LANCE TAYLOR*

RESEARCH DIRECTIONS IN INCOME DISTRIBUTION, NUTRITION, AND THE ECONOMICS OF FOOD†

The number of potentially researchable questions about how income distribution, food production and consumption, and nutritional status work themselves out together is large. This paper attempts to chart the terrain and identify some interesting specific topics. The criteria of selection are that the problems be amenable to policy intervention, that they bear on the welfare of poor people in poor countries, and that they can be effectively studied by fairly small research teams with major specialization in economics.

Chart 1 shows in diagrammatic form some of the causal links among agricultural, food processing, and nutritional variables. The diagram is far from complete, but it makes the point that interactions among these variables are elaborate and complex. Of course, many relationships have been investigated extensively over the years (for example, the link between income flows and household consumption patterns à la Engel's Law), but others are virtually untouched. Details are given shortly.

In an amplification of Chart 1, Chart 2 outlines relationships among nutritional status and other socioeconomic variables. While the central part of the first diagram contains linkages traditionally studied by economists, those in Chart 2 are usually investigated by members of other disciplines—public health, nutrition, anthropology, and psychology especially. There is room for interdisciplinary research along Chart 2 lines.

In the remainder of this section, the general structure of the two diagrams is discussed and prominent sets of relationships pointed out. In succeeding sections, possible research topics focusing on each set are analyzed in more detail.

Beginning at the left of Chart 1, arrows 1 through 11 deal with the agricultural sector of the economy. A number of factors determine what animal and vegetable products will be produced. They include government crop price and acquisition

* The author is Professor of Economics and Nutrition at the Massachusetts Institute of Technology.

† An initial version of this paper was prepared for the International Food Policy Research Institute, whose support is gratefully acknowledged.

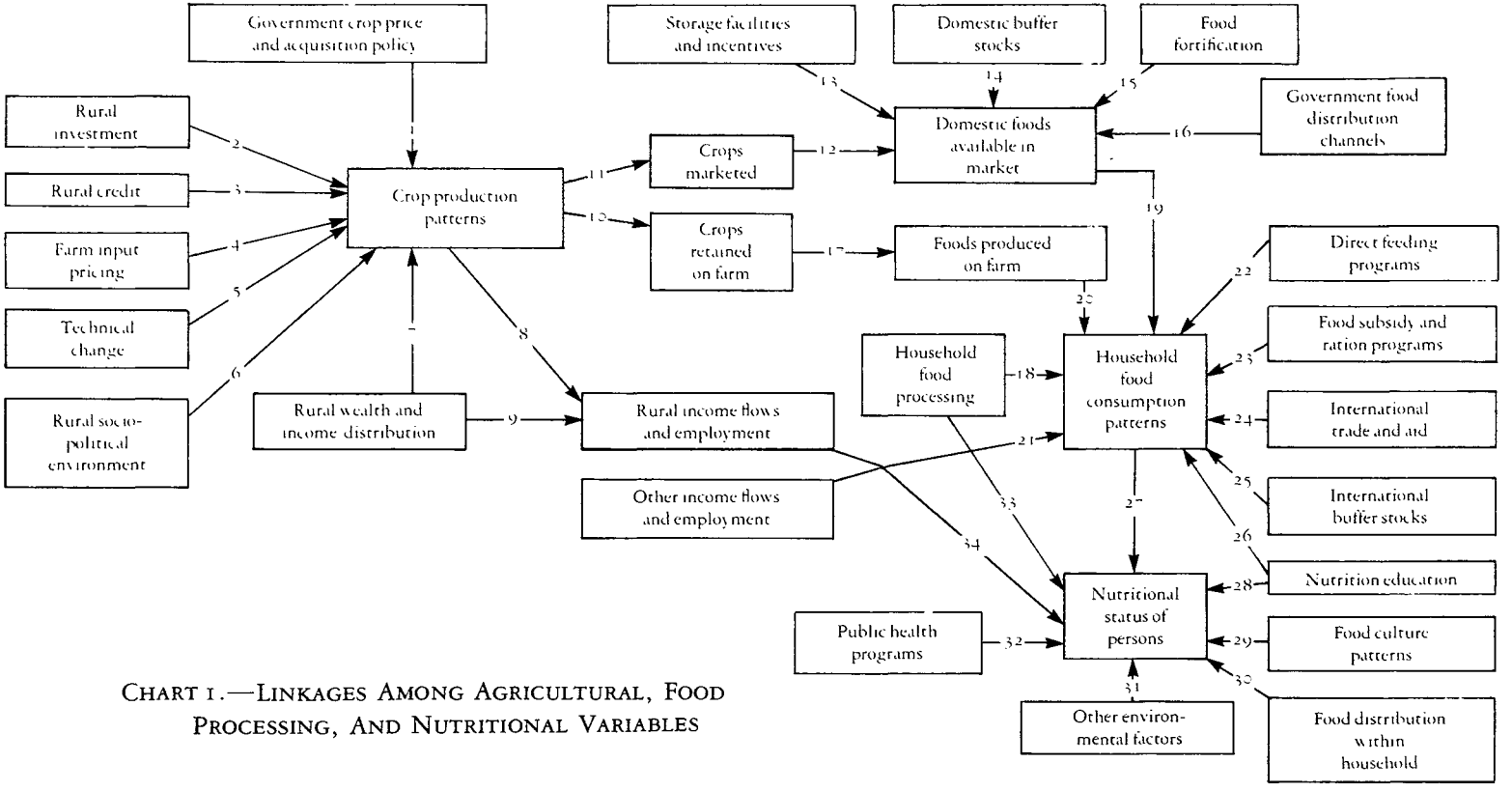

CHART 1.—LINKAGES AMONG AGRICULTURAL, FOOD PROCESSING, AND NUTRITIONAL VARIABLES

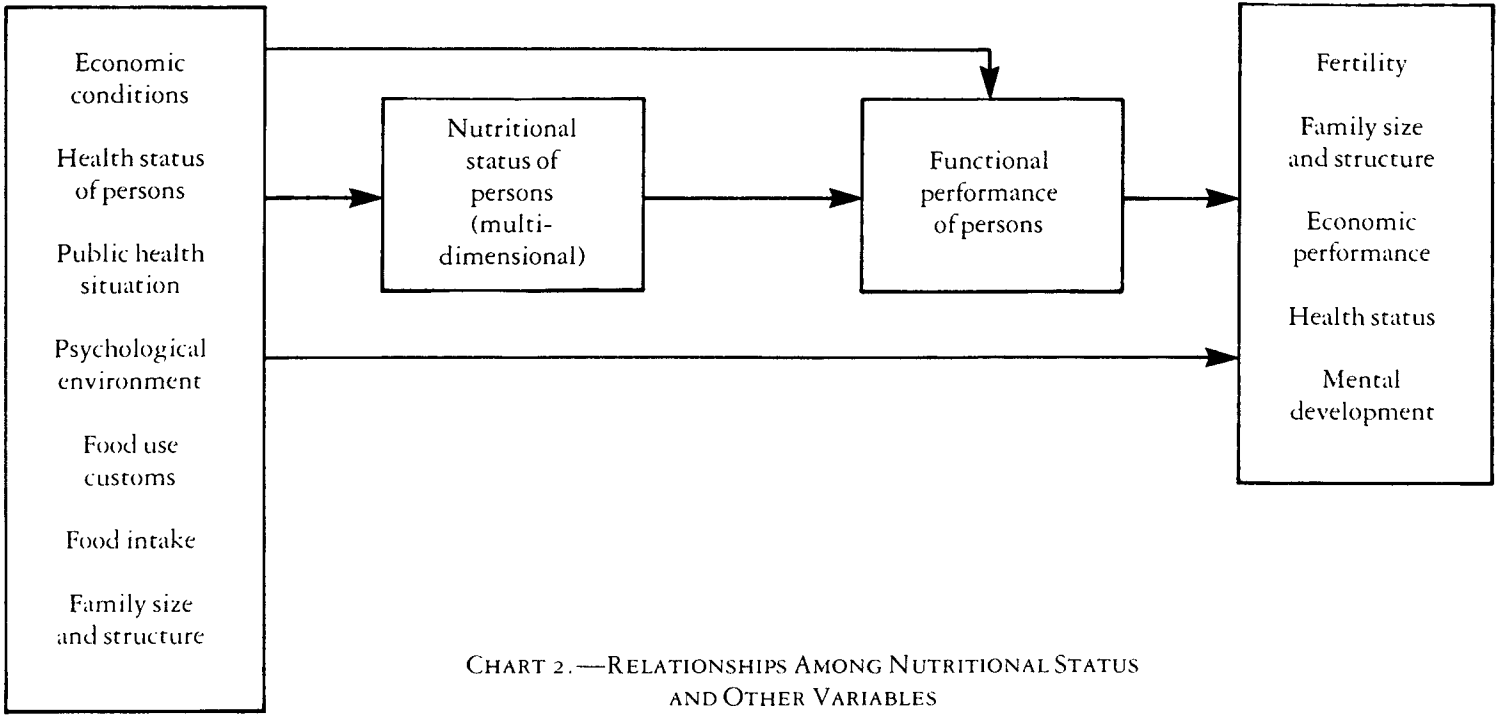

CHART 2.—RELATIONSHIPS AMONG NUTRITIONAL STATUS AND OTHER VARIABLES

policies (including official restrictions on the cropping pattern and compulsory deliveries), rural investment programs, farm credit, input pricing policies (for example, fertilizer and water subsidies), the general technological level of agriculture, the rural sociopolitical environment (for example, power relationships in the countryside), and rural wealth and income distributions. The distinctions drawn by arrows 10 and 11 between crops entering the market and those retained at home are important in both nutritional and income distribution terms.[1] On the nutrition side, marketed and non-marketed crops are processed into "foods" in different ways. In terms of income distribution, typically the larger and richer farmers benefit more than do smallholders or landless laborers from policies aimed at increasing marketed surplus through either technical change or price manipulation. Finally, crop production, the pre-existing wealth distribution, and, more generally, power relationships within the countryside and within the city determine rural income flows (*11*, 9). On the right side of the diagram, income is a major determinant of food consumption and nutritional status.

Causal arrows 1 through 11 traditionally fall into the domain of the agricultural economist or rural sociologist and have been investigated extensively in many countries. However, other variables not in the agricultural scientist's bailiwick intervene between farm output, food supply, and nutritional status and the whole package has not been adequately studied. For example, there is very little in the literature about linkages between the mode of production in agriculture and the distribution of food consumption within the family. Peasant and especially plantation agricultural techniques in poor countries are often built around large inputs of human labor requiring high calorie expenditure. When total caloric intake is limited by poverty, such a technology automatically creates great risk of destructive competition for food within the family between workers and non-workers. Infant, female, and child malnutrition can be a natural consequence of this particular micro mode of production (*12*).

After crops leave the field, they are transported, processed, and stored before they are eaten. Traditional processing techniques and a host of cultural patterns influence final nutritional status. In a poor country, a very large share of production may be consumed in the farm household or distributed by non-market mechanisms. For example, in Pakistan the marketed surplus of grain may amount to a third or less of total production. What happens to non-commercialized food is clearly influenced by economic variables (the government price and acquisition policy for the staple crop is a clear example), but cultural practices and known processing techniques are at least equally important. Economic anthropological research into non-food channels could help in the design of nutritional education programs and introduction of new storage and food-processing methods at the household level.

As a country becomes richer, food shifts from non-market to market channels, and the value added along the latter increases until farmgate prices make up a very small share of food costs, as in Europe and the United States (*16*, ch. 5).

The government can intervene in market distribution of foodstuffs in several ways. Examples are the storage of grains and animal products as insurance against

[1] Intermediate products such as hay or other fodder crops are not shown in this simplified diagram.

shortages; provision of roads, marketplaces, slaughterhouses, public storehouses, and other structures to facilitate distribution; food fortification programs which in effect put new products on the market; and setting up its own distribution channels such as government-subsidized supermarkets or ration shops in urban areas. Also, in a mixed economy, private initiatives in processing and packaging can be expected (for example, sale of canned baby foods, expansion of frozen food products, and more elaborate packaging). For good or ill, such entrepreneurial innovations can be influenced by tax and subsidy policy.

Use of food in the household is influenced by another set of variables. The government can attempt to modify food intake by programs to distribute food directly to members of some target group within the population (direct feeding programs) and food subsidy or ration schemes; outside agencies enter through international trade and aid, and international buffer stocks. More generally, the trade strategy of a country may largely determine its food consumption patterns. For instance, Egypt exports cotton and may increasingly export vegetable and fruit products to pay for cereal imports. Should it continue with this strategy, or shift toward autarchy and use its limited land for cereal self-sufficiency? Nutrition is not the least important factor which should influence such a decision.

Finally, the nutritional status of individuals is affected by another set of factors, including the cultural influences on food consumption mentioned previously: public health activities, the overall health status of the population, other environmental factors, and accepted rules about food distribution within the family.

Factors influencing the incidence of malnutrition range from the economic condition of the population down through customs governing breast-feeding and cooking practices. The degree and nature of malnutrition is also important. Is it overnutrition or undernutrition? If the latter, is it shortage of protein or calories, or shortage of essential vitamins and minerals? If malnutrition is only moderate, perhaps subclinical, what are the prospects for remission or worsening?

Whether or not being malnourished affects a person's functional role in his society is the next question. The answer will again depend on specific conditions. Having iron deficiency anemia may be economically dysfunctional for workers in some environments (3), but not in others where different factors are limiting productivity. (For example, the widespread tropical disease, schistosomiasis, may cause negligible productivity losses in the environments where it is endemic (2). Similarly, the common assertion that infant protein-calorie malnutrition leads to mental retardation has to be analyzed in terms of a model of mental development in a given environment, à la Piaget or otherwise (21). Finally, improved nutrition may widen or narrow birth intervals, depending on the circumstances (25, 1). To summarize, a particular set of conditions may induce malnutrition in some and not in others; the degree and nature of the malnutrition can differ greatly in the individuals suffering from it; malnutrition may not be dysfunctional in a given environment; and the extent of dysfunctionality depends on a host of other factors. There are ample research bones to chew on in this set of interactions.

MACROECONOMIC RESEARCH TOPICS

There have been few attempts to investigate food production, distribution, and consumption as a system. The macro food system comprises the agricultural sector treated as an aggregate producer of crops and associated income flows, food processing and distribution channels, and food consumption behavior of easily manageable groupings of households. So defined, the food system does not encompass interrelationships among food intake, other variables, and nutritional status. For normative purposes food consumption at the household level is often taken as a convenient indicator of nutritional status.

Aggregate flows of crops and foods are usually analyzed with food balance sheets. These can be interpreted as demand-supply balances for a number of food products, and are usually used to point out rather roughly inconsistencies between apparent food supplies and food consumption levels in the future. Evidently this crude methodology can be extended, perhaps by a fairly small group. Some possible research topics include the following:

1. Improvement and coordination of data. For example, food balance sheets are usually estimated from agricultural production statistics together with foreign trade data and a set of more or less arbitrary guesses about use of grains for seed and feed and storage losses. Consumption (or "disappearance") is the residual item. Where independent estimates are available for food consumption, production and consumption data sets are often inconsistent conceptually and contradictory in their implications. One illustration involves pulses in Pakistan, where during the early 1970s supply-side data indicated that their production was increasing, while without apparent imports household expenditure surveys showed their consumption decreasing. The inconsistency in Pakistan is not easily resolved with existing data, but the existence of a problem somewhere is known only because there are two data sets. If it were possible to integrate both sources of information into overall demand-supply balances, then so much the better. A good statistical description of the food system in several countries would open the doors to much fruitful research.

2. Calculation of worldwide calorie or protein gaps. A recent example is the World Bank-sponsored exercise by Reutlinger and Selowsky (23), who used Engel functions for food consumption plus estimated income distributions to calculate calorie consumption distribution on a country level. An estimate of the malnourished population was then derived by integrating the intake distributions up to the required level of calorie consumption as specified by the Food and Agriculture Organization. This exercise can be faulted on several grounds, such as lack of reliable data. Another, emphasized by Sukhatme (29), is that the population distributions for income, caloric intake, and caloric requirements are bound to be correlated, making a calculation based on marginal distributions of the Reutlinger-Selowsky type almost surely biased. The quantitative importance of Sukhatme's reservation could easily be assessed by computer simulations, though no one has apparently done any as yet.

3. With baseline supply-demand balances in hand, a number of other problems can be tackled. For example, what would be the impact of shifts in any of the variables affecting production, marketing, or food consumption patterns on nutritional status, at least as measured by household consumption levels dis-

aggregated by income level, region, or other attributes, in some policy-relevant way? The standard approach to answering these questions is partial equilibrium. How, for instance, does marketed surplus respond to price incentives? The answer might say something about food availability in the market, but nothing about nutritional status. Or to follow a tack laid out long ago in the field of computable planning models and recently followed by Pinstrup-Andersen et al. (20), how might tax and subsidy policy affect nutrient consumption by using some complete system of consumer demand equations à la Frisch or Stone-Geary? But this approach says nothing about consumers' incomes (by income class) or food availability. Partial equilibrium questions give partial answers. Sometimes the answers are policy relevant, as in the fertilizer demand-supply model by Timmer (31), but their limited scope should be acknowledged.

4. The obvious extension is to some sort of general equilibrium model. The importance of general equilibrium for food and nutrition policy is heightened by some of the macroeconomic implications of Engel's Law. In a supply shortfall, for example, low income and price elasticities for staple foods mean that food prices in an uncontrolled market would rise by far more than their consumption would decline. Real consumer income would of course drop because of the inelastic quality response to price increases, and the reduction would spill over into other markets. Further, there would be significant macro repercussions because the food sector in poor countries is large compared to the rest of the economy.

Recent research on Egypt and Pakistan by Desmond McCarthy and the author at the Massachusetts Institute of Technology illustrates the magnitude of some of these macro effects. In Taylor (30), it is shown that staple food subsidies in Egypt in 1975 amounted to about 500 million Egyptian pounds (£E), over 11 percent of the 4.417 billion gross domestic product (GDP). The agricultural and food-processing sectors also loom large, accounting for 42 percent of total value-added. Table 1 presents numerical simulation results from a general equilibrium macro model of Egypt incorporating rural, urban, and food-processing sectors.[2] The table shows how the economy might respond to an attempt to reduce food subsidies by £E200 million ex ante by increasing subsidized food prices about 29 percent.

In the second column, it can be seen that the food price increases would drive up the cost of living for separate rural and urban income recipient groups by about 2.2 and 8.2 percent, respectively (rural people consume less processed food). Because of low food demand elasticities, much of the real income loss would spread into the urban sector—the resulting multiplier contraction would reduce real GDP by about £E 240 million. Food imports would fall from an initial £E 569 million by no more than £E 60 million, although the overall balance of payments would improve by £E 114 million because of the economic contraction from the subsidy cut.

In real income terms, poor people would be hurt more than rich people because

[2] The model resembles the "closed" Leontief input-output system, except that prices are determined endogenously by sectoral mark-up rates in the manner of Kalecki, instead of being held fixed as in most macro models. Consumer demand responses to price and income changes are modeled with the Stone-Geary linear expenditure system, with parameters calculated from income elasticities and a guess at the income flexibility of demand. The approach is basically similar to that used by Pinstrup-Andersen (20) and a host of previous model builders in the planning field

of the relatively high proportion of their budgets devoted to food. A calculation along the lines of Pinstrup-Anderson (20) suggests that the price increases might reduce food energy intake by about 200 calories per person per day on the part of rural poor, and 100 calories for urban poor (with less income-elastic demand).

Political repercussions of such large income changes could be profound—witness the food riots in Egypt in January 1977 after a policy similar to the one studied here was proposed. The announced food price increases were soon rescinded, but even less violent responses than riots could divert their goals. Suppose that money wages rose enough to offset the real income loss caused by more costly food. The third column of Table 1 shows what would happen if the wage increases were passed on in higher prices—this is in fact a description of the first round of a wage-price spiral which might be touched off by the reduced subsidies. A price index weighted by initial value-added levels in the three sectors would go up by 4.5 percent, with extra costs for rural and urban consumption baskets of 3.8 and 3.4 percent, respectively. The wage increases would generate enough demand to restore 1.75 of the 5.37 percent contraction in GDP resulting from higher food prices. Further rounds in the wage-price spiral would close the gap by more, but only at the cost of a significant inflationary burst.

A second way to offset the subsidy decrease would be to increase aggregate demand—say by more investment. The last column of Table 1 shows what would happen if enough capital formation were forthcoming after the wage increased to restore GDP to its initial level. The important point is that there still would be significant distributional effects, since investment activity employs urban workers preferentially. Rural real income still would fall by about 6 percent from the initial situation, enough to reduce energy intake by 200 calories or so for the poor. This could be potentially fatal for a child already on the verge of starvation.

5 Extensions of either partial or general equilibrium models of the food system to take into account a number of potential government policy interventions—such as direct feeding programs, domestic buffer stocks, and international trade policy—are in principle straightforward. Some of these policies affect demand-supply balances directly. For example, a single crop such as wheat would enter on the supply side of balances for non-marketed and marketed foods like bakery bread, chapatis, or tortillas. These foods would in turn flow to various consumer groups in quantities determined by their income levels and socioeconomic characteristics. Wheat imports or releases from a government wheat-stocking agency would affect this set of interrelated demand-supply balances by increasing total supply available for the diverging flows of wheat and its products. A direct feeding program might affect the supply of one of the products. Price policies and nutrition education would affect flows along various distribution channels. Many conceptual models of this type may be set up and the cost-effectiveness of different possible interventions aimed at the same general target even determined, but careful specification of how markets operate is necessary before sensible conclusions can be drawn.

6. An example of the analysis of price effects is provided by the debate over the impacts of commodity food aid of the PL 480 type. Schultz pointed out long ago that if the donated food enters unobstructed market channels it may reduce domestic prices, producer incentives, and the overall level of food availability

TABLE 1.—ECONOMIC IMPACTS OF AN ATTEMPT TO REDUCE 1975 EGYPTIAN FOOD SUBSIDIES BY £E 200 MILLION[a]
(billion Egyptian pounds)

	Base	With price increase	With price and wage increases	With price, wage, and investment increases
Gross domestic product in base prices	4.42	4.18	4.26	4.42
Percent change in real gross domestic product		−5.37	−3.62	0.01
Percent changes in costs				
Rural			2.73	2.73
Urban			5.56	5.56
Food			0.70	0.70
Total			4.52	4.52
Total imports	1.62	1.51	1.54	1.63
Food imports	.57	.51	.53	.53
Trade deficit	.50	.39	.42	.51
Government expenditure	1.79	1.55	1.65	1.65
Government expenditure on food subsidies	.49	.26	.28	.28
Percent changes in cost of living				
Rural		2.17	5.99	5.99
Urban		8.23	11.66	11.66
Percent changes in real income				
Rural		−6.77	−7.19	−6.20
Urban		−13.98	−8.80	0.60

[a]The consumer food price increase is from 0.59 to 0.75. Wage increases are rural sector, 0.19 to 0.20; urban sector, 0.45 to 0.48; food sector, 0.54 to 0.58. Gross capital formation increases from 0.84 to 1.00.

(26). On the other hand, since most governments intervene massively in food markets anyway, they might be able to rig distribution channels in such a way as to create enough aggregate demand from the poor to absorb the extra food without depressing prices. There is conflicting evidence, reviewed by Isenman and Singer (15), about the extent to which governments in the Indian subcontinent have been able to carry through such a policy.

An alternative way of looking at the impact question is to ask how total food imports respond to an extra ton (or dollar's worth) of commodity aid. Here, econometric evidence summarized by Sarris, Abbott, and Taylor (24) suggests that in most poor countries (with India a partial exception), food aid imports may substitute roughly on a dollar-for-dollar basis with commercial food imports. In other words, food aid does not represent an addition to national food supplies, and provides neither disincentives to producers nor extra calories to poor consumers. This result can be questioned, both in its short-term econometrics and lack of consideration of long-term effects such as reduction of government effort in agriculture due to reliance on donated food (32), but the result and the points raised above suggest that the macro and nutritional impacts of food aid are still poorly understood. In a time of burgeoning grain surpluses, the policy pay-off to research about these issues may be substantial.

MICRO ISSUES: FROM FOOD CONSUMPTION TO NUTRITIONAL STATUS

So far, nutritional status has been gauged from the input side—how much food of what kind are people actually consuming? Such an approach is misleading. There are many complex linkages between what a person eats and performance of his socioeconomic role. Along this route from food to function are a number of topics researchers might want to explore. A few are discussed here.

Nutrition Standards

As the debate about the size of the world "calorie gap" mentioned above demonstrates, there is much interest in the policy implications of nutrient requirement standards. However, the whole field is a mare's nest, especially for somebody without biomedical credentials. In the past, recommended nutrient intakes have been dictated by the doctors' main notion about social functionality—a person should eat well enough to avoid getting recognizably sick. In practice, this criterion is reduced to setting calorie requirements high enough to support normal growth and development in average children and energy use in average adults, protein requirements high enough to keep 99 percent of the population from having net nitrogen losses over the long term (at least theoretically), vitamin requirements several multiples of the levels which seem to preclude overt deficiency disease in most of the population, and so on. These rather purist standards side-step all issues of "scaling" the severity of malnutrition in a given environment—how great is the social, economic, or even personal loss if individual A is somewhat malnourished during season X in region Y of country Z? Answering such questions requires value judgments and technical competence in a wide (and expensive) range of fields.

Even if the political issues are ignored, a thorough analysis of a sociocultural system is something an economist cannot do; nor are biomedical assessments of nutritional debility within a social scientist's skills or research funding. Any serious rescaling of nutritional standards in socioeconomic terms relevant to poor countries will be a long and combative process (27), and it is not clear that a small research group should put many eggs in such a basket.

Monitoring Changes in Nutritional Status

For immediate policy purposes, another set of questions becomes relevant—how is the nutritional status of important groups within the population monitored on a continuous basis to check if there is improvement in the medium run or incipient deterioration from currently achieved levels due to short-run problems? Two difficulties arise here. First, policy makers have to know how to measure the nutritional status of the population. Some of the conceptual pitfalls into which this apparently simple activity can head have been noted here. Second, even if a set of standards is agreed upon, there must be some base level to which they can be compared in order to measure change. On the measurement issue itself, some sort of rough and ready agreement regarding techniques and standards is perhaps possible. Furthermore, there are methods for detecting protein-calorie malnutrition and some nutrient deficiencies which can be used in the field in poor countries. Anthropometric measurements are usually feasible, and biomedical techniques based on very small blood samples may soon prove so. Establishing accurate reference data about the extent and severity of malnutrition in policy-relevant groups of the population is an information-gathering activity similar to those already discussed. Not much is known beyond anecdotal evidence about either the macro food system or the micro details of nutritional status in most underdeveloped countries. Yet this information is critical.

Consequences of Malnutrition

Related to the issue of setting standards is assessment of the impacts of malnutrition on economic productivity, fertility, resistance to infection, and mental development—and vice versa. All of these linkages are controversial. All that can be presented here is a brief review of conflicting claims, plus some suggestions as to how they might be resolved.

Some nutritionists and economists claim that better infant nutrition is likely to reduce mortality and lead to reductions in birthrates as more children survive. At the same time, if infants survive longer they are likely to be breastfed longer which may reduce fertility. How does one distinguish between these two effects? Nutritionists also assert that better nutrition for mothers will increase fertility and perhaps the birth-weight and health of their children. The interactions between food flows into the nuclear family and its fertility performance become complex. Keeping up to date with all claims and counterclaims is time consuming in itself; testing them on the basis of existing data is virtually impossible. An economist armed with faith that households really maximize utility functions in determining how many sound children to rear might rush in where more sensible people fear to tread—those who return with more than a slew of ambiguously signed second partial derivatives are rare.

A considerable amount of theoretical economic effort has gone into investigating the effect of improved nutrition on worker productivity and on the market for unskilled labor. The major conclusion—that such a productivity effect may stabilize the real wage—is ably reviewed by Bliss and Stern (7). They go on to discuss the more interesting policy issue of how much in fact better nutrition adds to productivity. A good deal of additional empirical work by teams of economists and nutritionists could prove to be useful here.

Over the years, medically trained nutritionists have built up a large body of knowledge (and prejudice) about mother-child relationships. Much emphasis has been placed on the importance of breast-feeding as a means both to maintain nutritional levels among infants and to delay additional conceptions. There have also been large-scale longitudinal studies of interactions among nutrition, infection, public health, fertility, and other variables at selected village locations in various corners of the world (for example, the Khanna and Narangwal studies in India and the Instituto de Nutricion de Centro America y Panama three village study in Guatemala). Finally, there has been practical experience in attempting to influence nutrition and health status among mothers and infants in "mothercraft centers," maternal and child health centers, and similar agencies throughout the world. The microeconomics of none of these activities has been seriously investigated. There are hints about the economic importance of breast-feeding (5, 23), but they are mostly impressionistic. Perhaps such knowledge can be built up by economists working on the fringes of large medical projects; the studies by Levinson (17) and Heller and Drake (14) of infant morbidity in the face of protein-calorie malnutrition and other insults, and by Popkin (22) of vitamin A deficiency make a beginning. Similarly, existing work by medical people on such activities as mothercraft centers could be built upon. For example, see Beaudry-Darisme and Latham (4).

Finally, one can study relationships among food customs and the structure of cultures anthropologically à la Julian Steward and followers (10). This approach attempts to encompass all of the determinants and consequences of nutritional status in one whole model of a society, and makes a good deal of methodological sense. Unfortunately, it is more easily applied in the context of a static, "primitive" culture than in changing circumstances in an underdeveloped country attempting to modernize. Nonetheless, such ecological investigations probably hold keys to an understanding of how nutrition fits into socioeconomic systems and can avoid the errors of omission which arise when analytical investigators focus on one link in a complex pattern (as amply illustrated by the inconclusive quality of debates about malnutrition versus fertility, morbidity, or mental development).

MICRO ISSUES: DETERMINANTS AND CONSEQUENCES OF FOOD CONSUMPTION BEHAVIOR

Issues more amenable to economists and marketing experts are examined here. First, some data gaps are summarized which might usefully be filled, and then a few conceptual problems are considered.

Distribution Within the Family

As hinted above, the most important conclusion from past debates about nutritional status is that certain groups are likely to be especially vulnerable to food deprivation—infants and small children and pregnant and lactating mothers are the target populations usually cited. If a planner wanted to avoid the worst long-term effects of malnutrition, he would direct food distribution programs preferentially toward children and expecting or recent mothers. The major problem for planners is that extremely little is known about distribution of food and nutrition *within* the family. Consumer budget surveys typically collect data at the household level; partial information from nutritionists about breast-feeding and weaning practices does not take into account the full complexity of food allocation practices among all family members. Comprehensive studies of food use within the family (based either on recall procedures or from placing an observer in the household) would be extremely useful, both scientifically and for the design of programs for intervention. Gathering and analyzing such data is difficult, but probably feasible in underdeveloped countries with good statistical services.

Nutritional Implications of Economic and Technical Change

Economists emphasize the importance of income and prices in determining consumer behavior; other social scientists stress sociocultural conditioning variables, and in addition there are always advertising and education. More research may be counseled, but yet another standard household expenditure survey in a country where two or three have already been done will not add much to our knowledge of consumer responses to possible policy interventions.

More helpful would be delineation of the linkages between the nutritional status of specific groups within the economy and government policies intended to influence various other economic variables. Retrospective studies might be of interest. For example, the effects on employment and income distribution of the Green Revolution have been well documented in some areas. What were the probable linkage effects to nutrition within the effected populations? Looking to the future, it is now becoming customary to try to say something about the income distributional impacts of investment projects, rural development schemes, or "small farmer strategies" in general. The usual research focuses on relationships between farm size and productivity, new technological options, employment and income distribution, and so on. A natural extension would be to trace probable shifts in income distribution and employment through to possible shifts in consumption patterns, food intake, and nutritional status.

Evaluation of Nutrition Programs

Next, there is the problem of trying to measure benefits from policies aiming to shift food consumption patterns. Some studies have been made using traditional benefit-cost techniques (*3*, *28*); but their results are not completely convincing for two reasons. First, the accepted benefit-cost methodology bogs

down in endless discussion of "welfare weights" and other intangibles when it is applied to public expenditure programs focusing on income distribution. What is needed is a simpler set of tools to cut through the theoretical rococco. Secondly, when dealing with nutritional issues, how far does the distribution of food intake across the population go toward satisfying the distribution of nutrient requirements required to support some standard of well-being?

Both of these distributions can presumably be shifted by policy—such as food distribution programs for the intake distribution and public health measures for the requirements distribution. The question is, how does one find a simple benefit measure, sensitive to income distribution, which can measure the impacts of policies aimed at shifting one or both distributions? One approach might be to choose policies which lead to a high level of consumers' surplus under the food demand curve while insuring that, say, every person but one in a hundred receives enough food to be at or above his "safe" nutrient requirement level. The theory of such benefit-cost assessment has not been worked out fully, although there are some tantalizing suggestions (*33*). An analytically able but policy-oriented economist could usefully bring the theory down to earth, extending tentative beginnings (*23*).

Finally, with or without newly sharpened benefit-cost tools, something can be learned from failed attempts to alter food consumption patterns in the past. There are already useful reviews of the history of protein-supplemented foods for children (*18*), fish-protein concentrates (*19*), and the Chilean milk distribution program (*13*). Food fortification schemes of one kind or another beg for similar treatment, as do the few serious nutrition education programs that have been carried out. Such studies require a lot of legwork and in economists' terms are not particularly glamorous. But this is another area in which a modest research effort could bring a fairly high and rapid return.

MICRO ISSUES: FOOD PROCESSING AND DISTRIBUTION AND AGRICULTURE

Earlier there was some discussion about gaps in our knowledge of food processing and distribution practices in underdeveloped countries. As pointed out, most development economists understand very little about the food industry. Perhaps experts on marketing in advanced countries who occasionally show up in poor country capitals as advisers on advertising and nutrition education know even less about what they are talking about. For this reason, a good deal of methodical gathering of facts and a feel for local institutions are necessary before generalization is possible. Some areas of interest are suggested below.

Many less developed countries have set up some sort of food subsidy or rationing system. The announced goals of these programs vary—helping the poor, stabilizing food prices, and improving nutrition levels—but their general orientation is always toward altering existing markets to increase the availability of food. Non-market schemes have also been attempted, frequently by international agencies such as CARE or the World Food Program which aim their donations at vulnerable groups through school lunch and similar programs. Field studies of successful or unsuccessful food subsidy programs and evaluations would be useful.

There are efficiency issues in food processing and distribution which also appeal to economists. For example, just how extensive are food storage losses in poor countries? Is their reduction only a matter of new technology, or are economic incentives rigged against effective storage procedures? Would domestic buffer stock schemes in fact complement existing private storage, or would they lead to its extinction? All along the food chain similar questions can be posed. What are incentives toward production of high extraction flour? And highly polished rice? These can only be answered by field research, but again economists from developed countries could consider collaboration with local institutions.

SUMMARY

The agricultural sector affects nutrition levels in three main ways: (a) production of crops which are sold and pass through commercial food-processing chains to consumers; (b) production of crops for use at home with their own processing and storage technologies; and (c) generation of income and employment which directly affects the pattern and level of household food consumption.

Marketed foodstuffs can be studied using traditional partial equilibrium economics, and knowledge can be expected to accumulate gradually about this particular set of markets, as it has about others. Household food production for own consumption is less well understood, and some sort of conference or seminar among nutritionists, home economists, anthropologists, and others might clarify the current state of knowledge and point to promising research possibilities. Finally, there is the need to look at distributional impacts of agricultural production patterns, tracing them through to nutritional status. At our present stage of knowledge about income distribution in rural areas, a many-pronged attack on the problem is probably desirable, with the prongs ranging at least from the neoclassicism of Cline (*8*) through the eclecticism of Gotsch (*11*) to the new-Ricardian and neo-Marxian formulations of Bhaduri (6) and de Janvry (9). One natural line of research would be the development of multisectoral income distribution models parallel to the multi-market analyses of the food system suggested above. Some prototype models of this type exist (most of them supported by the Development Research Center of the World Bank), and their elaboration to deal with the details of the macro food system would be feasible. However, it should be recognized that little enough is known about rural income distribution to make almost all roads to understanding it equally good.

CITATIONS

1 B. A. Anderson and J. L. McCabe, "Nutrition and Fertility of Younger Women in Kinshasa, Zaire," *Journal of Development Economics*, forthcoming.

2 R. E. Baldwin and B. A. Weisbrod, "Disease and Labor Productivity," *Economic Development and Cultural Change*, *22*, 3, April 1974.

3 S. S. Basta and A. Churchill, "Iron Deficiency Anemia and the Productivity of Adult Males in Indonesia," World Bank Staff Working Paper No. 175, Washington, D.C., 1974.

4 M. Beaudry-Darisme and M. C. Latham, "Nutrition Rehabilitation

Centers—An Evaluation of Their Performance," *Environmental Child Health*, 19, 3, September 1973.

5 Alan Berg, *The Nutrition Factor*, Brookings Institution, Washington, D.C., 1973.

6 A. Bhaduri, "Agricultural Backwardness under Semi-Feudalism," *Economic Journal*, 83, 329, March 1973.

7 C. J. Bliss and N. H. Stern, "Economic Aspects of the Connection between Productivity and Consumption," *Journal of Development Economics*, forthcoming.

8 W. R. Cline, "Interrelationships between Agricultural Strategy and Rural Income Distribution," *Food Research Institute Studies*, 12, 2, 1973.

9 Alain de Janvry, "The Political Economy of Rural Development in Latin America: An Interpretation," *American Journal of Agricultural Economics*, 57, 3, August 1975.

10 C. Geertz, *Agricultural Involution: The Process of Ecological Change in Indonesia*, University of California Press, Berkeley and Los Angeles, 1963.

11 Carl H. Gotsch, "Technical Change and the Distribution of Income in Rural Areas," *American Journal of Agricultural Economics*, 54, 2, May 1972.

12 D. R. Gross and B. A. Underwood, "Technological Change and Caloric Costs: Sisal Agriculture in Northeastern Brazil," *American Anthropologist*, 73, 3, June 1971.

13 P. Hakim and G. Solimano, *Development, Reform, and Malnutrition in Chile*, M.I.T. Press, Cambridge, 1978.

14 P. S. Heller and W. D. Drake, "Malnutrition, Child Morbidity and the Family Decision Process," *Journal of Development Economics*, forthcoming.

15 P. J. Isenman and H. W. Singer, "Food Aid: Disincentive Effects and Their Policy Implications," *Economic Development and Cultural Change*, 25, 2, January 1977.

16 Simon S. Kuznets, *Modern Economic Growth: Rate, Structure and Spread*, Yale University Press, New Haven and London, 1966.

17 F. J. Levinson, *Morinda: An Economic Analysis of Malnutrition Among Young Children in Rural India*, Cornell-M.I.T. International Nutrition Policy Series, Cambridge, Massachusetts, 1974.

18 E. Orr, "The Use of Protein-Rich Foods for Relief of Malnutrition in Developing Countries: An Analysis of Experience," Tropical Products Institute, Overseas Development Administration, London, 1972.

19 E. R. Pariser, M. B. Wallerstein, C. Corkery, and N. L. Brown, *Fish Protein Concentrate: Panacea for Protein Malnutrition?* M.I.T. Press, Cambridge, 1978.

20 P. Pinstrup-Andersen, N. Ruiz de Londono, and E. Hoover, "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.

21 Ernesto Pollitt and Carol Thomson, "Protein-Calorie Malnutrition and Behavior: A View from Psychology," in R. J. Wurtman and J. J. Wurtman, editors, *Nutrition and the Brain*, 2, Raven Press, New York, 1977.

22 B. M. Popkin, "Vitamin A Deficiency in the Philippines: The Development and Economic Analysis of Alternative Interventions," Ph.D. dissertation, Cornell University, Ithaca, 1974.

23 S. Reutlinger and M. Selowsky, "Malnutrition and Poverty," World Bank Staff Occasional Papers No. 23, Johns Hopkins Press, Baltimore and London, 1976.

24 A. H. Sarris, P. C. Abbott and L. Taylor, "Grain Reserves, Emergency Relief and Food Aid," Overseas Development Council, Washington, D.C., 1977.

25 T. P. Schultz, "Interrelationships Between Mortality and Fertility," in R. G. Ridker, editor, *Population and Development: The Search for Selective Interventions*, Johns Hopkins Press, Baltimore and London, 1976.

26 T. W. Schultz, "Value of U.S. Farm Surpluses to Underdeveloped Countries," *Journal of Farm Economics*, 42, 4, December 1960.

27 N. S. Scrimshaw, "Strengths and Weaknesses of the Committee Approach: An Analysis of Past and Present Recommended Dietary Allowances for Protein in Health and Disease," *New England Journal of Medicine*, 294, 2 and 3, January 1976.

28 M. Selowsky and L. Taylor, "The Economics of Malnourished Children: An Example of Disinvestment in Human Capital," *Economic Development and Cultural Change*, 22, 1, October 1973.

29 P. V. Sukhatme, "Malnutrition and Poverty," Ninth Lal Bahadur Shastri Memorial Lecture, Indian Agricultural Research Institute, New Delhi, 1977.

30 Lance Taylor, "Food Subsidies and Income Distribution in Egypt," World Bank, Washington, D.C., 1977.

31 C. Peter Timmer, "Food and Fertilizer Policy in LDC's," *Food Policy*, 1, 1, November 1975.

32 ———, "Food Aid and Malnutrition," Harvard School of Public Health, Boston, 1977.

33 M. L. Weitzman, "Is the Price System or Rationing More Effective in Getting a Commodity to Those Who Need It Most?" Department of Economics Working Paper No. 140, Massachusetts Institute of Technology, Cambridge, 1974.