30(3) (March 1977), pp. 322–25; Fernando E. Viteri and Benjamin Torun, "Ingestion calorica y trabajo fisico de obreros agrícolas en Guatemala,"* Boletin de la oficina sanitaria panamericana *78(1974), p. 58; W.D. Keller and H. A. Kraut, "Work and Nutrition,"* World Review of Nutrition and Dietetics *3 (1962), pp. 65–81.*

[5]*Robert E. Klein, Jerome Kagan, Howard E. Freeman, Charles Yarbrough, and Jean-Pierre Habicht, "Is Big Smart? The Relation of Growth to Cognition,"* Journal of Health and Social Behavior *13(3) (September 1972), pp. 219–25; E. M. Widdowson, "Prenatal Nutrition," in "Food and Nutrition in Health and Disease," ed. by N. H. Moss and Jean Mayer,* Annals of the New York Academy of Sciences *300 (1977), p. 188.*

[6]*Myron Winick, ed.,* Nutrition and Development *(New York: John Wiley and Sons, 1972); Myron Winick, Pedro Rosso, and John Waterlow, "Cellular Growth of Cerebrum, Cerebellum, and Brain Stem in Normal and Marasmic Children," Experimental Neurology 26(2) (February 1970), pp. 393–400; Ernesto Pollitt and Carol Thomson, "Protein–Calorie Malnutrition and Behavior: A View from Psychology," in* Nutrition and the Brain, *vol. 2, ed. by Richard J. Wurtman and Judith J. Wurtman (New York: Raven Press, 1977).*

[7]*Pollitt and Thomson, "Protein-Calorie Malnutrition and Behavior"; Joaquin Cravioto and Elsa DeLicardie, "Nutrition and Behavior and Learning,"* in World Review of Nutrition and Dietetics, *vol. 16 (Basel: S. Karger, 1973), pp. 80–96; M. B. Stoch and P. M. Smythe, "Fifteen-Year Development Study on Effects of Severe Undernutrition during Infancy on Subsequent Physical Growth and Intellectual Functioning,"* Archives of Disease in Childhood *51(5) (May 1976), pp. 327–36.*

[8]*Cravioto and Robles, "Rehabilitation from Kwashiorkor."*

[9]*Robert E. Klein, Barry Lester, Charles Yarbrough, and Jean-Pierre Habicht, "On Malnutrition and Mental Development: Some Preliminary Findings,"* in Prognosis for the Undernourished Surviving Child, *vol. 2 of Proceedings of the Ninth International Congress of Nutrition, Mexico D.F., 3–9 September 1972, ed. by Adolfo Chávez, Hector Bourges, and Samir Basta (Basel and New York: S. Karger, 1975).*

[10]*Robert E. Klein and others, "The INCAP Logitudinal Study of Malnutrition and Mental Development," mimeographed (Guatemala City: Institute of Nutrition for Central America and Panama, August 1978).*

[11]*Linda N. Edwards and Michael Grossman, "The Relationship between Children's Health and Intellectual Development," paper presented at the Functional Health Status Conference, Public Services Laboratory, Georgetown University, Washington, D.C., 23–24 September 1977, reprinted in* Health: What is It Worth? Measures of Health Benefits, *ed. by Selma J. Mushkin and David W. Dunlop (Elmsford, N.Y.: Pergamon Press, 1979).*

[12]*Celia Martinez and Adolfo Chávez, "Nutrition and Development in Infants of Poor Rural Areas,"* Nutrition Reports International *4(3) (September 1971), pp. 139–49.*

[13]*M. D. C. Immick, Fernando E. Viteri, and R. W. Helms, "Energy Intake and Human Capital Formation," paper presented at the Eleventh International Congress of Nutrition, Rio de Janeiro, 28 August–1 September 1978.*

[14]*G. B. Spurr, M. Barac-Nieto, and M. G. Maksud, "Energy Expenditure Cutting Sugarcane,"* Journal of Applied Physiology *39(6) (December 1975), pp. 990–96; K. J. Collins, R. J. Brotherhood, C. T. M. Davies, and others, "Physiological Performance and Work Capacity of Sudanese Cane Cutters with Schistosoma Mansoni Infection,"* American Journal of Tropical Medicine *25(1) (1976), pp. 420–21; K. Satyanarayana and others, "Body Size and Work Output."*

[15]*Vinodini Reddy, V. Jagadeesan, N. Ragharamulu, C. Bhaskaram, and S. G. Srikantia, "Functional Significance of Growth Retardation in Malnutrition,"* American Journal of Clinical Nutrition *29(1) (January 1976), pp. 3–7; J. Geefhuysen, E. U. Rosen, J. Katz, T. Ipp, and J. Metz, "Impaired Cellular Immunity in Kwashiorkor with Improvement after Therapy,"* British Medical Journal *4(5786) (27 November 1971), pp. 527–29.*

[16]*D. G. Jose, J. S. Welch, and R. L. Doherty, "Humoral and Cellular Immune Responses to Streptococci, Influenza, and other Antigens in Australian Aboriginal School Children,"* Australian Pediatrics Journal *6 (1970), p. 192; Roy E. Brown and Michael Katz, "Antigenic Stimulation in Undernourished Children,"* East African Medical Journal *42(5) (May 1965), pp. 221–32; Michael Katz and E. Richard Stiehm, "Host Defense in Malnutrition,"* Pediatrics *59(4) (1977), pp. 490–94.*

[17]*A. A. O. Laditan and P. J. Reeds, "A Study of the Age of Onset, Diet, and Importance of Infection in the Pattern of Severe Protein-Energy Malnutrition in Ibadan, Nigeria,"* British Journal of Nutrition *36 (1976), p. 411; Ruth Rice Puffer and Carlos V. Serrano,* Patterns of Mortality in Childhood, *Report of the Inter-American Investigation of Mortality in Childhood, Scientific Publication no. 262 (Washington, D.C.: Pan American Health Organization 1973).*

[18]*See N. R. Butler and E. D. Alberman, "Maternal Factors Affecting Duration of Pregnancy, Birth Weight, and Fetal Growth,"* in Perinatal Problems, *ed. by N. R. Butler and E. D. Alberman (Edinburgh: E. and S. Livingstone, 1969); U.S. National Research Council/National Academy of Sciences,* Maternal Nutrition in the Course of Pregnancy *(Washington, D.C., 1970).*

[19]*Lawrence Bergner and Mervyn W. Susser, "Low Birth Weight and Prenatal Nutrition: An Interpretive Review,"* Pediatrics *46(6) (December 1970), pp. 946–66; Richard L. Naeye and others, "Relation of Poverty and Race to Birth Weight and Organ and Cell Structure in the Newborn,"* Pediatric Research *5 (1977), p. 17; Farida K. Shah and Helen Abbey, "Effects of Some Factors on Neonatal and Postneonatal Mortality,"* Milbank Memorial Fund Quarterly *49(1) (January 1971, part 1), pp. 33–57; U.S. Department of Health and Human Services,*

Public Health Service, Office of Health Research, Statistics, and Technology, Health, United States, 1980, *DHHS Publication (PHS) 81-1232 (Hyattsville, Md., October 1980).*

[20]*Richard L. Naeye, William Blanc, and Cheryl Paul, "Effects of Maternal Nutrition on the Human Fetus,"* Pediatrics *52(4) (October 1973), pp. 494–503; Aaron Lechtig, Jean-Pierre Habicht, Hernan Delgado, Robert E. Klein, Charles Yarbrough, and Reynaldo Martorell, "Effect of Food Supplementation during Pregnancy on Birth Weight,"* Pediatrics *56(4) (October 1975), pp. 508–20; Agnes Higgins, "Nutrition Status and the Outcome of Pregnancy,"* Journal of the Canadian Dietetics Association *37(1) (1976), p. 17.*

[21]*V. A. Beal, "Nutritional Studies during Pregnancy,"* Journal of the American Dietetic Association *58 (1978), p. 321.*

[22]*D. B. Jelliffe and E. F. P. Jelliffe, "The Volume and Composition of Human Milk in Poorly Nourished Communities: A Review,"* American Journal of Clinical Nutrition *31 (1978), p. 492.*

[23]*Ibid.*

[24]*Amplification of these points can be found in Alan Berg,* The Nutrition Factor: Its Role in National Development *(Washington, D.C.: The Brookings Institution, 1973).*

[25]*Guy Standing,* Labour Force Participation and Development *(Geneva: International Labour Organisation, 1978), pp. 91–100.*

[26]*Adolfo Chávez and Celia Martinez, "Nutrition and Development of Children from Poor Rural Areas, III: Maternal Nutrition and Its Consequences on Fertility,"* Nutrition Reports International *7 (1973), p. 1; Robert H. Cassen, "Population and Development: Survey,"* World Development *4 (10/11) (October–November 1976).*

[27]*Christopher Stevens,* Food Aid and the Developing World: Four African Case Studies *(New York: St. Martin's Press, 1979).*

Chapter 3

[1]*Reutlinger and Alderman's estimates of calorie intakes, by income group, were derived by using quotations reported by Odin K. Knudsen and Pasquale L. Scandizzo in "Nutrition and Food Needs in Developing Countries," Staff Working Paper no. 328 (Washington, D.C.: World Bank, May 1979); details are given in Appendix F. See also Shlomo Reutlinger and Harold Alderman, "The Prevalence of Calorie-deficient Diets in Developing Countries," Staff Working Paper no. 374 (Washington, D.C.: World Bank, March 1980). Data on calories per capita are from the* 1979 FAO Food Production Yearbook *(Rome: Food and Agriculture Organization of the United Nations, 1980), pp. 249–50.*

[2]*T. N. Srinivasan, "Malnutrition: Some Measurement and Policy Issues," Staff Working Paper no. 373 (Washington, D.C.: World Bank, February 1980); D. V. Sukhatme, "Assessment of Adequacy of Diets at Different Income Levels,"* Economic and Political Weekly of India *13(31–33) (August 1978), pp. 1373–84; Shlomo Reutlinger and Marcelo Selowsky, letter to the editor in rebuttal to a review of their book* Malnutrition and Poverty, Food Policy *2(4) (November 1977), pp. 352–53; P. R. Payne, the reviewer, responds,* Food Policy *2(4), pp. 353–54; "The Uses of Energy and Protein Requirement Estimates: Report of a Workshop," Cambridge: Massachusetts Institute of Technology, 27–29 May 1980,* Food and Nutrition Bulletin *3(1) (January 1981), pp. 45–53.*

[3]*Shlomo Reutlinger and Marcelo Selowsky,* Malnutrition and Poverty: Magnitude and Policy Options, *World Bank Staff Occasional Papers no. 23 (Baltimore and London: The Johns Hopkins University Press, 1976).*

[4]*Reutlinger and Alderman, "Calorie-deficient Diets in Developing Countries."*

[5]*Per Pinstrup-Andersen and Elizabeth Caicedo, "The Potential Impact of Changes in Income Distribution on Food Demand and Human Nutrition,"* American Journal of Agricultural Economics *60(3) (August 1978), pp. 402–15.*

Chapter 4

[1]*A review and analysis of experience in a wide range of nutrition intervention programs is given in a publication prepared by James E. Austin and others for the ACC Sub-Committee on*

Nutrition of the United Nations, "Nutrition Intervention Assessment and Guidelines" (Cambridge, Mass.: Harvard Institute for International Development, June 1978).

[2]*The study was subsequently published in fuller detail than in Appendix C; see Davidson R. Gwatkin, Janet R. Wilcox, and Joe D. Wray, "Can Health and Nutrition Interventions Make a Difference?" Monograph no. 13 (Washington, D.C.: Overseas Development Council, 1980); see also Arnfried A. Kielmann, C. A. Ajello, and N. S. Kielman, "Evaluation of Nutrition Intervention Projects," a report to the U.S. Agency for International Development, mimeographed. (Baltimore: The Johns Hopkins University, 1980); see also Carl E. Taylor, Arnfried A. Kielmann, Dov Chernichovsky, and others, "Malnutrition, Infection, Growth, and Development: The Narangwal Experience," a report to the World Bank (Washington, D.C., forthcoming).*

[3]*National Science Development Board, Food and Nutrition Research Institute,* First Nationwide Nutrition Survey: Philippines, 1978 *(Manila, 1980).*

[4]*Hans W. Singer and Simon Maxwell, "Food Aid and Supplementary Feeding," Report for the World Food Program, Institute of Development Studies (Sussex, 1978).*

Chapter 5

[1]*Per Pinstrup-Andersen and others, "The Impact of Increasing Food Supply on Human Nutrition: Implications for Commodity Priorities in Agricultural Research and Policy,"* American Journal of Agricultural Economics *58(2) (May 1976), pp. 131–42.*

[2]*See T. James Goering, "Tropical Root Crops and Rural Development," Staff Working Paper no. 324 (Washington, D.C.: World Bank, April 1979).*

[3]*Robert Chambers, "Health, Agriculture, and Rural Poverty: Why Seasons Matter," Discussion Paper DP 148, Institute of Development Studies (Sussex: University of Sussex, December 1979); Richard Longhurst and Philip R. Payne, "Seasonal Aspects of Nutrition: Review of Evidence and Policy Implications," Discussion Paper DP 145, Institute of Development Studies (Sussex: University of Sussex, November 1979); and other papers from the conference "Seasonal Dimensions to Rural Poverty," Institute of Development Studies, University of Sussex, July 1978; Sue Schofield, "Seasonal Factors Affecting Nutrition in Different Age Groups and Especially Preschool Children,"* Journal of Development Studies *2(1) (October 1974), pp. 22–40; Rafael Flores, Alfonso Mata, Benjamin Torun, and Fernando E. Viteri, "Variations in Physical Fitness and Energy Intake of Agricultural Workers during Two Periods of the Agricultural Cycle," paper presented at the Eleventh International Congress of Nutrition, Rio de Janeiro, 28 August–1 September 1978.*

[4]*David Bigman and Shlomo Reutlinger, "National and International Policies toward Food Security and Price Stabilization,"* American Economic Review *69 (May 1979), Papers and Proceedings from the 92d Meeting of the American Economic Association, pp. 159–63.*

[5]*Theodore W. Schultz, "Economic Distortions by the International Donor Community," paper presented to a World Bank Agricultural Symposium, Washington, D.C., 9 January 1981.*

[6]*Mercedes Hernandez, Carlos Pérez Hidalgo, Juan Ramirez Hernandez, Herlinda Madrigal, and Adolfo Chávez, "Effect of Economic Growth on Nutrition in a Tropical Community,"* Ecology of Food and Nutrition *3(4) (1974), pp. 238–91; K. Dewey, "The Impact of Agricultural Change on Diet and Nutrition in Tabasco, Mexico," Paper presented at the annual meeting of the American Anthropological Association, Los Angeles, 14–18 November 1978.*

[7]*Julian N. Lambert, "Does Cash Cropping Cause Malnutrition?" mimeographed (Port Moresby, Papua New Guinea: National Planning Office, March 1978).*

[8]*Patrick Fleuret and Anne Fleuret, "Nutrition, Consumption, and Agricultural Change,"* Human Organization, *Journal of the Society for Applied Sociology, 39(3) (Fall 1980), pp. 250–60; see also R. N. Adams, "Some Observations on the Interrelations of Development and Nutrition Programs,"* Ecology of Food and Nutrition *3 (1974), pp. 85–88.*

[9]*Hans W. Singer and Simon Maxwell, "Food Aid and Supplementary Feeding," Report for the World Food Program, Institute of Development Studies (Sussex, 1978); Christopher Stevens,* Food Aid and the Developing World: Four African Case Studies *(New York: St. Martin's Press, 1979); George H. Beaton and Hossein Ghassemi, "Supplementary Feeding Programs for Young Children in Developing Countries," report prepared for UNICEF and the ACC Sub-Committee on Nutrition of the United Nations (New York: United Nations Children's Fund*

(UNICEF), October 1979); Eileen T. Kennedy, "Evaluation of the WIC Supplemental Feeding Program on Prenatal Infants in Massachusetts," (Ph.D. dissertation, Harvard University, 1979).

[10]*Beaton and Ghassemi, "Supplementary Feeding Programs for Young Children."*

[11]*Vital Didonet, "Atendimento integrado de educação, saúde, nutrição, e envolvimento comunitário do pré-escolar, através de metodologia de baixo custo e ampla cobertura: síntese da exposição" [methodology of integrated health, nutrition, and education program and community involvement in preschool education], paper presented at the World Assembly of Preschool Education, Quebec, 28 August–2 September 1980.*

[12]*See Shahid Javed Burki and others, "Public Works Programs in Developing Countries: A Comparative Analysis," Staff Working Paper no. 224 (Washington, D.C.: World Bank, February 1976).*

[13]*Paul Isenman, "Basic Needs: The Case of Sri Lanka,"* World Development *8(3) (March 1980), pp. 237–58.*

[14]*J. S. Hammer, "Essays in Economic Development and Income Distribution," (Ph.D. dissertation, Department of Economics, Massachusetts Institute of Technology, 1979); see also Beatrice L. Rogers and F. James Levinson, "Subsidized Food Consumption Studies . . . in Pakistan," International Nutrition Planning Program Discussion Paper 13 (Cambridge: Massachusetts Institute of Technology, 1978).*

[15]*Shubh K. Kumar, "The Impact of Subsidized Rice Distribution on Food Consumption and Nutrition in Kerala," IFPRI Research Report 5 (Washington, D.C.: International Food Policy Research Institute [IFPRI], January 1979); P. S. George, "Public Distribution of Foodgrains in Kerala: Income Distribution Implications and Effectiveness," IFPRI Research Report 7 (Washington, D.C.: IFPRI, March 1979).*

[16]*Hollis B. Chenery, Montek S. Ahluwalia, C. L. G. Bell, John H. Duloy, and Richard Jolly,* Redistribution with Growth *(Oxford and New York: Oxford University Press, 1974).*

[17]*The political attractiveness of food-consumption programs is discussed by Marcelo Selowsky in "The Economic Dimensions of Malnutrition in Young Children," Staff Working Paper no. 294 (Washington, D.C.: World Bank, October 1978).*

[18]*F. James Levinson, "Incorporating Nutrition in Agricultural, Food, and Health Policies and Programs in South Asia," paper presented at the Regional Seminar on an Integrated Approach to Population, Food, and Nutrition Policies and Programs for National Development, sponsored by the United Nations Economic and Social Commission for Asia and the Pacific, Bangkok, 24–31 July 1979; Rezaul Karim, Manjur Majid, and F. James Levinson, "The Bangladesh Sorghum Experiment,"* Food Policy *5(1) (February 1980), pp. 61–63.*

[19]Nutrition Action *7(11) (November 1980), p. 16.*

[20]*For an extensive treatment of relevant economic issues, see Selowsky, "The Economic Dimensions of Malnutrition in Young Children."*

[21]*Kumar, "The Impact of Subsidized Rice Distribution . . . in Kerala"; see also James Gavan and I. S. Chandrasekera, "The Impact of Public Foodgrain Distribution on Food Consumption and Welfare in Sri Lanka," IFPRI Research Report 13 (Washington, D.C.: International Food Policy Research Institute [IFPRI] 1979). For similar conclusions about the U.S. food-stamp program, see William Boehm and others, "Progress toward Eliminating Hunger in America," ESCS AER no. 446 (Washington, D.C.: U.S. Department of Agriculture, 1980).*

[22]*Brady J. Deaton, "Public Law 480: The Critical Choices,"* American Journal of Agricultural Economics, *62(5) (December 1980), pp. 988–92.*

[23]*Gurushi Swami, "Public Food Distribution in India," Agriculture and Rural Development Department, Economics and Policy Division Working Paper (Washington, D.C.: World Bank, May 1980).*

[24]*Lana L. Hall, "Evaluating Effects of P.L. 480 Wheat Imports on Brazil's Grain Sector,"* American Journal of Agricultural Economics *62(1) (February 1980), pp. 19–28.*

[25]*Stevens,* Food Aid and the Developing World.

[26]*Singer and Maxwell, "Food Aid and Supplementary Feeding."*

[27]*Stevens,* Food Aid and the Developing World; *see also Carlos Benito, "Policies for Food Production and Consumption in Underdevelopment: The Case of Mexico,"* Journal of Policy Modeling *3 (1979), pp. 383–98.*

[28]*John W. Mellor, "Food Aid and Nutrition,"* American Journal of Agricultural Economics *62(5) (December 1980), pp. 979–83.*

[29]*Gavan and Chandrasekera, "The Impact of Public Foodgrain Distribution . . . in Sri Lanka."*

Chapter 6

[1]*Lloyd S. Harbert and Pasquale L. Scandizzo, "Food Distribution and Nutrition Intervention: The Case of Chile," Agriculture and Rural Development Department, Economics and Policy Division Working Paper no. 29 (Washington, D.C.: World Bank, May 1980); Judith Graves and Pasquale L. Scandizzo, "The Alleviation of Malnutrition: Impact and Cost-Effectiveness of Official Programs," Agriculture and Rural Development Department, Economics and Policy Division Working Paper no. 19 (Washington, D.C.: World Bank, October 1980); Odin Knudsen, "Economics of Supplemental Feeding of Malnourished Children: A Case of Leakages, Benefits, and Costs," Staff Working Paper (Washington, D.C.: World Bank, forthcoming).*

[2]*World Bank,* Agricultural Research, *Sector Policy Paper (Washington, D.C., June 1981).*

[3]Meeting Basic Needs: An Overview, *Poverty and Basic Needs Series (Washington, D.C.: World Bank, September 1980); Carl E. Taylor, Arnfried A. Kielmann, Dov Chernichovsky, and others, "Malnutrition, Infection, Growth, and Development: The Narangwal Experience" (Washington, D.C.: World Bank, forthcoming).*

[4]*Alan Berg, C. Peter Timmer, Doris Calloway, Sol Chafkin, and others, "Nutrition," Report of Study Team 9, National Research Council, Commission on International Relations,* World Food and Nutrition Study: Supporting Papers, *vol. 4 (Washington, D.C.: National Academy of Sciences, 1977).*

[5]Meeting Basic Needs: An Overview.

Appendix B

[1]*Shlomo Reutlinger and Marcelo Selowsky,* Malnutrition and Poverty: Magnitude and Policy Options, *World Bank Staff Occasional Papers no. 23 (Baltimore and London: The Johns Hopkins University Press, 1976).*

Appendix C

[1]*See, for example, the findings of James E. Austin and others, "Nutrition Intervention Assessment and Guidelines," report prepared for the ACC Sub-Committee on Nutrition of the United Nations, mimeographed (Cambridge, Mass.: Harvard Institute for International Development 1978), and those of Jean-Pierre Habicht and William P. Butz, "Measurement of Health and Nutrition Effects of Large-Scale Intervention Projects," paper presented at the Conference on the Measurement of the Impact of Nutrition and Related Health Programs in Latin America, Panama City, 1–4 August 1977.*

[2]*Kenneth W. Newell, ed.,* Health by the People *(Geneva: World Health Organization, 1975).*

[3]*In addition to Newell's* Health by the People, *see Mary V. Ammel, "Rural Health Promoters' Program: Fifteen Years' Experience in Community Health, Huehuetenango, Guatemala," paper presented at the second annual conference of the International Federation of Public Health Associations, Halifax, Nova Scotia, 23 May 1978, mimeographed; Zafrullah Chowdhury, "The Mother and Child in Bangladesh: A View from the People's Health Centre,"* Les Carnets d'Enfance/Assignment Children *33 (January–March 1976); Eric R. Ram, "Integrated Health Services: The Miraj Project in India,"* Les Carnets d'Enfance/Assignment Children *39 (July–September 1977); P. M. Shah and others, "Communitywide Surveillance of 'At Risk' Under-Fives in Need of Special Care,"* Environmental Child Health *(June 1976), pp. 103–7; David Bradford Werner, "Health Care and Human Dignity: A Subjective Look at Community-based Rural Health Programs in Latin America," mimeographed (Palo Alto, Cal.: Hesperian Foundation, 1976); Working Group on Rural Medical Care, "Delivery of Primary Care by Medical Auxiliaries: Techniques of Use and Analysis of Benefits Achieved in Some Rural Villages in Guatemala," in Pan American Health Organization,* Medical Auxiliaries, *proceedings of a symposium held during the twelfth meeting of the PAHO Advisory Committee on Medical Research, 25 June 1973, PAHO Scientific Publication no. 278 (Washington, D.C.: 1973), pp. 24–37.*

[4]*Walsh McDermott, "Modern Medicine and the Demographic-Disease Pattern of Overly Traditional Societies: A Technologic Misfit,"* Journal of Medical Education *41 (Supplement, 1966), pp. 137–62.*

[5]*Descriptions of other projects in which substantial thought was given to this question are to be found in the publications cited in footnote 3 and in John Briscoe, "Improving Health Care Where Health Is Underdeveloped: Do Foreign Voluntary Agencies (Particularly Oxfam) Help in Bangladesh?" (Dacca: Oxfam, 1978); Zafrullah Chowdhury, "Organization, Supervision, and Evaluation of Primary Health Care Workers," paper presented at the Ninth International Conference on Health Education, Ottawa, August 1976; and David Bradford Werner, "The Village Health Worker—Lackey or Liberator?" paper prepared for sessions on health auxiliaries and the health team of the International Hospital Federation Congress, Tokyo, May 1977.*

Appendix D

[1]*James E. Austin and others, "Nutrition Intervention Assessment and Guidelines," report prepared for the ACC Sub-Committee on Nutrition of the United Nations (Cambridge, Mass.: Harvard Institute for International Development, June 1978).*

[2]*Ibid.*

[3]*Ibid.*

Appendix E

[1]*W. Keller, G. Donoso, and E. M. DeMaeyer, "Anthropometry in Nutritional Surveillance: A Review Based on Results of the WHO Collaborative Study on Nutritional Anthropometry,"* Nutrition Abstracts and Reviews *46(8) (August 1976), pp. 591–604.*

Appendix F

[1]*Reutlinger and Alderman, "The Prevalence of Calorie-deficient Diets in Developing Countries," Staff Working Paper no. 374 (Washington, D.C.: World Bank, March 1980); Knudsen and Scandizzo, "Nutrition and Food Needs in Developing Countries," Staff Working Paper no. 328 (Washington, D.C.: World Bank, May 1979).*

[2]*World Bank,* World Tables 1976 *(Baltimore and London: The Johns Hopkins University Press, 1976). Data concerning fifty-nine countries are for 1975 or the nearest year for which data are available.*

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