AGENCY FOR INTERNATIONAL DEVELOPMENT
WASHINGTON, D. C. 20523

BIBLIOGRAPHIC INPUT SHEET

FOR AID USE ONLY

1. SUBJECT CLASSIFICATION

A. PRIMARY: Public Health

B. SECONDARY: Nutrition

2. TITLE AND SUBTITLE

Nutrition intervention in low income countries: a planning model and case study

3. AUTHOR(S)

Levinson, F.J.; Call, D.L.

4. DOCUMENT DATE	5. NUMBER OF PAGES	6. ARC NUMBER
1970	44 p.	ARC

7. REFERENCE ORGANIZATION NAME AND ADDRESS

Cornell University, Department of Agricultural Economics, New York State College of Agriculture, Ithaca, New York 14850

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

(In Cornell International Agricultural Development Mimeograph 34)

9. ABSTRACT

The primary target group for nutritional intervention is the low-income preschool child. The secondary target group consists of adult production workers whose caloric intake is a factor limiting productivity. Optimal nutritional intervention programs require specific national nutrition policies and an effective delivery system. These are discussed in terms of a model that describes the sources, functioning, and effects of programs. General requisites for a successful national program include a minimum foreign exchange outlay, political acceptance, timely implementation, and continuing evaluation of the programs. The model is discussed in terms of its application to two ongoing nutritional intervention programs. The first is the wheat atta fortification program initiated in 1970 in Bombay. The second is the child feeding program operated by the Bombay Municipal Corporation with the assistance of CARE. These represent two significantly different approaches to a single target populace. Some 24 aspects and effects of the two programs are compared and discussed. The authors caution that the data presented are a somewhat artificial application of the model, since the programs are not independent of other nutritional intervention programs in India. But the comparative data, together with a discussion directed to planners of intervention programs, tend to imply that both Bombay programs could be improved. The child feeding program is reaching no low-income preschool children; the atta fortification program is reaching only 12% of them.

10. CONTROL NUMBER

PN-AAC-334

11. PRICE OF DOCUMENT

12. DESCRIPTORS

Developing countries
Economic development
Government policies
Technical assistance

13. PROJECT NUMBER

14. CONTRACT NUMBER

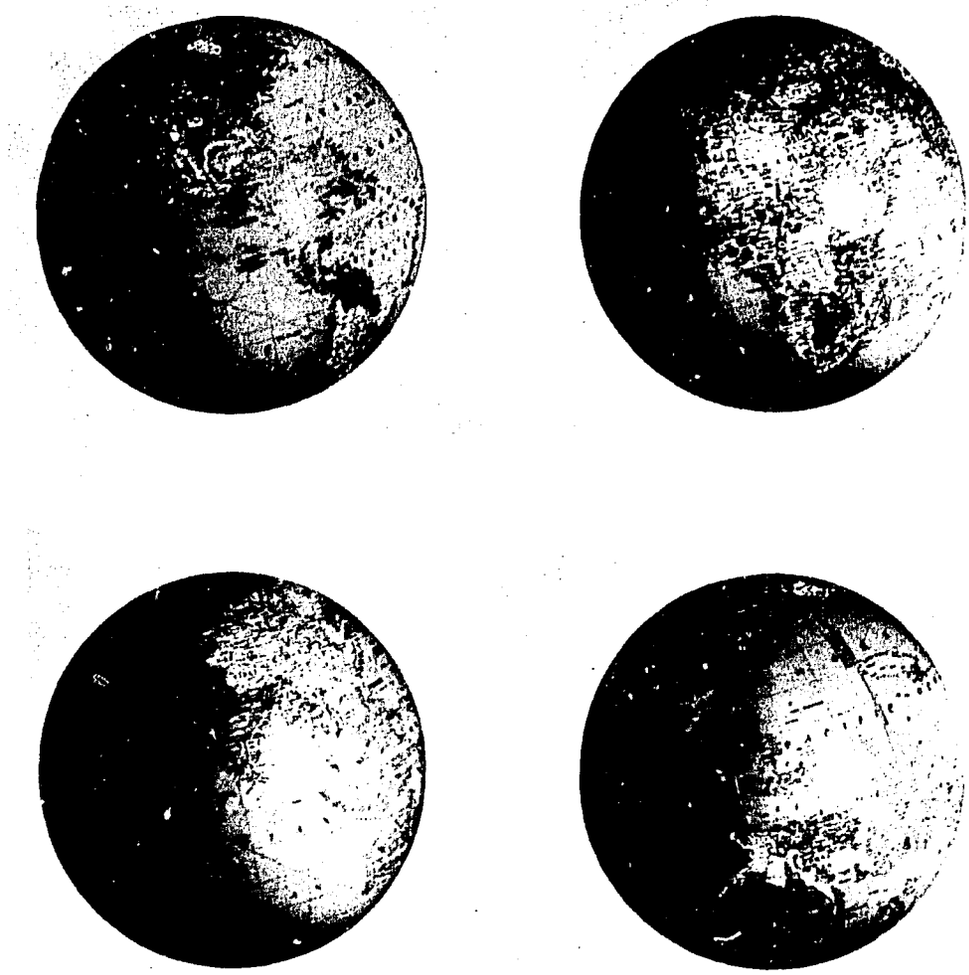
CSD-2823 211(d)

15. TYPE OF DOCUMENT

AID 590-1 (4-74)

CORNELL INTERNATIONAL AGRICULTURAL DEVELOPMENT MIMEOGRAPH 34

PN-AAC-334



NUTRITION INTERVENTION in LOW INCOME COUNTRIES: A PLANNING MODEL and CASE STUDY

F. James Levinson and David L. Call

DEPARTMENT OF AGRICULTURAL ECONOMICS
New York State College of Agriculture and Life Sciences
A Statutory College of the State University
Cornell University, Ithaca, New York
and
Graduate School of Nutrition
Cornell University, Ithaca, New York

WITH modern methods of travel and communication shrinking the world almost day by day, a progressive university must extend its campus to the four corners of the world. The New York State College of Agriculture at Cornell University welcomes the privilege of participating in international development — an important role for modern agriculture. Much attention is being given to efforts that will help establish effective agricultural teaching, research, and extension programs in other parts of the world. Scientific agricultural knowledge is exportable.

A strong agriculture will not only provide more food for rapidly growing populations in less-developed countries, but also a firmer base upon which an industrial economy can be built. Such progress is of increasing importance to the goal of world peace.

This is one in a series of publications designed to disseminate information concerned with international agricultural development.

Single Copy Free
Additional Copies 25¢ each

TABLE OF CONTENTS

	Page
INTRODUCTION	1
CHAPTER I. NUTRITION AND DEVELOPMENT	2
Labor Productivity	2
Family Planning Motivation	4
Direct Effect on Health	5
Development Theory -- Consumption Versus Investment	5
Summary	7
CHAPTER II. A MODEL FOR NUTRITION PLANNING	8
A National Nutrition Policy	8
Determination of Policy Content	10
Nutritional Effectiveness and Measurement of Potential Benefits	12
The Delivery System	13
Determination of Cost	13
Subsidization of Cost	14
Administration Cost	15
Distribution	16
Consumer Acceptability	16
General Requisites	17
Foreign Exchange	17
Speed of Implementation	18
Political Acceptance	19
Evaluation	20
CHAPTER III. ECONOMIC AND SOCIAL MULTIPLIERS	21
Completion of the Model	22
CHAPTER IV. TWO CASE STUDIES	23
Bombay -- the Nutritional Setting	23
The Atta Fortification Program	24
Nutritional Effectiveness	25
Delivery System	25
Requisites and Multipliers	27
The Child Feeding Program	28
Nutritional Effectiveness	29
Delivery System	30
Requisites and Multipliers	31
Summary of the Case Studies	31
Conclusion: The Planner's Analysis	34
REFERENCES	38

ACKNOWLEDGMENTS

Sincere appreciation is expressed to the Food and Nutrition Board of the Government of India, officials of UNICEF, USAID and CARE in New Delhi and Bombay, and flour mill operators in Bombay for their cooperation in preparation of the case studies contained in Chapter IV.

The authors also wish to thank Professors Michael C. Latham and John W. Mellor of the Graduate School of Nutrition and the Department of Agricultural Economics at Cornell University, respectively, for their review and helpful comments on the manuscript.

NUTRITION INTERVENTION IN LOW INCOME COUNTRIES:

A PLANNING MODEL AND CASE STUDY*

by

F. James Levinson and David L. Call

INTRODUCTION

We speak frequently these days of an increasing recognition of the role of nutrition in international development and of increasing efforts to combat the qualitative side of the world food problem. However, the more one looks at the field of international nutrition, the more one is struck by the lack of discernible direction to this effort. The problem is not one of scientists or administrators going off on conscious tangents. Rather it seems to trace back to a general lack of agreement on broad objectives and, therefore, on the planning process as well.

This monograph reflects a modest attempt to clarify the role of nutrition in the process of economic development and to develop a planning framework consistent with this role. Chapter I presents a rationale for explicit attention to nutrition in development planning and identifies population target groups. Chapter II discusses the establishment of a national nutrition policy, examines the primary means of accomplishing policy objectives, and proposes a model for the comparison and evaluation of alternative strategies or "nutrition intervention" programs. Chapter III looks beyond the nutrition objectives per se to the economic and social multipliers or the benefits of intervention programs to other development sectors. Chapter IV then attempts to elucidate the planning process embodied in the preceding two chapters by examining two ongoing nutrition intervention programs in that framework.

---

* Portions of this monograph were presented by the authors to the Protein Advisory Group of the United Nations in May 1970 under the title, "Nutrition Intervention in Low Income Countries: Its Economic Role and Alternative Strategies."

CHAPTER I

NUTRITION AND DEVELOPMENT

Until recently, efforts to combat malnutrition in low income countries were viewed as humanitarian gestures, politically necessary perhaps, but well removed from development concerns. Today such efforts increasingly are being considered in investment terms possibly with major ramifications for development planning. This newly recognized role of nutrition is seen as threefold. (1) Improved nutritional status may increase productivity in the agricultural and industrial sectors in certain carefully defined instances. (2) It may increase the motivation of reproductive age parents to accept birth control measures by decreasing infant mortality and increasing the likelihood that existing sons will survive. (3) It also improves health directly, a basic subgoal of development.

Labor Productivity

It has been suggested frequently that labor productivity in the agricultural and non-agricultural sectors is in large measure a function of adequate nutrition, and that raising the quantity and quality of food consumed by workers will bring about a proportional increase in production (13,17,24,27, 34). This assertion rests on an assumption which deserves careful examination, namely that the inadequate food intake of workers is the limiting factor inhibiting increased production. In the early stages of development in low income, labor surplus countries this is probably not often the case. In agriculture the limiting factor is generally capital or the quantity or quality of land. This means that even the existing lower level of work capacity cannot be effectively absorbed by the production system. It is similarly difficult to imagine a linear relationship between food intake and productivity in a factory environment more dependent on the state of its machinery than on the brute strength of labor. The International Labor Organization in a listing of over 70 factors influencing worker productivity failed to mention nutrition at all.

The extent to which food intake is the limiting factor in a productivity context would depend largely on (1) the severity of the food shortage, and (2) the complexity of the production process. It is entirely possible that in cases of severe undernutrition food intake might be the limiting factor. (The few examples of increased productivity from greater food intake that appear in the literature usually fall in this category.) This is somewhat difficult to imagine under normal conditions in a labor surplus economy where the undernourished laborer could always be replaced with one somewhat better off.[1] On the other hand, in periods of general food scarcity, including pre-harvest "hungry seasons", it would be a possibility. In such cases, however, the labor input might be the limiting factor only until moderate food intake was achieved, at which point other factors would probably become more limiting. In other words, it may be -- and solid empirical work is clearly called for here -- that below a certain percentage of minimum caloric requirements we can bring about productivity increases by increasing food intake of laborers, but above that point the returns of continued food increases would be negligible.

In regard to the second factor, the significance of food intake would seem to vary inversely with the complexity of the production process. If in a simple, unmechanized road building context we assume labor to be the only principle input, productivity would depend almost entirely on the capacity of that labor input. In this case, increments to caloric intake at any level up to the requirement may well have a positive effect on productivity. In an industrial context where the labor force is one of numerous inputs, the range in which calorie increments would have the same positive effect is probably quite small. Agricultural labor probably would fall somewhere in between.

The above might lead one to conclude that once development reaches a point where capital and land are in more abundant supply and are eliminated as limiting factors, a less than severe deficiency in food intake might once again become a limiting factor and may merit special attention. Though conceivable, this is unlikely because the modernization process itself serves to reduce the relative contribution of labor as a component of total inputs. With greater reliance on purchased inputs and with mechanization, the labor factor in agriculture, though increasing in absolute terms, will probably decrease in terms of its relative effect on productivity. This same case might be made with respect to modernization in industry as more efficient labor-displacing equipment is utilized.

It should be carefully noted that the above discussion refers only to undernutrition, a scarcity of total food or calories, as opposed to malnutrition, a poorly balanced intake in terms of nutrients, and refers only to adults. This is an important distinction, but one all too often confused by those who seek to improve adult productivity in low income countries by improving the quality of their diets and specifically by increasing their protein intake. The fact is that except in parts of the world (mainly in Africa) which rely heavily on low-protein roots and tubers, adequate caloric intake automatically will be accompanied by adequate protein. This in fact holds true for all age groups with the exception of young children and pregnant and lactating women in low income countries.

Even with adequate caloric and protein intake, adults may suffer from certain vitamin and mineral deficiencies. When serious deficiencies of these nutrients occur, particularly iron and vitamin A, there may well be adverse effects on productivity. Again empirical evidence on the social consequences of these deficiencies is lacking. It seems reasonably safe to assume, however, that in adults, as opposed to the more vulnerable groups, these deficiencies are not likely to be severe given a food intake that supplies adequate calories and protein. Hence the effect on productivity would not be great.

Thus, one role of nutrition in the development process relates to the labor productivity of a rather narrowly defined group of undernourished laborers in periods of general food scarcity. The need here would be one of increasing the volume of food consumed, i.e., increasing caloric intake.

To the extent limited labor capacity does adversely affect productivity, the major factor would seem to be not so much the current caloric adequacy of adults, but rather their nutritional status when they were children. While there is no intention here of entering into the malnutrition-brain damage-retardation discussion, one can probably conclude from the evidence presented

to date that (1) mental and physical debilitation does accompany malnutrition during the years of most rapid brain growth, and (2) in cases where the deficiency is severe, this debilitation may be irreparable. We also know that malnutrition decreases resistance to infection which not only inhibits nutritional absorption but has a direct and adverse effect on health and vitality. The evidence is clear that malnutrition does contribute to a reduction in physical growth and development.

Assuming these results are valid, they suggest a more serious drain on productivity, one involving not only decreased vitality but also lower aspirations, negative attitudes, and apathy regarding new opportunities. Again the impact of this on agricultural or industrial productivity would be limited in a low income, labor surplus economy by the same general considerations which minimize the negative effects of caloric-deficient adults. It is also unlikely that the large land owner, the entrepreneur, or the industrial decision-maker would grow up seriously malnourished. But among landless agricultural laborers or small tenants, one can envision retardation from inadequate infant nutrition leading to a low level of learning and experience which in turn leads to a lack of interest or ability with respect to developing new skills, and a general reluctance to innovate. Thus we can expand the role of nutrition as it relates to labor productivity by including the need to increase the quantity and upgrade the quality of food intake of the pre-school child.

Family Planning Motivation

A second role of nutrition relates to population stability and specifically to its motivational element. Those interested in the motivational dimension are becoming increasingly interested in the relationship between mortality and fertility. The argument made in support of the relationship is that living children, particularly sons, represent the only form of social security for the majority of the low income country's aging parents -- and that unless their survival can be assured, parents will compensate, and usually over-compensate, to guarantee the existence of at least two sons. Thus, it is suggested, a decrease in infant and child mortality and a public awareness that the decrease has been effected would be a key motivational tool in decreasing fertility.

The fact is that there is no definitive evidence either way thus far, none to indicate a clear causal relationship and none to disprove it, although the burden of proof is of course on the proponents of the position. These proponents admit that it would take a generation of decreased mortality to convince wary parents that their existing children will live.

If one accepts this hypothesis, one could measure the contribution of nutrition to population control by the resulting reduction in pre-school child mortality. In addition, certain nutrition intervention programs may have a more immediate effect on population control programs. One of the common operational problems in virtually all low income countries attempting to launch family planning programs has been the question of accompanying health services. Given the recognized priority of population control programs, the health services of rural centers frequently have been neglected or dropped altogether. All too often the result has been to antagonize potential contraceptors and to decrease the effectiveness and morale of the

workers. A center capable of caring for a young mother's children, it is argued, would be in a far better position to successfully disseminate the family planning message. If this is so, programming pre-school child feeding programs through family planning centers would not only strengthen these institutions but might also increase their drawing power. Similarly, it may be possible to use child, and particularly pre-school child, feeding programs for family planning purposes.

Direct Effect on Health

Thus far we have identified two separate roles for nutrition in economic development, one relating to labor productivity, the second to family planning motivation. Both are possibly of considerable importance in the development process, but both rest to some extent on hypotheses still lacking a firm empirical base. One might build (and people have built) a case for nutrition based on the above, and successfully claim some portion of a planning commission's budget. But the case for nutrition might rest on even firmer ground which, though understood and acted upon implicitly, has not been given much explicit attention. The roles we have identified up to this point have been essentially means of boosting the development process by boosting primary development sectors. We enhance the productivity of labor as an agricultural input, to increase agricultural production, to grow more food (or as an industrial input to produce more goods). And we increase the motivation of reproductive-age parents to adopt birth control measures so that we might alleviate population pressure, increase the per capita availability of resources in short supply, and contribute to a more rapid increase in per capita incomes. But, in addition to these indirect means of improving well-being, one might argue, it also can be addressed directly, and in short-cut fashion. Why not say that by improving the nutritional status of people we are directly improving their health, and hence well-being, in the same way we would by eliminating malaria or smallpox?

This direct health role of nutrition, above and beyond its productivity and survival functions for which we have already accounted, is primarily non-economic in that its effects will not be reflected in national income or in budgetary savings. Its one economic component relates to the medical expenses involved in treating morbidity. Probably half of all childhood disease is in some way a function of inadequate nutrition. In India an estimated $1.50 per person, or a total of almost $750 million per year, much of it public funds, is spent for medical services (2). Of course, this represents only a fraction of the costs that would be incurred if all medical needs were met. Given such magnitudes, even a relatively small percentage decrease resulting from improved nutritional status could emerge as a significant absolute reduction in a country's real and potential medical costs (12).

Development Theory -- Consumption Versus Investment

According to traditional development theory, however, this "direct" role of nutrition would be considered consumption rather than investment and hence non-viable. This point is rather critical in the analysis and requires examination. The now classical development model propounded by Feldman and Domar suggests that the key to development is growth of the capital stock suggesting investment-oriented planning and capital goods production. In

terms of such a model, the previously discussed roles of nutrition would qualify as being investment oriented. The third, when separated from its productivity and survival functions, and except for its effect in reducing medical costs, would not qualify. Economists would argue that government funds spent directly on consumption would no doubt increase well-being in the short run, but would leave behind nothing in the way of self-sustained growth. Instead, they suggest, some sacrifice of short run consumption may be necessary to permit investments which over time will create employment, raise income and bring about economically viable well-being.

The problems with this position in practice are now reasonably clear. First, the returns on capital investments in low income countries have, as a rule, been lower than originally anticipated resulting in relatively low rates of saving. Secondly, to the extent a nation's capital stock does increase, it is divided among more persons than originally anticipated. Finally, and perhaps most important, income distribution even in periods of reasonably rapid growth has been far from optimal in most low income countries. In countries now experiencing substantial growth in agricultural production there is a widening of income disparities, if not an actual decline in absolute income by landless agricultural laborers, tenants, and other disadvantaged groups. This is frequently the result of an increasing tendency among landlords to displace their tenants as production becomes particularly profitable and to reap the entire benefits for themselves. These now larger holdings also are unlikely to be cultivated as intensively as the smaller plots leading to a decrease in total employment of agricultural labor (32).

In addition, in countries currently pursuing positive agricultural price policies (including India, Pakistan, Libya, Syria, Paraguay, Guatemala, Nicaragua, Peru, Senegal, Tanzania, the Philippines, and Indonesia) income might further be redistributed away from low-income urban consumers who spend a relatively larger proportion of their income on food, and low-income rural cultivators who sell a smaller proportion of their production (25).

Those bearing the major brunt of all this in nutritional terms are the low-income, pre-school age children, the target group discussed earlier. As mentioned, the need here is one not only of calories but of supplemented nutrients.[2] The relative requirements of the pre-school age child for these nutrients is so much higher than for older persons that moderate increases in income are unlikely to meet them. Furthermore, in the course of development in most low income countries, these nutrients become progressively more difficult to procure. A listing of price relatives for India in the 1950's and 60's, for example, indicates that the ratios of protective foods to cereals have increased significantly[3] (38).

If for nutritional purposes the traditional "growth of the capital stock" approach in and of itself is inadequate, there may be other means of approaching income generation which more directly address these purposes. There is little question that in most low income countries today the factor most critically inhibiting growth is productive employment. In such countries it makes considerably more sense to concentrate investment in those areas capable of generating the largest number of productive employment opportunities in the shortest time period. To some, for example, the solution lies in massive rural works programs, to others town-centered labor intensive small industry. More recently it has been suggested that part of the

solution may lie right in agriculture itself -- that there are opportunities for productive employment-generating investment in such labor-intensive pursuits as milk production and fruit and vegetable cultivation.

Increasing the production of these commodities, per se, is not likely to affect directly the nutritional status of most of the low income malnourished. Abbott, for example, estimates that to consume a pint of milk a day would require one-half of the disposable income of the economically average Indian (1). An Indian government study completed in 1968 indicates that meeting vitamin and mineral deficiencies through fruit and vegetable production might be several hundred times more expensive than doing so with synthetically produced nutrients (2,7). Nonetheless, investment in such labor-intensive activity will raise the incomes of those low-income groups who will spend a substantial proportion of the income increments on food. For the adults whose need is calories, this would provide an immediate improvement in well-being.

Summary

In summary then we have identified a three-fold role of nutrition in development. We have also identified as a primary target the low income pre-school child[4/], and as a secondary group the more narrowly defined group of adults in the production process whose caloric intake is the factor limiting productivity. If we think of the latter as occurring primarily during periods of unusual food scarcity we might postulate that except in such periods, the need for independent nutrition concern and actions in low income countries is one of increasing the quantity and quality of the diets of low income young children. To devote explicit time and attention to older population segments would be, if we agree with the above analyses, both a diversion and a misallocation of resources. However anyone concluding that this unnecessarily limits the scope of international nutrition efforts has not calculated the actual and potential size of this target group.

CHAPTER II

A MODEL FOR NUTRITION PLANNING

Having discussed the role of nutrition in the development process, we now turn to the planning process itself and the planning model presented diagramatically on page 9.

Two brief comments on the diagram at the outset: First, it is considerably less complicated than it looks. Secondly, it represents, as do all models, a highly simplified picture of an enormously complex set of relationships. To add more realism to the diagram would require connecting lines from virtually every box to every other and the adding of many more boxes. This has been avoided in the interest of a sharper focus on those relationships which seem central to the basic theses.

This chapter proceeds to trace out relationships constituting the major portion of the model. The box at the far left side of the diagram represents the overall goal of development which might be stated as the raising, on a self-sustained basis, of the average level of living of the human population. Immediately to the right are listed some of the primary elements contributing to this developmental goal. A complete chart would include major categories of goods and services such as education, communication, certain material possessions, health and food. One might also list a number of less tangible elements such as security, relative income, and a closing of the inevitable rising expectations gap. Here for purposes of elucidation we have listed only food, health and education, those elements or subgoals which will have a direct bearing on this discussion.

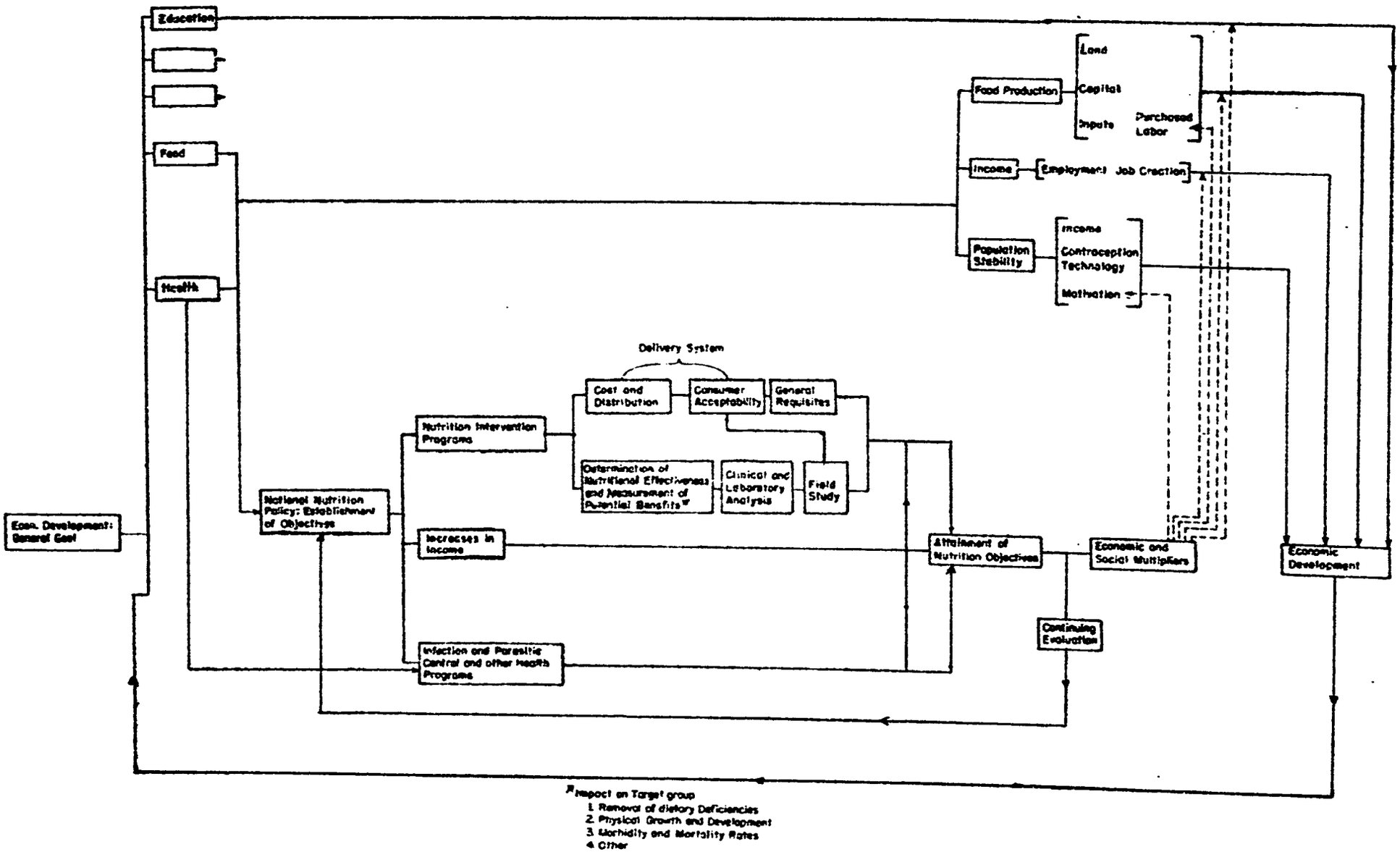
From the preceding chapter it is evident that the role of nutrition in this process relates primarily to the Food and Health subgoals and to the primary programs emanating from these subgoals, namely agriculture, employment, and population stability. For simplicity the labor productivity role has been placed as an element of food production. In a more complete diagram this would be broadened to include labor throughout the economy.

From these Food and Health subgoals which we merge into a single broad category, we proceed to the nutrition component of the process and specifically to the establishment of a national nutrition policy.

A National Nutrition Policy

While an explicit nutrition policy would appear to be an essential prerequisite for program development, there are in fact few such national policies in existence. Instead nutrition activities, if mentioned at all, are usually found scattered throughout various sections of national budgets or five year plans. For example, an Applied Nutrition Program might be lodged in a Community Development Ministry, while a school lunch program could fall under Education. Meanwhile a group of nutrition rehabilitation centers might be funded by the Health Ministry, fortification of a food staple by the Food Ministry, and dairy development by the Agriculture Ministry. Finally, a firm interested in producing a low-cost weaning food might have to work through a Ministry of Industrial Development.

THE ROLE OF NUTRITION IN THE DEVELOPMENT PROCESS



*Impact on Target group
1. Removal of dietary Deficiencies
2. Physical Growth and Development
3. Morbidity and Mortality Rates
4. Other

A country carrying out all of the nutrition intervention activities noted above might be considered quite committed to the nutrition principle and well along in program development. Furthermore, in terms of the specific goals and mandates of the particular ministries, the nutrition activities may be contributing significantly. In terms of the nutrition goals and the overall role of nutrition in development however, it is unlikely that such a piecemeal effort is coming close to optimal resource allocation. Clearly these activities should emanate from a single nutrition policy with well-defined objectives and priorities and should be the responsibility of a single planning body.

The wide range of government ministries noted above suggests that such a body must represent at least as many disciplines. The importance of this becomes even clearer in the discussion of inter-sectoral relationships in Chapter III. The establishment of such a body however raises a number of difficult and often sensitive organizational issues which must be faced at the outset if the planning body is to function effectively. First, it must be determined whether or not administrative responsibility for specific programs will remain with the earlier cited ministries. If so, how will these ministries relate to the nutrition planning body? Will the latter simply present a broad policy framework to be filled in by the Ministries? Or will the planning body determine the programs and funding levels itself and actively coordinate and evaluate the implementation? The arrangement to be followed will of course depend largely on the administrative structure and the political realities in the country being considered. In general, however, it appears unlikely that a planning body with merely an advisory role will allow the kind of detailed analysis, strategy determination, and evaluative functions which, as the following sections suggest, appear so essential for viable nutrition programs.

Determination of Policy Content

We turn now to the factors involved in nutrition planning itself and in determining the content of a national nutrition policy. Following the lower portion of the diagram, we see that the aim is to proceed horizontally from the policy toward our objective of reaching the target group. Note that instead of a single path, there are three. The first, and the one with which we shall be primarily concerned here, is that of the nutrition intervention programs. A second is income. While the earlier analysis suggests that (1) moderate increases in income alone are inadequate to meet the nutritional needs of the target group, and that (2) these increases in relative income are not an automatic function of economic growth in its early stages, there is still little question that income is a crucial determinant of nutritional well-being. In fact it is perhaps the single-most important determinant. It is the inability of income to accomplish the objective rapidly and single-handedly which suggests the need for additional action.

The third path involves the removal of other restricting health factors, primarily infection and parasitism, emanating from such problems as inadequate environmental sanitation, disease (e.g. malaria and measles), and respiratory infection, all of which seriously restrict the utilization of those nutrients which are ingested. The removal of these problems which relate to growth and vitality in and of themselves are linked not only to the national nutrition policy, but also directly to the general Health subgoal on the left side of the diagram.

The idea is not that these are three alternate paths, but rather that we probably have to pursue all three simultaneously if we wish to improve the odds of reaching the objective at all. Furthermore, these paths are so interrelated that pursuing them simultaneously hopefully will yield a synergistic benefit.

Returning to the first path, we are concerned with the means of determining optimum nutrition intervention programs in particular situations. In its most practical sense, this portion of the model might serve as something of a checklist for nutrition planners attempting to sort out the multitude of variables inherent in problem solving in any country. Applied in more sophisticated fashion, a country-specific weighting of the components of this "checklist" according to their relative importance could serve as the basis for a least-cost linear programming exercise. Such an exercise might not only permit some basis for a comparison of alternate strategies, but might also serve as a tool in the actual design of specific intervention programs.

Note that the path is comprised of two subpaths each proceeding through several groups of factors arranged by subject matter and in a logical sequence. The object is to begin with a particular nutrition intervention program and carry it across these subpaths asking of it a number of relevant questions. In some categories the answers will be obvious. In others they will require further investigation or exercises in estimation followed by another run through. Once this process is carried out in sufficient depth for each of the programs under consideration, it should be possible to form some rational basis for program initiation. Then once the program is under way the model can be used as the format for evaluation. At this evaluation stage, enough information hopefully will have been collected to provide more complete information on each of the factors.

As noted above, the nutrition intervention path is divided into two subpaths of program analysis and comparison. The two can and should be pursued simultaneously. The lower subpath determines the nutritional effectiveness of a proposed intervention program and seeks to measure its potential benefits through laboratory analysis and field study. The upper one involves analysis of costs and distribution and of consumer acceptability which together constitutes the "delivery system". It then proceeds to a set of what might be called general requisites which do not fall neatly into any of the earlier categories.

The two subpaths then come together and join the other paths in attaining specific nutrition objectives. The vertical line linking the intervention program path with that of the other health programs below suggests the continuing interaction between them.

Before proceeding with a discussion of the analysis involved in comparing and evaluating alternate nutrition intervention programs, a few caveats are in order. First, in an approach of this sort some sections will be more relevant and appropriate in the discussion of certain programs than others. Given the wide range of alternatives which could be considered, this is probably inevitable, but should be kept consciously in mind. Second, the sheer number of considerations which follow might suggest to some the need for extensive research on everything before doing anything. This is certainly not the intent. In cases where there is clearly no danger involved, planners

must view the decision-making process in a time frame and be willing to make decisions when they seem warranted by reasonable evidence. This contention is supported by three arguments. First, if the planners decide to wait for completion of all possible research, they may well wait forever. Research in both natural and social sciences has a tendency to become self-perpetuating. There are always new relationships to explore and each research finding adds to the list. Second, and more important, many of the critical elements under discussion here simply cannot be wholly resolved in a research setting but require actual project initiation. Finally, and most important, the magnitude of the problem itself increases with time, suggesting that low income countries can less well afford the luxury of Western-style open-ended research, and must impose a more rigid time constraint.

The types of nutrition intervention programs which are referred to in the discussion fall into six rough groupings: genetic plant breeding, agricultural production diversification, food fortification, child feeding, processed nutritious foods, and nutrition education. These categories are not intended to be restricting in any sense, but are the ones referred to in the analysis. No attempt is made to enter into the question of alternative protein sources except as they specifically relate to matters under discussion. It is considered more useful here to follow a market or consumption-oriented approach rather than one oriented to production (11). The former suggests first determining the strategy on broader development considerations and then comparing alternative protein sources on the basis of protein quality or content, cost or functional characteristics. This approach differs significantly from, and frequently conflicts with, the more familiar production-oriented approach. The latter, in part the result of a kind of industry parochialism, wants to produce the protein source first and then find ways to use it. While some of this is inevitable given our desire to move quickly, it hardly leads to the most effective and economic allocation of resources.

Nutritional Effectiveness and Measurement of Potential Benefits

Of the areas of analysis with which we are dealing, the determination of nutritional effectiveness is the one area which has received major attention to date. Still it remains an elusive one. While the nutrition laboratory is now equipped to determine the effects of various forms of intervention on specific deficiencies under controlled conditions, difficulties multiply rapidly when these controls are replaced by real life conditions. Simply stated the problem becomes one of isolating the nutrition intervention variable from numerous other influences on the parameters being studied. In measuring the potential health benefits of a particular strategy, we would want to know not only the effect of the strategy on specific deficiencies, but also its effect on physical growth and clinical and biochemical parameters. If the intervention program under consideration involves education, we may want to carry out these measurements on younger siblings and relatives as well to determine whether improved practices were being continued. Beyond measurements mentioned above, we would want to examine morbidity and mortality rates and perhaps mental development. Determination of these latter effects is probably essential if a planning commission or finance ministry is to be convinced of the program's validity, and if the program is to compete effectively for funds with other development sectors.

To imagine the non-nutritional factors which might also affect these measurements over a given time period is not difficult. We have already referred to infection and disease which have entirely wiped out the effects of numerous supplementation studies. Similarly a rise in any one of numerous economic growth indices might upset the measurements. Increased income resulting from new employment opportunities, a changing set of agricultural price ratios, or a new agricultural technology might have a considerable effect on the food purchased and consumed. The establishment of a health clinic, a new school, or even a new road might also change daily routines, energy expenditure, other health factors and mental stimuli. All of these could in turn affect the parameters being measured.

These difficulties should not discourage such testing. On the contrary, efforts should and are being made to sharpen our tools of field analysis and fully coordinate the laboratory and field testing facets of the research. The ideal is probably a continuous circular flow of information from the laboratory to the field and then back to the laboratory for further refinement. As will be clear from subsequent sections and as is indicated on the diagram, the field testing referred to here might also involve determinations of consumer or community acceptability and other factors impossible to gauge on a laboratory scale.

The Delivery System

Determination of Cost: While it makes little sense to launch a program with low returns in terms of nutritional benefits, the nutritional potential of a given intervention program will be negligible unless it constitutes an effective delivery system. We can think of a delivery system as the entire scope of an activity from development, organization or production to distribution and finally receipt and consumption by the target group. Its efficiency is measured in terms of the total costs and total time necessary to reach a large proportion of the target group.

Frequently, as in the case of fortification and plant breeding programs, the coverage of a specific nutrition intervention program will have to extend to a group larger than the target beneficiaries. In some cases this "spillover" may constitute a useful secondary effect. In others, where specific nutrient supplementation is required solely by a specified target group, there will be a certain amount of "waste" involved which must be accounted for in the costing exercise. This waste does not necessarily imply inefficiency if the blanket coverage of the fortification or plant breeding program, for example, proves less expensive, waste included, than alternative activities of a more directed nature. In any case, comparisons should be computed on a cost per true beneficiary basis. In other words, total cost should be based on the target group population and not on a simple total per capita basis.

Computing total cost is by no means a simple procedure. The usual presentation of cost per unit of food or of some nutrient usually covers only an estimation of the production or dissemination cost of a product or service. Even this cost may be somewhat misleading in terms of resource utilization. In most developed countries the cost of a raw material input, for example, is likely to represent its "opportunity cost", the highest price it can call forth from other buyers. Among low income countries, amid

considerable government control and intervention, and particularly in the presence of an unfavorable balance of trade, this may not be the case. Thus, for example, oilseed meal may sell for 6 cents a pound but be worth considerably more to the economy as an export and hence a foreign exchange earner. This true opportunity cost of the projected raw materials should be approximated particularly when large scale purchase is envisioned.

Frequently the production or dissemination cost may constitute less than 50 percent of the total expenditure involved. In the case of fortifying staple foods the cost of the actual supplementation is frequently omitted although it can involve significant capital costs and some recurring costs. For the fortification of wheat products, for example, few roller flour mills in the developing world are equipped with enrichment feeders for the addition of the vitamin and mineral premix. In addition, many are without bin dischargers for the bulkier addition or protein flours or concentrates. Finally, it is frequently necessary to extend the length of the screw conveyor to assure adequate mixing. In total this remodeling could add up to a significant expenditure. Unless the country has a reasonably sophisticated industrial sector, these will probably involve foreign exchange costs.

Transportation, handling, and storage costs will of course vary considerably from country to country and program to program. In the case of fortifying staples that will be distributed regardless of additives, the cost will be low. In the case of products for child feeding programs they probably will be high. In general, these costs including a loss adjustment may add a factor of 25 to 50 percent to product cost in the case of feeding programs. They will be highest in the case of animal protein products which being more perishable require more sophisticated facilities and may entail a considerable loss. It was in fact just this problem in the case of fish which led to initial research on fish protein concentrate. Transportation and storage costs will also vary of course according to the bulk of a product or additive. Thus it might be considerably more costly to transport and store a 5 percent oilseed flour supplement than one of 0.2 percent lysine (23).

Education and promotion costs relate to the motivation factor involved in the introduction of almost anything new. These costs will be discussed more fully in the following section. Suffice it to say here that in the case of commercially processed foods, Applied Nutrition Programs, and nutrition rehabilitation centers, this cost could represent a significant proportion of total cost.

Subsidization of Cost: A critical cost element which must be considered after other costs have been estimated is a potential public subsidy. As a direct budget expenditure, such a subsidy is a sensitive issue, and efforts usually are made to circumvent it. In part this sensitivity arises from its interpretation as disguised income distribution on top of an already heavy urban tax load. In low income countries the taxable upper income groups in fact would be financing a program from which they might derive no direct benefits. Circumvention of a subsidy however makes little sense if it eliminates the low income target group in the process.

The subsidy issue has been encountered most directly in the case of commercially processed foods. In Ethiopia, government producers of "Faffa", a supplementary food mixture for children, had to subsidize the product if they

hoped to reach the lower income brackets of the three million young children, most of whose families earned less than $18 per year (43). Incaparina and Pro Nutro, being produced privately in Central America and South Africa respectively, have not relied on subsidies although in the case of the former, product development work was partially subsidized since it was largely carried out by INCAP. Producers of both of these products claim broad coverage among lower income groups (14,15,41). With the possible exception of Incaparina in Guatemala, however, these products probably have had little significant impact on the nutritional status of low income youngsters. Even in Guatemala where Incaparina is known among all segments of the populace, the consumption per family reflects notably low intake by those in need. Pro Nutro claims that half of its production is purchased by Bantus, which in a population of one "European" for every eight to ten Blacks, suggests extremely limited coverage of the lower income African population. This is not meant in any way to downgrade the important and pioneering work done by Incaparina and Pro Nutro, but only to indicate the difficulties of having both viability and full coverage in these commercial, non-subsidized ventures. Studies now under way in Calcutta and Gujarat in India further underline the resistance among low income groups to new processed foods when these products put stress on family food budgeting. Furthermore, we have seen no empirical evidence to suggest an inevitable "filter down" process in the case of nutritious products geared initially to upper income groups. If the objective of these efforts is to reach those in need, at least initial government subsidies may be necessary.

The subsidy issue is also of importance in the planning of food fortification programs. Here the decision rests in large part on the magnitude of the cost increase. If the cost increase is small, 2 or 3 percent, and can be absorbed in normal price fluctuations of the staple, it probably can be passed on to the consumer with little difficulty. Such was the case with lysine fortified Modern Bread in India. If it exceeds 5 percent, an effort to do so could result in political protest if the food is a staple, and decreased consumption if the food has a price elastic demand. If this is done without being mandatory, it could well lead to the marketing of two varieties and the purchase of the lower priced, unfortified variety by the lower income groups. In addition, unless the staple is packaged, the indistinguishable appearance could well lead to misrepresentation. Should a subsidy be required, it may be possible to gradually reduce and eliminate it over a period of years.

Administrative Cost: A final cost element of a less easily quantified nature is that of administration. The cost here is not simply the sum of administrators' salaries since most or all of the government personnel involved would be employed anyway. Rather it is a kind of opportunity cost for a limited resource, namely administrative time and attention. In all countries, but particularly low income ones, capable project management personnel in government are in limited supply. In deciding on initiation of a new activity it is hardly academic to make some determination of the amount of administrative time and attention it will require, and the extent to which administrative manpower is available or can be diverted without loss from existing activities. One element of administration essential in virtually all of these programs is inspection. Government inspectors in most countries have a full time job insuring quality control on regular food supplies. Initiation of flour fortification might require many additional man-hours

to inspect the protein supplement produced at geographically scattered oil mills, more man-hours to inspect the vitamin-mineral premix, and many more man-hours to assure inclusion of these nutrients at desired levels at the numerous and widely dispersed flour mills.

Distribution: The transportation cost mentioned earlier assumes the existence of a distribution network capable of reaching a large proportion of the target group. Unless such a mechanism exists, the distribution costs may be prohibitive. In the case of increased agricultural production, genetic breeding for nutritive value, and fortification of staples which are otherwise centrally produced or processed, the distribution system already exists. If the plan is to fortify foods which do not reach centralized facilities, the mechanism clearly would not exist. To some extent a distribution network, namely the school system, exists for the operation of child feeding programs. Unless the school system also suffices for pre-school child feeding, however, reaching the pre-schoolers by this route could involve the costly development and equipping of another mechanism, say primary heatlh centers or maternal child health centers.

The case of new processed foods which are hitherto unknown in an area represents a particular challenge for planners anxious to achieve large scale coverage. To the extent processed foods are marketed in low income countries, they are usually limited to urban areas and seldom reach beyond to the majority of the populace. To reach those who do not participate in a market economy is particularly difficult. Still, there may be possibilities of extending coverage to rural areas by less conventional means. One may be government food outlets operated both in urban and rural areas in many countries for the sale of imported and government procured food stocks. A government sufficiently involved in the planning of even a purely private venture might be convinced on nutritional grounds to open up such outlets for the sale of low cost nutritious food products. Another alternative is the limited but vital marketing network bringing processed necessities into rural areas. Such necessities may include items like soap, salt, tea, and cooking oil. Additionally processed foods might be marketed through channels developed for the sale of agricultural inputs.

Consumer Acceptability

Implicit in the entire discussion is that nutritional deficiencies exist because of inadequate or unbalanced food consumption. These deficiencies will be met not by the production of more protein, calories, vitamins and minerals per se, but by the consumption of food. The previous section discussed the cost elements as a frequently inhibiting factor in the consumption of more and better food. This section is concerned with the non-economic factors of consumer acceptability. Of course in real life the two cannot be separated. Acceptability is a relative concept and would have to be measured in terms of units per a given expenditure. However, should the product be undesirable and unacceptable, its cost would have little relevance.

Unacceptability for our purposes might be divided into three categories which are self-explanatory: rejection for aesthetic reasons, rejection for cultural reasons, and rejection of unknown forms or institutions. All three can be ascertained by careful pre-program surveying on a seasonal basis. Rejection of say a fish protein concentrate fortified food might fall into

the first category if the supplementation imparted a grittiness or undesirable fish odor to the food. It would fall into the second if it were introduced in a traditionally vegetarian community. Cottonseed flour supplementation could fall into the first category if it discolored the staple. In those areas of Asia where eggs are considered a "hot" or heat-generating food, an attempt to market them during the summer months would lead to the second type of rejection. In an area where the concept of special foods for the weaning period is unknown, a processed weaning food might meet the third type of rejection. In such a case there would be no existing practice for which to substitute.

The cultural category should probably include some measure of status of the end product. This matter has received particular attention in the case of the low income groups in developed countries who are particularly sensitive to the status connotation of a product, and who might well choose to purchase smaller amounts of "status" items, or even in some cases pet food, rather than a product connoting a "poor-man's food". This phenomenon similarly exists in the developing world and served as the basis for the now questionable "filter down" process claimed in the introduction of new foods. In fact we still know remarkably little about the means of promoting and merchandising such products aimed at lower income groups.

In the case of rejection for aesthetic reasons, the undesirable characteristic might be eliminated, but at a cost which would have to be weighed. An undesirable taste for example might be "camouflaged" by the addition of flavoring agents. The cost of modifying a cultural pattern, removing a food taboo, or changing a food habit invariably will be far more expensive, and frequently prohibitive, if not impossible in the medium or short run.

General Requisites

This section and the next are less easily quantified than the previous ones, and weights attached to these elements will vary considerably from country to country. This section lists a series of what might be termed general requisites. Failure to score well on any one of these could well eliminate a particular program from serious consideration, depending again on the country and the alternatives.

Foreign Exchange: As basic as any such requisite is a minimum foreign exchange outlay. In countries with limited resources, foreign exchange probably will be the most limited. In the absence of adequate aid levels, foreign exchange stocks permit not only the import of industrial raw materials and spare parts (often meaning the difference between a plant's producing 50 percent or 100 percent of its capacity), but also the import of fertilizer for agricultural development or of just plain food for survival. As a result, foreign exchange stocks in these countries are carefully protected and generate the most rigid control system one is likely to encounter in the developing world. More often than not, a project's requirement for foreign exchange will necessitate a whole new series of forms, clearances and approvals, and in general a far more rigid scrutiny. If the imports are likely to be a recurring cost, they will be viewed with even greater suspicion.

As a rule then, a minimum foreign exchange outlay is a critical requisite for success in the appropriations process. Intervention programs vary

considerably in their usage of this scarce commodity. Fortification of processed foods relying on annual imports of an amino acid or protein concentrate will be costly in this regard, and may be difficult to launch unless simultaneous efforts are made to establish local production facilities. "Applied Nutrition" efforts on the other hand would require little foreign exchange unless seeds or implements were imported. Child feeding programs using internationally donated commodities will spend no foreign exchange in the short run but may lead to such expenditures in the future if imports, say of skimmed milk powder, are necessary to continue a program.

Finally, dependence on imported commodities carries with it considerable risk, both with respect to supply and price; the latter is particularly unstable in the case of milk powder, which constitutes the main element of child feeding programs in many countries. At present the price of skimmed milk powder varies between 5 and 15 cents per pound. In the absence of existing European and U.S. surpluses and export subsidies, the price could easily rise to 20 or 25 cents per pound.

Speed of Implementation: Frequently the factor most overlooked in consideration of nutrition intervention programs is the speed of implementation. This is understandable. Nutrition programs in the developed countries, relying primarily as they have on nutrition education, are by definition long range efforts. Seldom have they been viewed as critical immediate needs except in war time.

However, among low income countries the need is an immediate one and the time lost means opportunities foregone to reach children who otherwise would not be reached. This is not to suggest that long run educational and other developmental efforts are out of place, but only to indicate that possibly they should be accompanied by short run activities with greater payoffs.

Speed of implementation might be estimated by consideration of several important questions. The first is whether or not the necessary governmental policy base exists for the program. As an extreme example it might be folly to plan a program based largely on imported technology in a country with an unfavorable foreign investment climate. Similarly, relying on a commercial foods program in a country which heavily taxes its private sector may not produce rapid results. Perhaps these policies could be changed over time, and perhaps efforts should be made in these countries to change them. But considerable time must be allowed, and the end result will not be a certainty.

A second question closely related to the first is the number of clearances necessary to launch the program and the length of time necessary to procure such clearances. An Applied Nutrition Program or the launching of a child feeding program could involve a major and lengthy clearance process. It might begin with a central ministry of education or community development, go from there for clearances of food and health ministries, and perhaps from there to the medical council or perhaps to a nutrition advisory committee. Once these clearances have been obtained, it may go to the country's finance ministry and/or its planning commission. Thereafter, assuming a federal structure, the proposal might go to each of a number of state or provincial governments, from there to district governments and finally down to a given block of villages which may or may not opt to go along.

Initiating a program of expanded plant breeding research on the other hand would require relatively few clearances. Initiation of centralized fortification would also require less clearance time if local approvals were not necessary. Fortification however, involving a change in the specifications of existing foods, would probably require approval by the country's food standards committee. This in turn could lead to lengthy examination by expert panels, advisory groups and central laboratories, and add a year or more to projected implementation time.

A third question is the time necessary to procure necessary raw materials and equipment once approval has been granted. In the case of the equipment, this may involve foreign exchange and the problems discussed earlier. In some cases this will require an import license and then frequently several months to a year awaiting the availability of foreign exchange credit from the exporting oountry. Raw material supply may involve a similar set of problems if the raw material, say an oilseed or fish protein concentrate, must itself be manufactured. Although many low income countries produce large amounts of oilseed and fish meal, its processing for human consumption invariably requires a more refined technology and usually additional equipment or even new plants.

Once these questions are answered, time projections can be made. Even then, however, allowance should be made for the inevitable kinks inherent in large scale programs. In one country an amino acid analyzer could only be used half time because of a power shortage. Elsewhere production of a food blend for child feeding programs was delayed several months because of a single flavoring agent in short supply. It was subsequently delayed again because of infestation emanating from poorly positioned entoleters in the mills. The list is endless, and seldom are all the problems foreseeable. As a rule however, the number of these problems will be in direct proportion to the number of ingredients, the number of production facilities, and the number of separate entities involved.

Political Acceptance: A concern close to the hearts of policy makers in developing countries is inflation. Prices are often highly unstable, and major price rises have led to the demise of more than one government. Any program which increases the supply of commodities in short supply, namely food, is unlikely to have significantly inflationary effects. Large scale welfare transfers to low income groups however will invariably increase the pressure on these scarce commodities and force prices up.

Inflation is only one of many elements which may render a program "politically unacceptable". Some of these elements have already been mentioned. Large scale subsidies and high government costs per se are unlikely to win political support. Similarly the threat of a substantial rise in price of a staple, fortified or not, will be politically problematic as will possible claims of food adulteration or contamination. Beyond these, the national politician frequently objects to programs favoring specific geographic location or concentration regardless of need or economic advantage, when it is politically more expedient to spread resources evenly. A factor usually looked for in these projects is visibility. To the politician whose immediate concern is the coming election, the visibility and recognition of a project may be infinitely more important than its long run viability. Witness the proliferation of "monument building" in some countries at the expense

of sound development investment. In the last analysis however, the decision rests with the political leadership. A politically unacceptable project, no matter how sound nutritionally or economically, has no future.

Within this context is another similar problem that is rarely, if ever, consciously considered. This is the presence of an interest group, with a vested interest in project perpetuation. In the case of private firms, this presents no problem. Profits are usually related to program success, and losses are incurred when the program falters. Government nutrition intervention programs rarely have this built in interest group. When they do, the group may not have the necessary political potency. An Applied Nutrition Program operated by Community Development workers with numerous other responsibilities might falter without loss of profit to anyone except the program beneficiaries. When flour mills make an additional profit by fortifying, they will probably see to it that materials are available and equipment is in good repair. If on the other hand their return is unaffected or even reduced, they may not bother. Similarly the oil mill owner is unlikely to go out of his way to procure orders and modify plants to produce edible grade flour if his profits are no greater than those made from the sale of the oilseed meal as animal feed. The government planner, computing his budget on a pure cost basis and not taking this motivation factor into account, frequently will find himself without raw materials or quality end products when he needs them.

Evaluation

Comparison of alternate nutrition intervention proposals in terms of the factors discussed above would permit the development of a national plan and the implementation of rational programs. The likelihood of these programs accomplishing the policy objective will be increased if the system is equipped with a continuing evaluation mechanism. This is noted in the diagram by a path proceeding from the program back to the planning stage.

CHAPTER III

ECONOMIC AND SOCIAL MULTIPLIERS

Chapter I was an attempt to identify the role of nutrition in the development process. In doing so it was necessary to examine not only the direct effects of nutrition on economic goals, but also the indirect effects on these goals through its relationship to other priority development sectors. Now it becomes necessary to look again at the upper portion of the diagram and consider the effects of alternative nutrition programs on these other development areas. Some of the effects have already been suggested in the foregoing. Others will be examined briefly here.

The consideration of these relationships seems all the more important because of the fact that, like it or not, and in spite of considerable nutrition activity worldwide, the discipline remains outside of the mainstream of funds, concern, manpower and economic analysis. In most low income countries today this mainstream is dominated by the areas of agriculture, population control, education and industrial development. Well over 95 percent of international monetary assistance, for example, is channeled into these sectors. At least in the case of the first three, there are important areas of overlap with nutrition. By emphasizing these areas we will not only be creating important interdisciplinary linkages, but in terms of overall development we will be maximizing resource allocation.

The relationship between nutrition and agriculture is clear and direct, but strangely there has been an almost total lack of interaction between the two at the project level. In some countries the problem has been an agricultural research program oriented almost exclusively to major export crops rather than domestic food crops. In others the scarcity of total food supply not unjustifiably led to an obsession with quantity. Now, however, as increased yields in food grain production lead to consideration by the planner and the farmer of land diversification, such interaction is not only possible but clearly essential. There are numerous factors which might be considered by agricultural planners when they think through the question of diversification. As noted earlier, one of these is clearly the effect of such diversification on employment. Another would be its effect on the nutrition target group. Here the tools lie with the agricultural planner but the guidance must emanate from the nutritionist. If, for example, the nutritionists suggest a need for concentrated calories, the agriculturalist could initiate intensified research on soybean or groundnut production as a source of oil as well as protein. Supply might thus be increased by reducing production costs and increasing production profit. Efforts might also be made to improve marketing and thereby provide a further incentive to the producer. Finally if the item in question has a low price elasticity of demand -- which would not be the case with oil but might be with pulses -- the agriculturalist could resort to a negative price policy which, together with a positive shift in the production function, could depress consumer prices without serving as a production disincentive.

As agriculture is essential in the attainment of nutrition objectives, nutrition intervention programs also can contribute to agriculture goals. Applied Nutrition Programs, for example, can assist in increasing production and in some cases demand for protective foods. Programs utilizing oilseed

and fish protein can provide important outlets for increasing oilseed harvests and generate investment in fisheries development. Careful agriculture-nutrition coordination could also permit more sensible land use projections and estimates about the need for unconventional or synthetic sources of nutrients.

In addition to its relationship with agriculture, and as outlined earlier with family planning, certain types of nutrition intervention programs also will have a considerable bearing on the effectiveness of primary education in these countries. There is little question that well-fed, well-nourished children will out-perform the hungry. There is also increasing evidence that a child malnourished during the weaning period will perform less well even if these deficiencies have since been corrected.

Beyond this general relationship, school feeding programs may provide an additional boost to primary schooling by increasing registration and decreasing absenteeism. If a national goal is universal primary education, school feeding could be a most effective motivational instrument, particularly in areas of subsistence agriculture.

As mentioned earlier, a basic perhaps the basic developmental concern in many LDC's is inadequate employment and income in large segments of the populace. The problem has become so critical that the employment dimension of other programs is receiving considerable scrutiny. In this regard, nutrition intervention programs differ significantly. Food fortification programs on the low end of this spectrum will generate little if any additional employment, except as it increases production of raw materials which are intensive employers of labor. On the other end of the spectrum is the production of fruits and vegetables, and the dairy and livestock industries.

In general, then, the nutritionist who is capable of looking beyond his specific objective to broader development goals will be that much more successful in his planning endeavor, will win the confidence of the planner, and will move his discipline closer to the mainstream of development.

Completion of the Model

To complete the discussion of the model, we note that the paths of our national nutrition policy do not flow directly into the grand objective of economic development, as do the solid lines representing other development sectors, but rather boost these other sectors as noted by the dotted lines. In turn these other sectors clearly affect the success of the nutrition efforts. Thus, this diagram represents a continuous flow of development activity. Additionally, as noted by the line moving from right to left along the bottom, the flow is actually a circular one, in that economic development in turn increases the effectiveness of each of the paths and relationships.

CHAPTER IV

TWO CASE STUDIES

Having discussed the model in a necessarily generalized fashion, an attempt is made here to apply the model to two on-going nutrition intervention programs. The purpose is not to undertake actual evaluations of these programs but rather to run on-going program data through the categories of considerations presented earlier for purposes of elucidating the model in a practical framework.

Two programs have been selected which aim at the same general target group in the same geographic area, namely children in Bombay city in India. The first is the wheat atta fortification program initiated in February 1970. The second is the child feeding program operated by the Bombay Municipal Corporation with the assistance of CARE. For better focus, both of these have been taken out of the context of larger national programs. The atta fortification effort is part of a broader food fortification strategy of the Indian Government Food and Agriculture Ministry. The Ministry expects, for example, to fortify atta in the cities of Calcutta and Delhi during the coming year, and eventually in all of the 186 roller flour mills in India. The child feeding program is part of a nationwide effort now reaching over 10 million children and administered by the Ministry of Education. Thus, the construct presented below will be artificial in that it treats Bombay and these Bombay activities as wholly independent endeavors. Needless to say, any attempt to draw qualitative conclusions about these programs from the following analysis would be therefore seriously misleading.

The value of the construct is that it permits application of the model to two significantly different approaches to a single target populace. The fortification program might be termed the "blanket" approach in that it attempts to reach the target group by covering the entire populace. The child feeding activity would by comparison represent the "targeted" approach in that it aims specifically at the target group to the exclusion of others, but often at a higher cost per beneficiary.

The discussion will begin with a brief description of the nutritional environment in Bombay, will then proceed to analysis of the programs following the sequence of the model, and will conclude with some overall comments on the analysis.

Bombay -- the Nutritional Setting

Bombay with an estimated population of 5,300,000 is the second largest city in India, the largest being Calcutta. Located on the west coast of India, Bombay is a major port, a primary center of industry and commerce, and capital of the state of Maharashtra. While the city may not conjure up the same images of despair so frequently associated with Calcutta, Bombay is a city of major public health and nutritional problems. The extent of the problem is frequently hidden by "average" figures for the city which suggest health levels exceeding those in rural areas. The Bombay infant mortality rate (deaths prior to one year of age) for example was 80 per 1,000 live births in 1969 as opposed to 115 for India as a whole. Similarly the crude death rate in Bombay is 10 per 1,000 as opposed to 16 per 1,000 for the

country.5/ However, among the lowest income groups in Bombay, the infant mortality figure is estimated to exceed 150. Thus the analysis ceases to be one of averages.

In Bombay, an estimated 24 percent of the populace (1,272,000 persons) live in families with an income of less than Rs. 200 ($26.67) per month. For our purposes this group will be delineated as the "low income" populace. Five percent live in families with an income of less than Rs. 100. On the other extreme, 13 percent have family incomes exceeding Rs. 1000 ($133.35) per month (19).

The pre-school age population of Bombay has been estimated at 11 percent of the total or 583,000. The pre-school age population in the low income group as defined above would then be roughly 140,000 children.

Little survey data on the nutritional status of these children is available, but the results of a few studies suggest the dimensions of the problem. The average daily caloric intake of pre-school age children in Bombay city has been estimated at 1,060 as opposed to an official Indian requirement figure of 1,300 set by the Indian Council of Medical Research (ICMR) (22). The protein intake of this group is estimated at 16 grams as opposed to the ICMR requirement of 20 grams per day (19).

An unpublished study by Shah and Udani6/ of low income pre-school age children in Bombay coinciding roughly with the target group identified above found the following average vitamin intake per day:

	Intake	ICMR Requirement
Vitamin A (international units) (1-5 years)	225	900
Thiamine (mg.)	0.8	0.8
Riboflavin (mg.)	0.6	0.8
Niacin (mg.)	6	8

The Atta Fortification Program

Next to rice, wheat is the most important food staple in India. Eighteen to 20 million tons of wheat are now produced in the country, and a few million tons are still imported from the U. S. under PL 480 and to a lesser extent from Canada and Australia.

Most of the wheat consumed in the country is ground by individual consumers in small grinding units called "chukkis", or is ground by hand at home to produce the whole wheat "atta" used in making the Indian "chapatti"7/. Roughly 3 million tons or about one-sixth of the wheat is ground in the country's 186 roller flour mills. Although privately owned, these mills are under strict Government regulation and depend entirely on the Government for their purchases and sales. Until recently the mills ground only imported wheat which was then reserved for Government rationing or sales to bakeries. Since the mid-1960's the mills have also been grinding Mexican varieties of wheat grown in the northern part of the country, but are still unable to purchase wheat from the market.

The Government also regulates the products to be produced in the mills. In the northern part of India most of the wheat is ground into high extraction whole meal "atta" in which the only by-product is bran. As one moves further south, a higher proportion of the wheat is ground into white flour with a certain proportion of semolina, bran and "resultant atta". This "resultant atta" is now being fortified in Bombay.

The significance of this atta for fortification purposes is that it is the least expensive form of wheat available on the market and therefore is consumed by the lowest income urban dwellers.

Nutritional Effectiveness: The atta is fortified with 5 percent groundnut flour and with vitamins and minerals. In a nutritional sense, the value of the groundnut flour may not be primarily in its effect on protein levels. The addition of 5 percent groundnut flour raises the protein content of the wheat only from 10 percent to about 12 percent. Thus, a pre-school age child in Bombay consuming 40 grams of wheat a day (19) would be getting .8 gram of additional protein a day, increasing his protein intake by 5 percent and meeting about one-fifth of his protein deficiency. Were this .8 gram high quality protein, its addition might be significant for this age group. Tests carried out during the past year, however, indicate that the addition may have no effect on the PER of wheat flour. This is in part a function of the quality of the groundnut flour. The processing of this flour which is designed to minimize aflatoxin in the final product, also serves to reduce its lysine content significantly. Instead, the major value of the groundnut supplementation probably lies in the fact that it increases the total atta supply by 5 percent, thereby reducing by that percentage the pressure on product supply.

The vitamin and mineral supplementation, unlike the protein, may have nutritional impact on groups other than the pre-school age child. But focusing on the pre-school age target group, and assuming an average per capita intake of 40 grams of wheat per day, we can estimate the possible effects of the supplementation on the existing deficiencies noted earlier. These are summarized in the table on page 32. Unlike the child feeding program discussed below, this supplementation would occur daily, thus providing year-round protection for the wheat atta consumers.

Delivery System: The effectiveness of atta fortification as a delivery system is supposedly two-fold: First, wheat ground in the roller flour mills is technically capable of being fortified as opposed to the rice, wheat, or coarse grains ground in local grinding units; second, being the least expensive form of wheat available in urban areas, it reaches the lowest income groups in need of the nutrients.

The first point is certainly valid in India. To fortify rice in the country, for example, would involve equipping and regularly inspecting 50,000 rice mills. Furthermore, it is doubtful that any existing rice fortification technology could withstand the almost universal Indian practice of washing the rice and then cooking it in an excess of water which is then discarded. Similarly the logistics of fortifying wheat or coarse grains ground in "chukkis" would be an impossible undertaking unless supplementation of the whole grain were attempted. Thus the only cereal in the country presently capable of reasonably large scale fortification is flour milled wheat.

The problem lies with the utilization of that ground wheat. Only one-third of the 80,000 tons of wheat available per month in Bombay is ground in roller flour mills. Of this, only one-fifth is ground into resultant atta. Only 40 percent of the resultant atta is fortified and sold in Bombay itself. And of this, only 30 percent or 516 tons a month is left for sale through ration and fair price shops and thus available to the pre-school age target group. On the basis of average intake figures, an estimated 12 percent of the low-income pre-school age target group is reached by the program.

It should be noted parenthetically that this geometry is atypical of metropolitan India as a whole. In Calcutta and Delhi, for example, most of the wheat given to the flour mills is ground into atta and sold directly to consumers through ration or fair price shops or other distribution outlets.

The second point made above is that resultant atta from the roller flour mills is the least expensive form of wheat available and hence consumed by the lowest income groups. Over 85 percent of the low-income populace of Bombay regularly consumes wheat (19). Less than 5 percent of the same income group consumes bajra and jowar, coarse grains assumed to be less expensive than wheat but in fact more expensive in Bombay than the resultant wheat atta. Corn is consumed even less frequently.

The Bombay low-income consumer then is faced with 4 choices. He can buy flour mill-produced resultant atta at a cost of 89 n.p. (12¢) per kilogram, he can buy flour mill-produced whole meal atta at a cost of 95 n.p. (13¢) per kilogram, he can buy rationed wheat kernels and have them ground, a total expenditure of Rs. 1 (13¢), or he can buy wheat on the open market and have it ground involving an expenditure of roughly Rs. 1.30 (17¢). In terms of desirability the latter two are preferred for two reasons. First, the wheat itself is locally grown "white" wheat, clearly preferred in the preparation of the "chapatti". Second, the purchase of wheat kernels which are individually ground involves a presumed built-in quality control unavailable when the pre-ground atta is purchased. (The local grinding however involves a product loss of about 2 percent.) Nonetheless, the economics in this case outweigh the aesthetics so that resultant atta is consumed by low-income groups in the city to the extent it is available.

The cost of atta fortification is 3.61 n.p. (.48¢) per kilogram of atta representing a 4.1 percent price increase. The make-up and cost of the vitamin-mineral premix is given in tabular form below.

Item	Addition per ton of atta	Cost (Rupees per kg.)	Cost per ton of atta (Rupees)
Vitamin A	9.2 gms.	421	4.63
Thiamine	1.5 gms.	220	0.36
Riboflavin	1.38 gms.	340	0.52
Niacin	7.6 gms.	130	1.09
Calcium carbonate	0.8 kgs.	1.80	1.44
DiCalcium phosphate	0.8 kgs.	4.12	3.30
Iron (Ferrous sulphate)	96 gms.	6.30	0.60
Starch	283 gms.	2.50	0.71
	2.00 kgs.		12.65
		Sales tax	.38
		Rs.	13.03
	Premixed and packaged	Rs.	22.27

At present, the entire cost of the fortification is subsidized by the government. The plan is to continue this subsidy until the next change in the government procurement price of wheat and the resulting revision in ceiling prices for wheat products. At that time, the fortification cost would be absorbed into the price change and passed on to the consumer. For the present, using the production figures given earlier, government expenditure for the Bombay program would total Rs. 818,000 ($109,066) per year. This comes to Rs. 5.45 (73¢) per resultant atta-eating beneficiary per year or 1.5 n.p. (.2¢) per beneficiary per day.

In terms of resource utilization the opportunity costs of the groundnut flour and of the administration should be considered. To the extent groundnut meal has an export market, its opportunity cost is high. In India, out of a production of roughly 1.5 million tons of groundnut meal, approximately 600,000 tons or just over one-third is exported. As much as twice that amount has been estimated for export by 1976 (42). At present the unexported groundnut flour has a rather low opportunity cost as animal feed, and an even lower one as fertilizer. Even if the export projection proves valid and groundnut production remains constant, considerably more than the 40,000 tons of groundnut flour required for national atta fortification would be left behind for domestic usage. Thus, no competition for a scarce resource is in evidence or envisioned. If, as is expected, the groundnut flour in fortified atta and other processed foods is eventually replaced by locally produced soy flour, this would cease to be a factor at all.8/

In the case of administrative time and attention, the program once launched appears capable of running itself as a commercial venture. The government need here would be largely regulatory and additional inspection staff would be required and is being provided.

The acceptability of resultant atta has already been discussed. In theory, the addition of 5 percent groundnut flour, vitamins and minerals should in no way affect the characteristics of the atta. Acceptability trials undertaken by the Indian Food Ministry further reinforced this contention. However, in actual operation the ferrous sulphate reacted with the phenolic substances in the cuticles of the groundnut flour to produce a noticeable darkening of the atta in cooking. Acceptability problems ensued, followed by temporary elimination of the iron compound for further testing. No further acceptability problems have been encountered to date.

Requisites and Multipliers: The single foreign exchange component of the atta fortification program is the import of vitamins and minerals not locally produced. Part of the existing government stock of vitamins has been contributed by UNICEF. Assuming no external assistance, the foreign exchange cost would be roughly $5,500 (Rs. 41,250) per year to import the unavailable vitamins necessary for the program in Bombay.

In theory, a fortification program should require fewer clearances and permit more rapid implementation than other programs. In fact, because of the critical nature of the staple, the potential political difficulties in raising its price, and the difficulties in agreeing on a subsidy, the program was several years in getting underway. Furthermore, the procurement of an adequate supply of edible-grade groundnut flour proved to be a serious bottleneck in the early stages of the project. In this case, the oil millers had

no economic incentive to produce high quality groundnut flour when the returns were no higher than from the sale of groundnut meal as animal feed. Overall however, in spite of the time lags, the number of persons actively involved in the planning and clearance process was small.

At present, there is no promotion involved in the fortification program. As a result, few of the beneficiaries are aware that the product in any way differs from regular atta. Aside from the problem of necessary finance for the advertising, the decision against promotion was made to minimize claims of adulteration and the resulting political effects. While this fear is probably valid in the short-run, the lack of public awareness of the fortification seems to remove the government as a major vested interest in program perpetuation. Cessation of the program would probably have no political effect whatever. The flour mills and the supplier of the vitamin-mineral premix, therefore, would represent the only vested interests in the program. Even for these entities however, the extent of financial commitment to the program relative to their operations as a whole is not large.

Other than through its effects on productivity and family planning by improving the nutritional status of the pre-school child, the fortification program has no important multiplier effects. The one exception, as noted earlier, may be in increasing the supply of atta by 5 percent through the use of an additive not previously utilized as human food. In Bombay an additional 1,000 tons are thus added to the wheat supply each year, but in aggregate terms it amounts to only one-tenth of one percent of the total Bombay wheat supply.

The Child Feeding Program

At the outset two difficulties arise in setting up an analytical construct similar to the preceding one. First, the child feeding program in Bombay has thus far been directed almost solely at school-age children rather than at the target pre-school age group. Second, two major inputs into the program thus far have been donated commodities under PL 480 Title II, and distribution administration by CARE. In the case of the first, extrapolations will be made where possible to project for pre-school age feeding through a similar mechanism. In fact, such planning is now underway through a national government-sponsored pre-school feeding program aimed at low-income urban areas and rural tribal areas. In dealing with the second problem, estimates will be made on the basis of a wholly indigenously supported program.

Metropolitan school feeding differs considerably from the more common school feeding approach in low income countries. While rural or small town schools usually involve a self-contained structure, and some sort of court yard or playground however inadequate, the metropolitan primary school is more often a crowded back portion of a house or a floor of a multi-story building. Other potential child feeding outlets (primary health centers, local clinics, nursery schools, and family welfare planning centers) are not much different. Thus the traditional approach of supplying bulk unprepared food which is then cooked at the center is inappropriate. Instead efforts are made to supply ready-to-eat foods to the schools from central points in the city.

In Bombay several somewhat overlapping programs have been launched by the Bombay Municipal Corporation (BMC) with this approach in mind. The largest is a milk distribution program in which CARE makes available nonfat dry milk which is then reconstituted in a local dairy and distributed at BMC expense. A second program involves the distribution of biscuits. Here CARE supplies the necessary milk powder and wheat flour while the BMC finances the cost of the other raw materials, the production at a local bakery, and the distribution. In addition to these, a peanut distribution program was operated for a few years but is being withdrawn and a bun distribution program is being started. These latter two programs are not explicitly considered in the following discussion.

Nutritional Effectiveness: As with the atta fortification program no explicit study has been carried out on the nutritional effectiveness of the program. A study of the effects of the school lunch program in the Indian state of Orissa being conducted by the Council for Social Development for the U. S. Agency for International Development seems to indicate that at least in that state there is no significant difference between the nutritional and health status of children in schools with and without feeding programs. It also seems to indicate that a school lunch usually leads to a concomitant reduction in food given at home. If the nutritional results are valid and can be generalized for the country as a whole, they suggest that the school-age recipients are probably too old to reap the same benefits that would accrue to pre-school age recipients in such a program.

While there is no similar study for Bombay, some assessment is possible by looking at the nutritional content of the food itself and relating it to the nutritional status figures presented earlier. Looking at the ideal distribution (which is not always achieved because of unavoidable shortfalls in milk distribution) the .85 oz. of nonfat dry milk plus 10 biscuits a day provide a total of 90 plus 70 or 160 calories per day to the child and 9 plus 2 or 11 grams of protein per day.9/ The non-metropolitan CARE-assisted program on the other hand provides an average of over 400 calories and roughly 14 grams of protein through its distribution of CSM, bulgar wheat and vegetable oil. On the basis of the nutritional intake figures discussed earlier, the protein supplied through the Bombay program would appear adequate to meet most deficiencies of protein per se, assuming that the protein were absorbed as such. Similarly, the vitamins and minerals supplied through these commodities (listed in the table on page 32) go a long way toward meeting deficiencies of these nutrients.

The shortfall would seem to be in calories. For Bombay as a whole, average adult daily caloric intake has been estimated at 1535 as opposed to ICMR requirements ranging from 2400 to 3900 for men and 1900 to 3000 for women. Similarly the average pre-school age caloric intake is 1060 against a requirement of 1300 which would suggest a more serious shortfall for the low income target group. If school age child caloric deficiencies fall somewhere in between, the distributed commodities would be meeting only about one-fourth of the existing deficiency. It might meet roughly one-third of the existing deficiency of low income pre-school age children.

Finally, any discussion of the nutritional effectiveness of school feeding should recognize that feeding corresponds to the school calendar. In Bombay 195 feeding days per year is the norm.

Delivery System: During 1970, 113,000 Bombay school children received milk on a regular basis. For about one-half of these the milk was regularly supplemented by one of the other commodities. The 1971 targets are 150,000 milk recipients and 110,000 biscuit recipients. Assuming that half of the 110,000 is incorporated in the 150,000 and the other half is additive, the feeding recipients would constitute just under one-third of the 634,000 students registered in the municipal primary school system. Since the first four years of primary education are compulsory and almost wholly effective, the same figure can be used as the percentage of total persons in that age group.

To operate the milk program the BMC spends 6 n.p. (.8¢) per child per day or Rs. 1,755,000 ($234,000) a year. To this, roughly 600,000 kilograms of nonfat dry milk are provided under PL 480 at a C.I.F. cost of 53¢ (Rs. 4) per kilogram. If locally produced milk were used and assuming a total cost of Rs. 0.60 (8¢) per liter of milk pasteurized, bottled, and delivered, the program would cost Rs. 3,600,000 ($480,000) or roughly 12 n.p. (1.6¢) per child per day.

The BMC spends Rs. 2.95 (40¢) per kilogram of biscuits for processing and purchase of the non-donated commodities. To supply 110,000 children 10 biscuits (16 grams) a day for 195 days costs the BMC just over Rs. 1 million ($133,333). If the wheat flour and milk powder donated under PL 480 were procured locally, the cost would increase by roughly Rs. 700,000 ($93,333) to a total of Rs. 1,700,000 ($226,666) or 8 n.p. (1¢) per child per day.

Taking the two programs together and retaining the same assumptions about recipient overlap, a wholly BMC-supported milk-biscuit program reaching one-third of the city's school age children would cost Rs. 5.3 million ($706,666) a year or 14 n.p. (1.9¢) per child per day.

The national pre-school child feeding plan, referred to earlier, projects an expenditure of 23.5 n.p. (3.1¢) per child per day for food supplements designed to meet the deficiencies of this age group. Given the magnitude of the deficiencies and the larger built-in expense of reaching pre-school age children, such a cost projection is probably realistic. If so, to reach the entire low income, pre-school age target group of 140,000 on a daily basis would cost the implementing agency roughly Rs. 12 million ($1.6 million) a year. This, of course, makes the unrealistic assumption that the target population is so geographically concentrated that it could be reached without feeding any others in the process. Thus it might be more realistic to increase the cost by 25 percent to Rs. 15 million ($2 million).

Administrative costs have been included on most of the above estimates. In the case of wholly self-operated programs however, the administrative burden now borne by CARE would have to be absorbed by the BMC, or the State Education Department. Without detailed studies of these bodies, and some subjective "weighting" of ongoing activities, estimates of the opportunity costs of administrative time could not be made. Nonetheless the administrative costs and the requirement for skilled administrators would be considerably higher than for the atta fortification program.

Consumer acceptability on the other hand presents no problem whatever in this program. Milk and biscuits are not only accepted but are clearly

luxury goods. This of course increases the possibility of the goods being sold along the pipeline and further reinforces the need and expenditure for administrative surveillance.

Requisites and Multipliers: Assuming an adequate indigenous supply of ingredients there would be no need for foreign exchange expenditure. However, if inadequate milk were available in the country or if there were a reluctance to divert milk from the commercial pipe line, milk powder could be imported at Rs. 2,000 ($266) per ton, certainly less expensive at official exchange rates than milk locally, but still a drain of foreign exchange with particularly high opportunity costs. For the existing Bombay program the cost would be just under $1.6 million.

The administrative clearance procedure for operations of the BMC feeding program appears remarkably uncomplicated, requiring essentially the approval of the BMC Education Officer and in some cases the Commissioner. On the other hand, extra financing has been problematic due primarily to the inability of the BMC to float municipal bonds given existing low interest rates. At the same time there appears to be an increased political interest in Bombay and in the country as a whole in child feeding as a reflection of government concern in the face of increasing challenge to its authority. Thus the government itself probably represents a "vested interest" at least in perpetuation of existing child feeding programs if not in development of larger ones.

Until the evaluation of the school lunch program in Orissa there was a generally widespread belief that school feeding increases registration, decreases absenteeism, and improves classroom performance, thus boosting primary education in the country. The Orissa study results appear to throw some doubt on these except in the case of the lowest income groups for whom the food is apparently a major incentive.

Still as suggested in Chapter I of the paper, the multiplier effects of the feeding program appear to be considerably more important when the recipients are pre-school age children. In this case the productivity and family planning multipliers become effective, and the more observable results themselves become forces for program perpetuation and enlargement.

The major effect of a wholly indigenous feeding program on agriculture would be the increased pressure placed on milk supplies. In the short run this would serve to push milk prices up, possibly with some political repercussions, milk being both a luxury and to some extent a necessity (e.g. infant feeding and tea whitening). In the longer run the higher prices might serve as a necessary incentive to boost production, and as noted in Chapter III significantly boost employment and income.

Summary of the Case Studies

On the basis of the preceding discussion the following would seem to be the primary factors in considering these programs as two of perhaps several alternative intervention programs. This information is presented in tabular form on pages 32 and 33. Again it relates only to the isolated and artificial Bombay context constructed for the discussion.

COMPARATIVE DATA ON THE BOMBAY
ATTA FORTIFICATION AND CHILD FEEDING PROGRAMS

	Atta fortification	Child feeding
Number of persons reached	150,000	200,000
Percent of low income persons reached	12%	10%[a]
Number of pre-school age children reached	16,500	0
Percent of low income pre-school age children reached	12%	0
Daily calorie increment per recipient	0	160
Daily protein increment per recipient (grams)	.8[b]	11[c]
Daily vitamin A increment (I.U.)	1,220	1,391
Daily thiamine increment (mg.)	.06	.155
Daily riboflavin increment (mg.)	.055	.479
Daily niacin increment (mg.)	.301	.779
Daily iron increment (mg.)	3.84	1.92
Daily calcium increment (mg.)	32	317
Days per year provided	365	195
Total government cost per year	$109,066	$706,666[d]
Cost per child beneficiary per day	1.9¢[e]	1.9¢[f,g]

a Assumes two-thirds of child feeding recipients are in low income category.
b Per pre-school age recipient; meets 20 percent of the average protein deficiency for that age group but with protein of low biological value.
c Per school child recipient; meets 25 percent of the average protein deficiency for that age group with protein of high biological value.
d If wholly indigenously supported.
e Pre-school child beneficiary.
f School child beneficiary.
g An estimated 3.1 cents per day to reach pre-school age children.

COMPARISON BY OTHER INDICES

	Atta fortification	Child feeding
Consumer acceptability	High[a]	High
Foreign exchange utilization	None	None
Administrative cost[b]	Low	High
Political "vested interest"	Low	High
Visibility	Low	High
Potential effects on agriculture	Minimal[c]	Minimal[d]
Potential effects on family planning	--[e]	--[f]
Potential effects on education	--[g]	High
Potential effects on income generation	Low	Low

a Assuming resolution of iron discoloration.
b Defined as the opportunity cost of trained administrators.
c Assuming oilseed protein will be obtained by reallocation of supplies for domestic uses.
d Under existing supply arrangements, once the program is wholly indigenously supported, the effect could be significant.
e Depends on the nutrition-family planning relationship postulated in Chapter I, and on the relationship between infant mortality and protein and/or vitamin-mineral deficiencies.
f Depends on the extent to which child feeding can be coordinated with family planning outlets or family planning information dissemination.
g Depends on the improvement in mental facilities resulting from protein supplementation.

The atta fortification program:

1. reaches 150,000 low income persons or 12 percent of the low income populace in the city.
2. reaches 16,500 low income pre-school age children or 12 percent of the low income pre-school age target group in the city.
3. provides the recipients with no additional calories but significant amounts of vitamins and minerals and some additional but relatively low quality protein.
4. provides these on a daily basis to the resultant atta consumers.
5. is currently wholly subsidized costing the government Rs. 818,000 ($109,066) per year, and thus

6. costs the government 1.5 n.p. (.2¢) per resultant atta-eating beneficiary per day or 14 n.p. (1.9¢) per pre-school age resultant atta-eating beneficiary.
7. requires regular government surveillance but relatively little administrative attention for program implementation.
8. has no major economic or political vested interest groups behind it.
9. increases the atta supply in the city by 5 percent but has no significant effect on the total wheat supply.
10. may boost productivity and/or family planning through its effect on the pre-school age group.

The child feeding program:

1. reaches 200,000 school age children or just under one-third of the school age population of the city.
2. provides roughly one-quarter of this group with 1/5 liter of milk and 10 biscuits containing a total of 160 calories and 11 grams of protein per day.
3. provides roughly three-quarters of this group with one commodity or the other or some less regular combination.
4. supplies adequate protein, vitamins and minerals for this group but probably inadequate calories to meet existing deficiencies.
5. provides these commodities only during the school year -- 195 days.
6. if wholly indigenously supported would cost the government Rs. 5.3 million ($706,606) a year, and thus
7. would cost the government 14 n.p. (1.9¢) per school child per day.
8. if aimed at pre-school age children might cost 23.5 n.p. (3.1¢) per child per day or roughly Rs. 15 million ($2 million) a year to meet the nutritional requirements of the entire low-income pre-school group in Bombay.
9. would involve a major administrative burden if wholly self operated.
10. if wholly indigenously supported would put increased short-run pressure on milk supplies, thus increasing milk prices but possibly providing in the long run a production incentive thereby boosting employment and income.
11. would cost $1.6 million per year in foreign exchange if the milk were neither donated nor locally available.
12. has in the government a vested political interest at least in perpetuation of existing programs.
13. may boost school registration and decrease school absenteeism among low income children.

Conclusion: The Planner's Analysis

What might the nutrition planner conclude from the information just presented? If he were forced to choose between the two programs the decision-making might be somewhat problematic. Basically he would be choosing between (1) moderate supplementation without calories to 16,500 low income pre-school

age children (and their families) at a total cost of just over $100,000 a year, and (2) significant supplementation with calories to 200,000 school age children but at a total cost exceeding $700,000 a year. If the planner's sole interest were in reaching pre-school age children or if he were faced with a particularly serious budget constraint, he would opt for atta fortification. If his interest were in number of beneficiaries or in visible government intervention, he would clearly choose the child feeding program.

However, the planner's decision-making is rarely so straightforward. Normally he is acting in the context of several on-going activities rather than starting from scratch. He may decide to expand or terminate a program on the basis of such information. But he is interested primarily in determining whether such programs are achieving their full potential and, if not, how they might be modified or reoriented.

In the case of the fortification program, the planner might begin by examining the distribution system. If the resultant atta in Bombay is consumed largely by low income groups but reaches only 12 percent of them, could the percentage be raised by increasing the wheat allocation to Bombay, perhaps at the expense of other cereals if necessary? Could ways be found to increase the percentage of wheat milled by the roller flour mills? Could more of this milled wheat remain in Bombay itself? Could unfortified whole meal atta be sold to restaurants and hotels rather than fortified resultant atta? Alternatively, if the atta fortification route is indeed the most efficient means to reach the target group, would it be in the government's interest to further subsidize the product?

The planner then might look at the fortification itself. If the groundnut protein added to the atta has little effect on the protein quality, would it be possible to add a protein flour, say soy, with a more advantageous amino acid composition? Is such a substitute readily available in the country? If not, should such production and/or processing be encouraged and perhaps subsidized? Alternatively, does it make sense to consider, alone or in conjunction with a protein flour, the addition of synthetic amino acids? What would be involved in their production or procurement?

The planner thinking farther into the future might work through the logistics of fortifying unmilled wheat kernels by means of fortified premix. Through this process perhaps one-hundredth of the wheat kernels is heavily fortified through impregnation and then reintroduced to the main body of wheat during government procurement. Such a technology now exists for the introduction of amino acids and may soon be possible for vitamin fortification. Through such a process all centrally handled wheat could be fortified.

Finally, as the government develops greater confidence in the program it could begin publicizing the nutritious value of the atta as a reflection of constructive government intervention and as a means of increasing political support.

Looking at the child feeding program, the planner's first question would be whether or not the feeding is having the desired effect on the school age recipients. Is the Orissa study in fact applicable or is it impossible to generalize on the basis of such a study? Are there certain unmeasured factors such as vitality and better eye-sight being contributed by the feeding which

would justify its continuation or expansion? Should an Orissa-type study be carried out in Bombay to find out for sure?

What would be involved logistically and administratively in redirecting the feeding to pre-schoolers? Can the government afford the additional $1.3 million needed to effect the transfer? Is the government capable of supporting such an effort with trained administrative manpower?

Finally, the planner would want to know how the government can upgrade the nutritional value of the food given and how it could decrease operational costs. One possibility being used increasingly by CARE, particularly in urban programs, involves cooking of food in centrally located food preparation centers. From these kitchens, the food is transported to the schools by truck in large thermos vessels. Foods prepared in these centers could vary from CSM or bulgar wheat recipes used in rural feeding, to extruded products capable of a longer storage life. Alternatively, normally consumed wheat or rice products could be prepared. In each case the caloric and protein value of the meal would probably exceed that currently supplied while the recurring costs would be lower (28).

Thus the nutrition planner uses the information not only for short-run allocation decisions but also for long-run planning purposes. It is in the latter that he would and must interact creatively with the other sectors and disciplines discussed earlier. From agriculture and food distribution officials he must determine the effects of a larger Bombay wheat ration or a decreased atta outflow on national grain flows and procurement. He would also want to examine an increased wheat subsidy in the light of existing concessionary imports and the price policy for wheat. In looking for a groundnut substitute he would have an array of questions relating both to production, processing, economics, and consumer acceptability. In the case of oilseeds these questions are complicated by the fact that the cake or meal is the secondary product in processing. Measuring the benefits of the feeding program would require the involvement of health and medical personnel plus education officials to assess the effects on school performance. A switchover to central kitchens would require coordination with small scale industry and transport officials.

The planning process has long been neglected in international nutrition programs. As a result, while the need for effective programs increases, the discipline has not yet managed to win its place in the development mainstream. At the same time there is perhaps no discipline which is so interdisciplinary and so in need of integrated planning. For the nutrition planner an understanding of the role of nutrition in the economic growth process and the means of appraising alternative strategies in the broader development context should permit the development of a sensible efficient nutrition policy.

FOOTNOTES

1/ With increasingly potent labor legislation and trade unions, of course, there is no assurance that he will be. At the same time both land owners and industrial entrepreneurs appear to be concerned with the difficulties of managing large labor pools and usually hesitate to hire indiscriminately regardless of low labor wages.

2/ The calories themselves however ought not to be shortchanged. It is now well recognized that supplemented protein will be metabolized largely as calories in the absence of near-adequate caloric intake. Nonetheless, nutrition intervention sometimes becomes equated with increased protein, vitamin and mineral levels even in cases where calories are in seriously short supply. In part, perhaps, this is because increasing the intake of calories has not been considered the domain of the operational nutritionist. It should be.

3/ This is primarily a reflection of increasing demand for, but inadequate supply of the protective foods. With food grains, supply has been more successful in keeping pace with demand. As these supply increases continue, food grain prices are likely to fall somewhat, increasing the profitability of land diversification toward "luxury foods", i.e. fruit, vegetables and livestock. While this would successfully boost employment, the difficulties and costs of producing and marketing these products still would limit their consumption largely to the upper-income groups which could afford them.

4/ Here and elsewhere we are assuming that this nutritional well-being of the pre-school age child is also a function of the nutritional status of its mother during pregnancy and lactation.

5/ Information procured from the Directorate of Family Planning, Government of Maharashtra. Note that the infant mortality rate in the U.S. is presently 20 per 1,000 live births, and in Scandinavia roughly 13.

6/ Tables procured from Shah, P. M. and Udani, P. M. at the Child Welfare Center, J. J. Hospital, Government of Maharashtra, Bombay.

7/ A flat unleavened bread baked on a hot griddle and somewhat resembling a tortilla.

8/ Because of the aflatoxin problem often associated with poorly harvested or stored groundnut, special precautions are employed to assure safety in its use for human consumption. Groundnut flour used in such programs must conform to specifications set down by the U. N. Protein Advisory Group.

9/ These figures and the ones which follow assume that the nutrients provided through the school lunch program are completely additive and there is no concomitant reduction of food given at home. As discussed below this is a questionable assumption with respect to total food intake. It is probably safe to assume however that a qualitative improvement occurs even with the substitution factor.

REFERENCES

1. Abbott, John C.: Economic Factors Affecting the Distribution of World Food Protein Resources, In Milner, Max, ed., Protein Enriched Cereal Foods for World Needs, American Association of Cereal Chemists, 1969.

2. Ahuja, S. P.: Some Economic Aspects of Malnutrition in India. Paper presented at the meeting of the Association of Food Technologists, Eastern Regional Branch, Calcutta, India, February 1969.

3. Altschul, Aaron M.: The Agricultural, Scientific and Economic Basis for Low-Cost Protein Foods. Paper presented at the International Conference on Single-Cell Protein, Massachusetts Institute of Technology, October 9, 1969.

4. Altschul, Aaron M.: Food: Proteins for Humans, In Chemical and Engineering News, November 24, 1969.

5. Altschul, Aaron M.: Proteins: Their Chemistry and Politics, Basic Books, 1965.

6. Berg, Alan D.: Malnutrition and National Development. Foreign Affairs, October 1967.

7. Berg, Alan D. and Levinson, F. James: Combating Malnutrition: A Working Model. International Development Review, June 1968.

8. Berg, Alan D. and Levinson, F. James: A New Need: The Nutrition Programmer. American Journal of Clinical Nutrition, Vol. 22, No. 7, July 1969.

9. Brooke, C. L.: Enrichment and Fortification of Cereals and Cereal Products with Vitamins and Minerals. Journal of Agricultural and Food Chemistry, March/April 1968.

10. Call, David L.: Some Notes on Evaluation of Amino Acid Fortification. Paper presented to FAO/WHO/UNICEF Protein Advisory Group, 1969.

11. Call, David L.: Alternative Approaches in Combating the Protein Problem. Paper presented to the Conference on Amino Acid Fortification of Protein Foods, M.I.T., 1969.

12. Cook, R.: The Financial Cost of Malnutrition in the 'Commonwealth Caribbean'. The Journal of Tropical Pediatrics, June 1968.

13. Davies, T. A. Lloyd: Nutrition in Industry. Proceedings of the Sixth International Congress of Nutrition, 1964.

14. DeMuelenaere, H. J. H.: Development, Production and Marketing of High Protein Foods. In Milner, Max, ed., Protein Enriched Cereal Foods for World Needs, American Association of Cereal Chemists, 1969.

15. Domino, A.: Incaparina in Colombia. In Milner, Max, ed. Protein Enriched Cereal Foods for World Needs. American Association of Cereal Chemists, 1969.

16. Eichenwald, Heinz F. and Fry, Peggy Cooke: Nutrition and Learning. Science. February 14, 1969.

17. FAO, Nutrition and Working Efficiency, Freedom from Hunger Campaign Basic Study No. 5, 1962.

18. FAO/WHO/UNICEF, Protein Advisory Group, Recommendation on Amino Acid Fortification of Foods , September 15, 1969; and Recommendations on Marketing, October 20, 1969.

19. Operations Research Group, Food Habits Survey - Gujarat and Maharashtra, conducted for the Protein Foods Association of India, 1969.

20. Howe, E. E., Jansen, G. R., and Anson, M. L.: An Approach Toward the Solution of the World Food Problem with Special Emphasis on Protein Supply. The American Journal of Clinical Nutrition, October 1967.

21. India, Government of. Planning Commission, Fourth Five Year Plan 1969-1974 (Draft), March 1969, pp. 174-181.

22. Jai, V. N.: "Nutrition for the Pre-School Age Toddlers," In Child Care, November 1964.

23. Kracht, U.: "Economic Aspects of the Supplementation of Cereals with Lysine." Ad Hoc Group on Amino Acid Fortification, FAO, May 1969.

24. Kraut, H. A. and Muller, E. A.: Calorie Intake and Industrial Output. Science. November 29, 1946.

25. Krishna, Raj: "Agricultural Price Policy and Economic Development." In Southworth, H. M. and Johnston, B. F., ed., Agricultural Development and Economic Growth, Cornell University Press, 1967.

26. Krishnaswamy, P. R.: The Protein Foods Association of India. FAO/WHO/UNICEF Protein Advisory Group Document, 1969.

27. Leibenstein, Harvey: The Theory of Underemployment in Backward Economics. Journal of Political Economy, April 1957.

28. Levinson, F. James: "Our Child Feeding Overseas: A Development Resource for the Seventies?" Journal of the American Dietetic Association, December 1970.

29. Levinson, F. James and Berg, Alan D.: With a Grain of Fortified Salt. Food Technology, Vol. 23, September 1969.

30. Mellor, John W.: The Economics of Agricultural Development. Cornell University Press, 1966.

31. Mellor, John W.: The Functions of Agricultural Prices in Economic Development. The Indian Journal of Agricultural Economics, Jan.-March 1968.

32. Mellor, John W.: Report on Technological Advance in Indian Agriculture as it Relates to the Distribution of Income. Report prepared for the International Bank for Reconstruction and Development, December 1969.

33. Milner, Max, ed. Protein Enriched Cereal Foods for World Needs. American Association of Cereal Chemists, 1969.

34. Oshima, H. T.: Food Consumption and Nutrition, and Economic Development in Asian Countries. Economic Development and Cultural Change, July 1969.

35. Parman, G. K.: Fortification of Cereals and Cereal Products with Proteins and Amino Acids. Journal of Agricultural and Food Chemistry, March/April 1968.

36. Patankar, V. N.: Protein Foods Market Development Programme in India. FAO/WHO/UNICEF Protein Advisory Group Document. 1969.

37. Rajadhyaksha, V. G.: Rural Marketing in India. FAO/WHO/UNICEF Protein Advisory Group Document, 1969.

38. Reserve Bank of India, Monthly Bulletins, 1965 and 1968.

39. Scrimshaw, Nevin S.: Infant Malnutrition and Adult Learning. Saturday Review, March 16, 1968.

40. Senti, F. R.: The Case for Plant Proteins. Paper presented to the American Society of Animal Science Meeting, Cornell University, June 28, 1967.

41. Shaw, Richard L.: Incaparina in Central America. In Milner, Max, ed., Protein Enriched Cereal Foods for World Needs, American Association of Cereal Chemists, 1969.

42. Dept. of Economics, University of Bombay, and Operations Research Group Baroda, Survey of India's Export Potential of Oilcakes, 1969.

43. Wickstrom, B. O.: Experiences in Marketing a Supplementary Food Mixture for Children in Ethiopia. FAO/WHO/UNICEF Protein Advisory Group Document, 1969.