

SUPPORTING PAPERS:
WORLD FOOD
AND NUTRITION
STUDY

VOLUME IV

Study Team 9

Nutrition

Study Team 12

New Approaches to the
Alleviation of Hunger





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New Approaches to the
Alleviation of Hunger

Commission on International Relations
National Research Council

NATIONAL ACADEMY OF SCIENCES
WASHINGTON, D.C. 1977

The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the Committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

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Volume I

Study Team 1 Crop Productivity
Study Team 2 Animal Productivity
Study Team 3 Aquatic Food Sources

Volume II

Study Team 4 Resources for Agriculture
Study Team 5 Weather and Climate

Volume III

Study Team 6 Food Availability to Consumers
Study Team 7 Rural Institutions, Policies, and Social Science Research
Study Team 8 Information Systems
Study Team 10 Interdependencies

Volume V

Study Team 14 Agricultural Research Organization

PREFACE

Shortly after the World Food Conference held in Rome in 1974, the President of the United States wrote to the President of the National Academy of Sciences asking the Academy to make an assessment of the problem of hunger and malnutrition and "develop specific recommendations on how our research and development capabilities can best be applied to meeting this major challenge."

The study was begun in June 1975 by a Steering Committee appointed by the President of the Academy. It produced two reports for the President: an Interim Report, published by the Academy in November 1975, and a final report, World Food and Nutrition Study: The Potential Contributions of Research, published in June 1977. The Steering Committee was assisted by 14 study teams appointed by the Academy to analyze and make recommendations to the Committee on various portions of the study (Table 1).

This publication is one of five volumes containing the reports of Study Teams 1-10, 12, and 14. Study Team 11's report overlapped the other reports and has been integrated with them. Study Team 13's report of its ranking of research priorities was an integral part of the work of the Steering Committee. Consequently, it is not published here. Study Team 13's work is explained in detail in Appendix B of the Steering Committee's report.

The Steering Committee is deeply grateful to the chairmen and members of the study teams for their dedicated work, undertaken for the most part under heavy pressure of time. This work provided the greater part of the source materials for Chapters 2 and 3 of the Steering Committee's report, dealing respectively with "High Priority Research" and "How to Get the Work Done." The study teams are responsible for the content of their reports, which were reviewed by appropriate members of the Steering Committee.

Study Teams 1-12 were asked to identify areas of research and development that had outstanding prospects for helping to meet world food and nutrition problems

Table 1. Study teams, World Food and Nutrition Study

Study Team	Title
1	Crop Productivity Subgroup A Pest Control
2	Animal Productivity Subgroup A Animal Health
3	Aquatic Food Sources
4	Resources for Agriculture Subgroup A Farming Systems B Land and Water C Fertilizers D Energy and Equipment
5	Weather and Climate
6	Food Availability to Consumers Subgroup A Food Losses B Food Processing and Preservation C Food Marketing and Distribution
7	Rural Institutions, Policies, and Social Science Research Subgroup A Policies and Program Planning B Research, Education and Training, and Extension C Finance, Input Supplies, and Farmers' Organizations
8	Information Systems
9	Nutrition
10	Interdependencies Subgroup A Population and Health B Energy, Resources, and Environment C International Trade Policy and Comity Between Nations D National Development Policies
11	New Approaches to Increasing Food Supplies
12	New Approaches to the Alleviation of Hunger
13	Research Priority Assessment
14	Agricultural Research Organization Subgroup A Research Organization in the United States B Global Agricultural Research Organization C Development of Research Personnel

over the next several decades. For each such area, they were asked to respond to three questions:

- What advances in knowledge will specific areas of research produce, and what is the scientific or technological significance of these advances?
- If the research produces results, what effect would they likely have on reducing global hunger and malnutrition over the next several decades?
- What supportive action will be required to conduct research for the accelerated activity recommended (e.g., more resources, policy changes, organizational changes)?

The study teams were asked to base their selection of research areas on their answers to the first two questions. Answers to the first and third questions provided insight on the feasibility of each research area. This information was used by Study Team 13 and the Steering Committee in the selection of research priorities. It also provided raw material for Study Team 14 and the Steering Committee when they considered steps to mobilize and organize resources to implement the proposed research.

Each study team's selection of high priority research areas involved two steps. In the first step, the study teams reviewed research recommendations and possibilities for research provided by existing reports, by the study team members themselves, and by hundreds of other people who were consulted, including many from other countries. From the hundreds of research possibilities, each team selected a limited set that would likely have the greatest global effect on hunger and nutrition. The second step narrowed this set to research areas whose potential was thought to stand out well beyond that of the rest of the group.

The Steering Committee hopes that these study team reports will provide rich source materials for those interested in pursuing the various subject areas in greater depth than could be done in the report of the Steering Committee.

Harrison Brown
CHAIRMAN
Steering Committee
World Food and Nutrition Study

Report of Study Team 9

NUTRITION

STUDY TEAM 9

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SUMMARY OF RECOMMENDATIONS

Worldwide nutrition problems probably will increase in severity over the next 10 years. The major knowledge gaps in how to deal with these problems require new and intensified research and new institutional arrangements to increase the utility of research for planning and operations.

The program we propose emphasizes the need for fresh perspectives in nutrition research, including encouraging the participation of institutions and researchers who thus far have not taken part in the traditional investigation into nutrition. We include the following integrated set of four research profiles:

Profile 1, "The Functional Significance of Nutritional Status." What are the effects of different levels of malnutrition (both undernutrition and overnutrition) on the function of the individual--work performance, school performance, behavioral adaptation, fertility, lactation, resistance to infections, and so on? What are the consequences of these effects for society? To decide which nutrition problems should receive priority and how resources may best be allocated among various target groups, it is essential to know the relative seriousness of different states of nutrition and the degree of benefit derived from specific increments of nutritional improvement. Research in this area should define malnutrition in terms of the degree to which it impairs the biological, social, and economic functions associated with different degrees of nutritional deficiencies.

Profile 2, "Ensuring the Quality, Safety, and Adequacy of Diets." What foods in what quantities and in what combinations are required to meet the needs established in Profile 1? Little is known about the nutritional adequacy, quality, and safety of diets as consumed, and the beneficial changes that could result from alternative practices for procuring, handling, and distributing food within the household. Research in such areas will provide guidance for making decisions on agricultural production issues (for example, goals for plant breeding), incentives to and regulation of

food industries, and the evaluation of policies affecting the availability of particular classes of foods to target populations. This research would facilitate identification of those intervention points and techniques that would most influence food habits, and thus nutritional status.

Profile 3, "Intervening to Improve the Nutritional Status of Selected Groups." Nutrition program planning decisions currently are made with little or no information about expected outcome. The failure to evaluate adequately ongoing nutrition intervention programs makes it difficult to determine the effectiveness of past investments in nutrition and of alternatives that might be considered in the future. This research program would include developing and testing evaluation methodologies (what to measure, how to measure it, and how to interpret the findings for the purposes of decision making), and applying such methodologies for direct food interventions, nutrition education, and health environment interventions. Such research is fundamental to nutrition policy formulation, planning, and program design.

Profile 4, "Nutritional Impact of Government Policies." The nutritional condition of a country's population is influenced basically by government policies that are formulated, implemented, and changed with little, if any, consideration for or understanding of their ultimate nutritional impact. One research area would encompass the nutritional effects of food supply policies and practices such as production strategies, agricultural research emphases, agricultural extension and rural credit programs, policies concerning food self-sufficiency, food aid, and resource use. Another set of research questions would deal with the nutritional consequences of food distribution and marketing policies and practices such as price policies, marketing technologies, delivery systems, international trade in cash crops, and grain buffer stocks. The third area would cover the nutritional implications of general government policies such as development strategies, income redistribution policies, and the budget and policy processes.

The United States should help finance nutrition research and development where it can best be done. Country-specific problems can best be studied in the research institutes of the particular country. Research that is not country-specific should be done wherever the research capability exists. The United States should mobilize the energies and ingenuity of biological and social scientists in its universities and other research institutions, including those in the private commercial and industrial sector, to work on such problems and to assist foreign organizations, when

requested, in training foreign scientists and in helping to solve nutrition problems in the developing countries.

Research undertaken by scientists in the United States should be part of an evolving international network. Cooperation among scientific communities around the world should be sought, not the creation of another intergovernmental organization or another U.S. research agency. Research carried on in the developing countries will be applicable to the United States and other industrialized countries and vice versa.

Three institutional mechanisms are needed to assure an efficient, long-term effort:

- A federal food and nutrition policy research council concerned with (1) the formulation of rational food and nutrition policies in the United States in relation to the rest of the world; (2) the magnitude, priorities, and coordination of U.S. government research funds for food and nutrition research in the United States and overseas; and (3) the use of research results for policy and operating decisions in the United States and overseas.
- An operating consortium of U.S. universities and other research institutes adequately staffed to help (1) to organize and link the presently fragmented and compartmentalized work scattered around the country; (2) to organize and maintain a nutrition research information bank; (3) to establish networks to disseminate information to research groups and research users in other countries; and (4) to maintain U.S. government programs for collaboration, training, contract research, technical assistance, and institution building overseas.
- An authoritative research review and applications entity, including people with program experience, (1) to synthesize, assess, and interpret what is now known about nutrition for use by nonscientists who make policy and program decisions; (2) to render authoritative judgments on the applicability and risk, if any, in using new research results; and (3) to identify new research issues requiring attention.

The financial commitment required for the first five years would amount to \$96 million. Of this amount \$75 million would go to research institutes in the United States and developing countries to finance the foregoing research profiles, \$15 million would be used for new approaches to basic research, and \$6 million would be used for infrastructure costs. This average

annual cost of \$19 million would be in addition to the current annual U.S. government expenditure of \$80 million for nutrition research.

PREFACE

This report, as requested by the National Academy of Sciences, is directed toward "a research role for the U.S. in combatting malnutrition and its effects." However, as reflected throughout the profiles, the work we propose should be viewed as one part of a larger international whole. The extent to which the international nutrition research process can be abetted by any government depends a great deal upon commitment--and other nonresearchable factors that are not addressed here.

Early in our deliberations it became clear that developing a list of interesting research topics would be less useful than establishing an appropriate context for nutrition research and the main outlines of a research map. Four areas (or profiles) were recommended for priority attention in this map. The relative priority of topics within each profile will, in our view, vary greatly by country. Moreover, because the work required to address the questions posed in the profiles is envisioned as part of mobilizing the research process and strengthening the capabilities of an international nutrition research network, we allow for flexibility and other perspectives within the priority areas, especially regarding the research communities of the developing countries. In short, the exact location of priorities within profiles relies heavily on local judgments of what is needed.

In our deliberations we attempted to identify the information most needed for effective decision making and the kinds of research that could best contribute to that end (see Appendix A). Study team members brought to these deliberations experience from international and national assistance agencies, foundations, business, agriculture, academia, the legislative branch, medical research institutes, and public interest groups. Half of the members have worked in developing countries.

In addition to the direct contributions of the study team itself, team members formed satellite groups

(totaling 48 experts) from their respective fields to assist in sifting through the many research possibilities posed to the team and to make their own suggestions. In addition, approximately 140 "outside" experts, representing a wide range of disciplines, institutions, and nationalities (about half were from the developing countries), reviewed the team's working papers, some at several draft stages. Each expert was asked to critique the suggested research topics and to question our assumptions. Comments and opinions were exchanged with 58 of these experts at regional team hearings held in Washington, Boston, Berkeley, and New York. Specialists from the international nutrition community sent written or taped responses.

Given the large number of research topics suggested to the team, interesting and possibly important research subjects inevitably were left out. In some cases, the decision not to include proposed topics was based on a judgment that the work could be done more efficiently as components of research proposed by other study teams. In other cases, it appeared to us that the topics were already receiving significant attention and were in little danger of being neglected. Finally, we note that our group had an opportunity at an early stage to comment on the nutritional aspects of research proposed by the other study teams.

Those who have contributed to the work of this study team include Paulos Abraham, K. T. Achaya, Kamal Ahmad, Harold Alcott, Rosalind Alfin-Slater, Ian Anderson, J. K. B. Ata, Cathy Overholt Austin, Kenneth Bailey, Richard Barnes, Wenche Barth Eide, Moises Behar, David Bell, Achmad Birowo, Sabra Bissette, David Boianovsky, Jean Bowering, Jack Bresler, George Briggs, E. Briskey, Norman Brown, Roy Brown, Josef Brozek, John Canham, Sidney Cantor, Leticia Casillas, Claire Cassidy, Chee-khoon Chan, Gerald Combs, C. W. Cook, Thomas Cooke, Joaquin Cravioto, Paul Crowley, David Dapice, William Darby, Alberto Carvalho da Silva, Guido Deboeck, Susan Demarco, Gunvant Desai, Rene Dubos, Johanna Dwyer, Ruth Emerson, Martin Forman, Rose Frisch, Marcel Ganzin, Frank Goffio, Richard Goldman, John Gordon, Gio Gori, Willis Gortner, George Graham, Robert Greenstein, Joan Gussow, Davidson Gwatkin, Peter Hakim, Ross Hall, Dale Hathaway, D. M. Hegsted, Howard Hiatt, Frederick Hill, Robert Hodges, Dorothy Hollingsworth, Abraham Horowitz, Joseph Hulse, John Hurley, Paul Isenman, Nasir Jafri, Derrick Jelliffe, Norge Jerome, Bruce Johnston, William Jones, Stephen Joseph, Leonard Joy, Mogens Jul, Darwin Karyadi, Judith Katona-Apte, Michael Katz, George Kerr, Kendall King, John Knowles, John Kramer, Carol Lancaster, Frances Moore Lappe, Francis Larkin, Michael Latham, Gilbert Leveille, James Levinson, Robert Levy, Charles Lieber,

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INTRODUCTION

PERSPECTIVE ON A ROLE

During the next 10 years there will continue to be nutrition problems which may vary in severity from year to year and country to country, but which generally will intensify in the absence of major national and international actions to assure equitable distribution of food, to improve food production, and to limit population growth.¹ The United States itself faces the problem of trying to harmonize domestic and international objectives--maintaining commercial exports of food for balance-of-payments reasons, expanding food aid, meeting domestic food requirements at lower prices, and assuring adequate returns to farmers to maintain high levels of food production.

Given this outlook, an adequate international research effort would seem essential to provide a basis for decisions in the following critical areas:

- Realistic and equitable national and international food resources management policies must be formulated. These policies should be based in part on explicit nutrition objectives in key countries including the United States, among other reasons to facilitate international cooperation on food, nutrition, and financing programs. Nutrition research is needed in both the high-income and developing countries to guide the development of these policies.
- The prevalence of malnutrition in many countries has been and will continue to be related to government decisions on economic development strategies, resource allocation, income distribution policies, and internal and external financial considerations. These decisions are influenced by political and other factors far removed from and more important than research capabilities and research results, but it is increasingly evident that such decisions must take

- into account their nutritional consequences, a process that depends on adequate research.
- Partly, but only partly, as a result of increased awareness of the nature and extent of malnutrition, political leaders in many countries have responded to pressures to provide food to people who need it. The U.S. government, for example, spends internally about \$7 to \$8 billion a year on food stamps and school feeding programs. The developing countries are spending hundreds of millions of dollars each year on food interventions aimed at low-income groups. Programs now underway are almost never based on adequate research nor are they being used as opportunities to generate information for evaluating these interventions. The magnitude of expenditures, now and in the future, is such that accelerated research is almost an imperative to assure more rational, efficient use of increasingly scarce food and financial resources.

Although it is clear that international cooperation of many kinds is required to solve global nutrition problems, each country ultimately must develop the institutional capability to deal with its own nutrition problems including policy and planning capacity, monitoring and surveillance, research and training in nutrition (agricultural, health, and industrial sectors), health care infrastructure, and program design and operational skills. Nutrition research and institution building should be coordinated activities.

Significance of Nutrition Research

Nutrition is fundamental to life, performance, and well-being, and nutritional state both influences and reflects the economic and social development of every country. It is difficult to think of a single disease, be it schistosomiasis in Africa or cancer in the United States, in which nutrition is not regarded as a significant factor. It is also difficult to grasp the magnitude of waste resulting from malnutrition. In some societies 20 percent of the newborn children die during their first year of life and some 40 percent of the survivors live with the crippling effects that inadequate diet and recurring illness have on learning, work capacity, and behavior (see Appendix B). Even in the United States, concepts regarding our nutritional state are undergoing revision. Surveys have revealed, for example, a startling incidence of iron deficiency anemia among children. Possible links between nutrition, diet, and the degenerative diseases and cancer on the one hand and learning disabilities and

mental illness on the other have begun to generate concern in governmental and scientific² circles about the state of our knowledge about nutrition.

Yet in facing the more immediate problem of world hunger the question might well be asked, "why bother with complicated research and why not simply concentrate our attention on getting some food to people who suffer from severe malnutrition?" Our selection of research topics rests on the fact that the recurring costs even for this limited population require that more efficient means be found to determine which people suffer from malnutrition, how much of what foods are needed, and how self-sustaining nutritional improvement in such populations can be generated. Without a much clearer understanding of the etiology of malnutrition, it is not possible to identify reliable and efficient alternative interventions. The prospect of continuing to rely on meal lines is not satisfactory unless the alternatives have been analyzed and rejected for valid reasons. Finally, the number of people who suffer from moderate malnutrition and who do not display the clinical symptoms of severe malnutrition is immensely larger than the number of people visibly affected.

We need to know the implications of the lesser grades of undernutrition and overnutrition. If this question is not addressed, we are blindly accepting unnecessary risks about the kind of world we will have a generation or two hence.

We swim in the same sea of nutritional unknowns as do the developing countries although the waves may differ in kind and degree. Research carried on in the developing countries will have increasing applicability in this country and vice versa. Research on the functional significance of energy deficits in the developing countries may help us understand the functional significance and consequences of obesity, a major problem in the industrialized countries. Thus the results of research on the functional significance of the range of energy intakes will be as important in the United States as it will be in India. As our sophisticated food processing technology spreads to the developing countries, they may begin to notice and investigate its nutritional effects and its relationship to the degenerative diseases we are studying in the United States.

A RESEARCH APPROACH

Key Questions

The research profiles set forth in this report are related to five fundamental questions:

- What kinds of nutritional problems affect what segments of the populations with what severity and prevalence in which countries?
- What is the significance of each of these problems for the people affected?
- What are the consequences to society of failure to reduce or eliminate these problems, and how can these consequences be usefully expressed in quantitative and qualitative terms?
- To what extent would each or some of the problems be solved through increased production or imports of what foods, if existing distributional mechanisms were not changed?
- How and to what extent would other kinds of direct or indirect food or nonfood interventions solve each or some of the problems and at what costs?

Each of these questions subsumes another series of questions that together encompass a broad range of disciplines in the natural and social sciences. All entail interactions among nutritional status and biological, physical, social, political, and economic environments of which a food production system is but one part. The international research community is already addressing some of these questions. For example, in relation to the first question, several groups are attempting to develop quick, inexpensive nutrition surveillance techniques to identify those at risk and early warning systems to alert planners to impending famine or acute malnutrition in vulnerable populations.

The topics in this report were selected with an aim toward filling critical gaps in knowledge. Four major topics have been identified and outlined as research profiles (see Appendix A). They are directed at limitations in knowledge that critically impede progress in policymaking and program formulation. Thus Profile 1 ("The Functional Significance of Nutritional Status") is designed to improve understanding about the consequences of different nutrient levels for the individual and for society. Profile 2 ("Ensuring the Quality, Safety, and Adequacy of Diets") is designed to provide guidance to those who, through food policy, influence the nutritional quality and safety of the diets as consumed, and to improve understanding of how socioeconomic, demographic, and cultural differences

influence the food consumption of individuals, households, and larger groups. Profile 3 ("Intervening to Improve the Nutritional Status of Selected Groups") concentrates both on measuring the effects of nutrition program interventions and on identifying possible direct and indirect intervention programs, including food and nonfood measures. Unlike Profile 3, which is program oriented, Profile 4 ("Nutritional Impact of Government Policies") is concerned with improving government decisions affecting food distribution and marketing, food and agricultural policies, and a range of other government policies, national or international, that have significant nutritional implications.

Each profile presents subtopics that fall into two categories:

- Research of immediate consequence for facilitating government decisions and likely to have an effect within five years from the time it is initiated (some elements of Profile 1 and most of Profiles 3 and 4). Governments need to have as soon as possible some quantitative and qualitative bases for understanding the functional significance of inadequate diets and for assessing the effectiveness of ongoing interventions in their countries.
- Research that represents long-term investigations of causative mechanisms and complex interactions, which could lead to new modes of interventions (Profile 2 and some elements of Profiles 1 and 4).

Within each profile, it should be possible to identify priorities in relation to particular country needs, as well as to the appropriate sequence for research.

The profiles reflect that nutrition research is quite different from traditional agricultural research, where the effects of the manipulation of agricultural inputs can be tested and measured with respect to effects on yields under a variety of conditions and where the yields can be valued in market terms. We do not know how much food a person requires for different levels of activities or functions. We do know that biological variability is large. Our knowledge of the etiology of malnutrition is severely limited, but we do know that availability of food is not necessarily the principal determinant.

Moreover, the use of research results to achieve beneficial change may depend on a government's political decisions on how much it spends or on what public policies it adopts or on decisions by individuals--how they dispose of their income, how they

eat, what they grow, what personal hygiene habits they adopt, what they choose to feed their children, and so on.

Most of our research topics will need to be interpreted in relation to specific countries. Therefore, it would make sense to consider national research strategies that can integrate data collection on diets and dietary behavior with other country-specific research. This in turn raises the possibility of achieving economies in research by using a national data collection system that can serve health- and nutrition-related research in particular countries, recognizing that basic data may need to be complemented and illuminated by specific investigations. The U.N. system is already at work designing national data collection systems, and it is important to use these opportunities to design nutrition components of such systems.

Basic Research

Our profiles largely elaborate on and give direction to ongoing basic research. However, in the opinion of many scientists the present level of funding and personnel for basic research is inadequate in the face of its potential significance. For example, more attention should be paid to defining more precisely the levels, causes, and implications of malnutrition and related food requirements, and to the critical and controversial questions of energy and protein relationships. Other basic knowledge gaps addressed in a limited way or not at all in the profiles include:

- nutritional factors in the causation and course of many chronic and degenerative diseases such as heart disease, diabetes, cancer, hypertension, and obesity;
- requirements, interactions, and significance of iron, magnesium, zinc, and other trace minerals;
- nutritional factors and environmental stresses such as diet-drug interactions (including contraceptive agents) and resistance to natural and manmade toxicants;
- interactions among mild deficiencies of several nutrients;
- interactions among diet, host, and intestinal microflora;
- effects of undernutrition on the brain and central nervous system function, including behavioral effects.

The decline in real terms of government funding for human nutrition research and training at universities over the past decade has been reflected in the size and nature of work at these institutions and the inadequate numbers of young researchers trained to work in the priority areas we identify. Many interviewed in connection with this study regarded adequate research/training grant incentives, which can best be met by government, fundamental to mobilizing a sustained research effort that is commensurate with the importance of the nutrition problems that need to be addressed.

Critics of nutrition research in the United States have sometimes questioned whether funds for basic research in nutrition are being deployed for the right purposes. This question should be addressed. A comprehensive review would be useful of how decisions are made on funding research and what the returns have been from this research investment over the past 10 years. Without waiting for such a review, however, it is important to encourage new perspectives on basic nutrition research and to attract more people into this work. For this reason we have specifically provided in our recommendations for an expenditure of \$15 million over the next five years to support work by scientists, U.S. and foreign, who may be new to the field and who have research ideas or approaches that do not necessarily fit the traditional framework of nutrition research. This could include those affiliated with institutions which thus far have not been engaged in nutrition research, as well as with institutions that already have nutrition research programs. Part of this process of encouraging a fresh perspective may be to involve university departments other than nutrition, nonuniversity institutions, and scientists from the private sector. Certainly more needs to be done to integrate nutrition research with activities in related fields such as physiology, toxicology, and the behavioral sciences.

The profiles in this report do not specifically identify research aimed at finding "technological fixes" to alleviate nutrition problems. Support for ongoing basic research in the nutrition-related sciences (including new participants as suggested above) should allow support for "wild cards." For example, basic work on immunological responses may suggest technological breakthroughs for monitoring nutritional status. As basic research probes the mechanisms controlling the relationship between nutrition and infection, preventive or quick treatment of diarrheal diseases may emerge. As more is learned about the pathways through which trace minerals and vitamins function, it may become possible to develop a

simple fortification technique that would reduce the debilitating effects of disease and other environmental stresses.

Using Research Results

One matter requiring particular attention is increasing the utility of nutrition research results to policymakers, planners, program designers, and program managers. Those we consulted almost unanimously expressed concern that they have no ready access to scientific advice and knowledge that is operationally understandable. What is now known about nutrition and nutrition interventions should be synthesized and assessed immediately for use by nonscientists who make decisions regarding intervention programs. Such information, brought up to date from time to time, also would be welcomed by private citizens and consumer organizations interested in public policies related to national and world food and nutrition problems.

As new research results emerge, there is a need for a mechanism that can render authoritative judgments about these findings. The scientific caution and qualifications that normally surround the findings of research scientists sharply affect the use of the findings by planners and program people. It is difficult enough for government officials to decide to invest in indirect or direct interventions based on present knowledge. This difficulty is multiplied when the expert findings are hedged with "but we need to know more" or "we cannot be absolutely certain." The admirably cautious behavior of research scientists needs to be complemented by an independent opinion on whether research findings can be applied with reasonably acceptable risk.

Finally, a mechanism is needed to disseminate both research results and the opinions and interpretations of an independent but application-oriented group to research groups, governments, and program people around the world. Such a mechanism is discussed below.

ORGANIZATION AND IMPLEMENTATION

A U.S. Role

What the U.S. government is able to do about mobilizing U.S. nutrition research capability to assist the developing countries is related in part to what the U.S. government decides to do about its own nutrition problems. Thus, for example, urging by U.S. experts that the developing countries adopt national nutrition

policies and programs is likely to be regarded as somewhat anomalous in light of the fact that the U.S. government itself has never done so and shows few signs of wanting to do so. Other countries may properly ask what and how much the U.S. government has done or intends to do about the nutrition problems of its low-income populations or what research has been done, for example, on the nutritional and performance effects of U.S. school lunch and breakfast programs.

To approach our task as one solely of helping find answers for the developing countries would be viewed by some as another patronizing U.S. activity reflecting the assumption that the United States has all of the talent. Some developing countries are ahead of the United States on nutrition research of certain kinds, for example, India on nutrition and resistance to infection and fortification of salt with iron, and Mexico, Guatemala, and Colombia on nutrition and learning.

The research program we propose be undertaken by scientists in the United States should be part of an evolving international network of research also to be carried out in other countries, industrialized or nonindustrialized. The international cooperation sought is not primarily intergovernmental, but among scientific communities. We are not suggesting the creation of an intergovernmental organization or another U.N. agency. To move in this direction would be a mistake.

With respect to the United States, we envision a research enterprise that has its own work to do and that is available to help others when asked. Possibly one or more nutrition operations research institutes, which other countries may wish to support and in which their scientists may work, might prove desirable for certain regions of the world. It is also possible that certain research can best be done within or in cooperation with international agricultural and health research institutions or U.N. agencies.

In this context, the role of the U.S. government is to finance nutrition research and development where it can best be done. Country-specific problems can best be studied in the research institutes of that country, and the United States should be prepared to provide financial help when requested. Research and development that is not country-specific can be done anywhere. The contribution the United States can make most easily in this regard is to mobilize the energies and ingenuity of U.S. and foreign scientists working in the United States.

A number of countries probably will want their own scientists to work with U.S. research institutions and will want to train their young scientists in such

institutions. Also, individual countries may want to draw on the knowledge and experience of U.S. experts to work on specific nutrition problems in their countries. Even if other countries choose not to use U.S. help, there is much work of scientific importance to be done by scientists in the United States.

The supply of highly qualified, experienced experts who can operate effectively in the multifaceted context of nutrition research is severely limited even in the United States. A significant increase in demand for such experts to assist the developing countries has outstripped the present scanty supply. Meanwhile there is no stable, organized employment market for the field training of more nutrition scientists and analysts. Universities now cannot carry such people on their faculties and there are few career ladders that will produce an increase in experts with extensive field experience. If the United States seriously intends to contribute an appropriate share of experts for the world's nutrition programs, it must find means of increasing the number and efficient use of such persons. The research programs and financial support recommended in this report are addressed in part to this problem.

Financial and Institutional Arrangements

Most likely a mix of contract research and conventional institutional grants will finance the research set forth in the following profiles. The timeliness and specificity of our research topics suggest that contract research (including nonuniversity, industrial, and commercial research organizations) as well as project grants may be appropriate. Conventional but more flexible institutional support grants may be more suitable and may encourage pioneer work in the more complex research areas and in expanding ongoing basic research referred to earlier.

It is possible to identify certain institutional arrangements that reflect the above considerations. First, there is the need to create within the U.S. government some form of a federal food and nutrition policy (or policy research) council that recognizes the interrelationships among food, agriculture, and health systems, and that can address the task of formulating a rational food and nutrition policy in the United States in relation to the rest of the world. Such a council, with adequate authority, can address the question of the magnitude and coordination of federal research funds to assure adequate funding for nutrition research in the United States and overseas. The research that

is conducted can contribute to sound decisions by the council on formulating and adjusting, as necessary, food and nutrition policies and programs.

A council of this kind would (1) devote a great deal of attention to harmonizing often conflicting national and international food and nutrition policies, (2) assign responsibilities to appropriate executive agencies for responding to requests for scientific and technical assistance, and (3) monitor the effectiveness of the U.S. effort in assisting global food and nutrition actions. It should have a small professional staff and a budget to cover the costs of outside policy studies and consultants. Financing might come through the Executive Office of the President.

Second, there is a need to form a consortium of U.S. universities and other research institutions with nutrition research capabilities. Thus they can pool their talent and experience and serve as a national resource for research and action on nutrition problems in the United States and overseas. Such a consortium, which has precedents in agriculture, atomic energy, and perhaps other research activities in the United States, would be responsive to the need identified by many in the nutrition research community to organize and to link the presently fragmented and compartmentalized work scattered around the country. The consortium, which would have a full-time staff, could organize a nutrition research information bank and establish effective information dissemination networks with research groups and research users in other countries. In this connection, it might develop arrangements with private food industry research groups to share their valuable work on consumption patterns, marketing, and technical investigations.

The consortium might serve as the vehicle through which the U.S. government would finance contract research performed at various institutions. The consortium staff, with leadership experienced in linking research to policy and operating decisions, could organize and monitor: consulting services to agencies and programs of the United States, developing countries, and international organizations; large-scale data collection and analysis; field demonstrations; training of developing country personnel financed through bilateral and international training programs; and so forth. An adequately financed consortium would serve as a mechanism for training American and other talent in nutrition and related fields and as an employment base for making effective use of young scientists interested in working on U.S. nutrition problems and those of the developing countries.

The U.S. government should provide directly, through the U.S. Agency for International Development

(AID), financial assistance to strengthen appropriate existing departments, institutes, and chairs, and to establish them if they do not exist, in selected universities in those developing countries that face major nutrition problems. These departments should, under the terms of the financial support, provide services to their governments. In some cases, new departments might be affiliated with their counterparts in U.S. universities. The consortium proposed above could facilitate forging affiliations with new and established overseas groups, advise on the selection of recipients, monitor progress, and/or serve as a conduit and manager of funds for these purposes.

The proposed consortium could participate in due course in international action to create one or more quality, operationally-oriented research and analysis institutes located in and concentrating efforts and services on special problems of a region, for example, South Asia or tropical Africa. Such an institute would be staffed by senior and junior people from several countries, including those from the consortium of institutions, and could be linked with strong research institutions in the region engaged in related research.

Financing for the consortium might be contributed by a special appropriation or through research budgets of the National Science Foundation (NSF), the U.S. Department of Health, Education, and Welfare (HEW), the U.S. Department of Agriculture (USDA), and AID, as reflected in Figure 1.

Third, there is the need for the authoritative review and applications mechanism discussed earlier. This might take the form of an entity, including members with program experience, within the National Academy of Sciences (NAS). Such a group perhaps could be financed by HEW, USDA, and AID, or through the consortium budget.

Process and Time Considerations

The foregoing discussion of institutional arrangements omits the possibility of creating a National Institute of Nutrition (or of Health and Nutrition, or of Food and Nutrition, or of Food, Health, and Nutrition). Such an institute may emerge eventually, but at this time it seems preferable to concentrate limited resources and personnel on starting a research process rather than a large new government institution.

The major elements of this research process are leadership at the policy level, clarity on research needs, linkages between research producers and users, and steady growth in capabilities of research

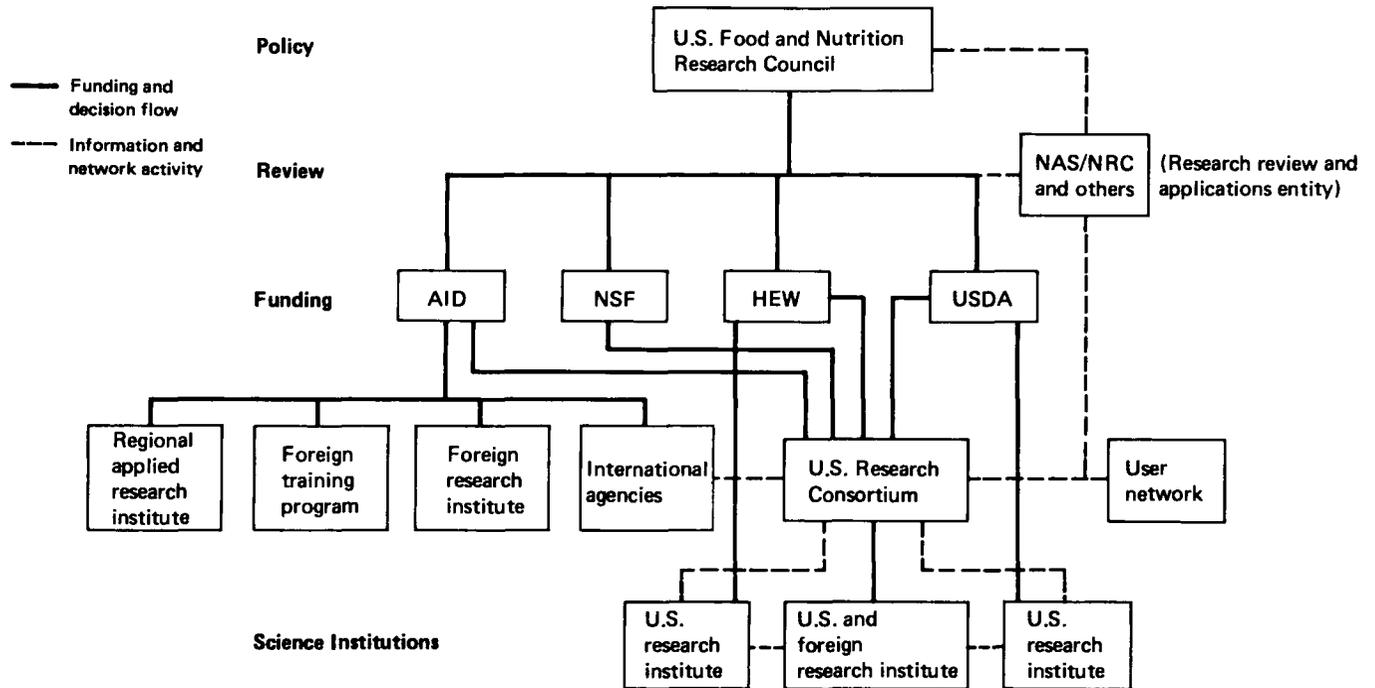


FIGURE 1 Model of possible nutrition research institutional arrangements.

institutions. Although the pace of this process depends on the level of funding, the process cannot begin without a clear, long-term commitment of support from the U.S. government and of willingness to experiment with organizational, managerial, and funding techniques.

Although this report limits its attention to programs and cost estimates for five years, the needed work will go beyond this time frame. The start-up process will be slow and the cost estimates below reflect a build-up in activity during the first five years.

The organization of the research process can begin now, and there is no reason why plans for organizing the policy leadership and the consortium of research institutions cannot be completed within a year. It also should be possible within a year and within existing funds to design and contract for the first few research projects on functional significance and assessment of direct interventions. Finally, the preparatory work could begin during this period on the research programs and funding requirements of the other major elements in this report for incorporation into the FY 1979 or FY 1980 budget.

The costs and sequence of mobilizing nutrition-related research capabilities and research work at this stage can be described only on a tentative basis. The financial requirements of the first five years, set forth in the following section, reflect the initial tasks of commencing research work in U.S. and overseas institutions and thus providing the base for recruiting and financing young biological and social scientists to enlarge the number of experienced workers in the nutrition field as well as building faculty in these institutions. As the first step, U.S. government agencies, principally USDA, AID, NSF, and HEW, probably should solicit proposals from U.S. research institutions based on the research topics identified in this report. The institutions chosen for support might form a nucleus for the consortium described above.

Concurrently, research institutions in the developing countries would be encouraged to submit proposals for country-specific research, for upgrading faculties and facilities, and for fellowships in the United States for predoctoral students studying nutrition-related sciences. The main source of funding would be AID. In this regard, the involvement of planning agencies in the developing countries, which have policy research capabilities, may build continuing local financial support for country-specific research.

Once the institutional support process is launched, the consortium could be organized, the staff recruited, a research data bank created, and contact made with

U.S. and overseas research institutions. When research results begin to flow, these would enter the consortium's data bank, would be reviewed by the applications mechanism described earlier in this report, and then would be disseminated by the consortium through the growing network of research institutions and user institutions.

As noted, much of the research may entail formal and informal collaborative arrangements between U.S. and foreign research organizations, and during this early period the consortium staff might participate in arranging and monitoring such institutional collaboration.

The first five years will be a period of building research capabilities and will undoubtedly require adjustments in both process and research projects as experience--good and bad--accumulates. By the end of the first five years, there should be 10 to 15 U.S. institutions and perhaps 20 overseas institutions strengthened and at work, some research results available (and in the hands of users) on segments of all of the profiles, and a functioning network between the research institutions and the users. It should be possible at that time to have a firm basis for decisions on the size and emphasis of future investments in research.

Cost Estimates

The additional financial commitment required during the first five years to conduct this program is estimated at \$96 million. Funding requirements by major areas of research are shown in Table 1 and by major cost components in Table 2. This proposed average annual investment of roughly \$19 million a year would be in addition to the \$140 million now spent annually in the United States for nutrition research, approximately \$80 million of which is spent by the government and an estimated \$60 million by the private sector.

Table 1. Financial commitments during first five years, major areas of research

<u>Research profiles</u>	<u>Estimated costs (\$ millions)</u>
The functional significance of nutritional status (Profile 1)	35.0
Ensuring the quality, safety, and adequacy of diets (Profile 2)	17.0
Intervening to improve the nutritional status of selected groups (Profile 3)	18.5
Nutritional impact of government policies (Profile 4)	5.0
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TOTAL RESEARCH PROFILE COSTS	75.5
New basic research approaches	15.0
<hr/>	
TOTAL RESEARCH COSTS	90.5
Infrastructure costs*	5.5
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TOTAL FIVE-YEAR COSTS	96.0

*See items 8 and 9 of Table 2.

Table 2. Financial commitments during first five years, major cost components

Research costs	Estimated costs (\$ millions)
1. To enable, through profile funding over a five-year period, nutrition-related institutions in the United States to launch basic and applied research investigations in the United States and overseas (in cooperation with foreign research institutions)	26.0
2. To support, through profile funding over a five-year period, upgrading and expansion of research through nutrition-related institutions in developing countries, particularly in connection with country-specific research problems	30.0
3. Special contract research centered in the United States over five years	8.0
4. Special contract research centered in developing countries over five years	8.0
5. Support for the first nutrition operations research center in one region (operating costs only)	2.5
6. Joint research projects carried out in conjunction with agricultural, health, and other institutions	1.0
7. New basic research approaches	15.0
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TOTAL RESEARCH COSTS	90.5
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<u>Infrastructure costs</u>	
8. To launch and support a consortium of U.S. research institutions with a full-time staff to create and operate research information bank, dissemination network, etc. Core administrative and operating costs for five years.	3.5
9. NAS review group, conferences, workshops over five years	2.0
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TOTAL FIVE-YEAR COSTS	96.0

Profile 1

THE FUNCTIONAL SIGNIFICANCE OF NUTRITIONAL STATUS

The research described here focuses on the effects of malnutrition (both undernutrition and overnutrition) on the function of the individual and the consequences of these effects for society.

A country's current nutritional status and its prospects for the future usually are described in terms of comparisons between aggregated estimates of physiological requirements and the food supplies available or consumed. However, such calculations do not take into account the distribution of supplies and nutrients within a country's population and do not indicate how many people are malnourished or who they are. For example, in the United States where the average supplies exceed requirements, these calculations fail to reveal existing nutrition problems.

Even if the data were sufficiently disaggregated, definitive conclusions about nutritional needs could not be drawn on the basis of observed food intake alone. A simple boundary does not exist between adequate and inadequate intakes. Rather, there is a relationship among levels of food required, amounts consumed, and levels of performance. Moreover, the relationship between intake and function for any individual will itself be governed by the history of previous intakes.

Our concern is with the degree to which a given intake maintains, enhances, or inhibits an individual's functional performance (activity, growth, resistance to disease, and so forth), rather than with the consumption of a population group per se. To decide which nutrition problems should receive priority and how resources might best be allocated among various target groups, the decision maker needs to know the relative seriousness of different states of nutrition and the degree of benefit derived from specific increments of nutritional improvement. It is generally

assumed that returns from improvements decrease as nutritional state advances, but this is not necessarily so for all functions and at all levels of intake. Thresholds may exist below which increments have little or no demonstrable benefit.

Many functional relationships have been described, but none has been quantified sufficiently for the purposes of nutrition planning. In an operational sense little is known about such basic functional relationships such as that between nutrient intakes and resistance to disease and other environmental stress and rates of recovery from them. Similarly, not enough is known about the relation of malnutrition to intellectual ability, sensory and motor functions, school performance, and general behavioral adaptation, and to expressed fertility, lactation, and infant mortality rates.

Issues are unresolved regarding ideal rates of human growth. At what stages of development are growth rates most critical? Is there an "optimum" body size? In nutritional terms, the questions might be phrased: For which nutrients is it critical to provide 70, 85, 100 percent of recommended allowances, at what period of development, and for how long? What are the long-term and short-term functional costs of providing only 50 or 60 percent? Or as much as 120 or 150 percent? At what stage or degree are changes irreversible? How much variability is there in the individual capacity to adapt physiologically and psychologically to altered nutritional states?

Whatever functional assessment of nutritional status that has been made usually has focused on physiological performances and on morbidity and mortality indices. Social and economic activities also must be considered. It is not enough to know that a very low energy intake will limit growth and energy output in the form of physical activity. One also must investigate the extent to which various degrees of restriction of energy intake limit the expenditure of energy enough to affect the productivity of labor, exploratory behavior and learning, school performance, participation in such activities as community development, and ability to take advantage of opportunities and new ideas.

The survival of children depends largely on adequate nutrition in utero and after birth and a viable family unit capable of sustaining the child. Nutrition intervention during pregnancy can improve infant birth weight and chances for survival; however, information is still needed on how early in pregnancy intervention must be introduced and what augmentation is required. Similarly, adequately fed infants and children are better able to resist infections and to

grow and develop, but little is known about the significance of marginal (in contrast to severe) states of nutritional deprivation or how to define them with precision. Little or no attention has been paid to the effects of nutritional deficits in parents on maintaining an integrated and coherent family structure. We know which family members are most vulnerable physiologically, but we have no basis from which to rank-order vulnerability in the broader and equally significant social sense.

The functional relationships between nutritional status, infant and child mortality, and family competence take on added significance if it is shown, as many believe, that resistance to family planning is strongly related to high infant and childhood death rates. Fertility rate is another measurable function of nutritional status that needs to be considered.

Effective nutrition planning requires identifying the people who are malnourished and the nutrients involved. What are the best indicators of nutritional status? Laboratory investigations have taught us much about biochemical and clinical symptoms and the inhibition of growth that occurs with shortages of single essential nutrients. This information has been used effectively in surveys of nutritional status. However, sample population surveys are costly, and while they indicate present status, they do not provide enough evidence to determine the trend of change in nutritional state. It is necessary to identify parameters that capture meaningful relationships, have a low variability over time, and are highly sensitive to changes in nutritional inputs. Nutritional status and changes in nutritional status thus could be monitored efficiently. Combinations of indicators may be required to give full and reliable information for different age-sex-culture categories.

RESEARCH NEEDS

The purpose of this research is to define malnutrition in terms of the degree of its impairment of biological, social, and economic functions associated with different degrees of nutritional deficit or excess. Fast, simple, inexpensive methods are needed for measuring a limited number of characteristics that will indicate nutritional state and changes in nutritional state of a population or of individuals with which functional characteristics can be associated.

A rather lengthy list of functions that might be impaired by inadequate or excessive nutrient intake can be constructed. Because of the societal costs and

sheer human misery involved, priority should be given to the functions of (1) resistance to and recovery from stress, especially that resulting from infection, acute food deprivation, and environmental conditions; (2) adult work performance or potential; (3) fertility, lactation, and infant death rates; (4) intellectual ability, school performance, and general behavioral adaptation; and (5) age-specific and sex-specific morbidity and mortality.

First, a review of the state of knowledge and a systematic comparison of information from humans with more abundant data from farm and experimental animals is needed. Methodology must be developed to measure various aspects of performance. Research on indicators should include a review of cost in relation to varying amounts of information and related chance of error and the value of extra information, or reduction of error, when combinations of indicators are used.

Proposals for further work should stem from such reviews, including work (1) of a clinical nature to determine functional relationships; (2) of an epidemiological or case history nature to appraise the significance of specific types and degrees of functional impairment; (3) for field trials in the assessment of indicators; and (4) for planning exercises to establish priorities in nutritional improvement.

Determining energy needs and the effects of substandard intakes of energy should receive priority. On a worldwide basis inadequate intake of energy because of inadequate intake of food appears to rank ahead of all other types of malnutrition. Sufficient food for growth and development, work, and other forms of physical activity is an obvious primary need. When the total intake of food and thus energy is low, the intake of many nutrients is usually low as well.

Diets in which protein is the primary deficiency do not seem to be a major problem except for those populations with diets based on cassava, yams, and plantains and who lack the means to supplement these diets adequately with other protein sources. Efficient utilization of dietary protein, however, seems to depend upon an adequate intake of energy. It has been hypothesized recently that body protein is wasted and that protein requirements are elevated when the intake of energy is low or marginal. Thus the protein intakes of individuals or populations subsisting upon marginal energy supplies appear to be of significance, yet precise relationships between levels of each cannot be specified now.

In addition to energy and protein, nutrient intakes of special importance in certain regions are iron, iodine, vitamin A, and possibly other micronutrients.

Research is needed to establish methods for easy detection of present status and changes in status and to identify the most relevant measures for improvement. In contrast to the provision of food energy and protein, the cost of adequate amounts of the micronutrients is nominal. Hence since the micronutrient cost is low (the major cost is in the delivery) and corrective measures do not require that individual dietary requirements of micronutrients be closely defined, research on micronutrients should focus on techniques for determining which individuals are in a deficient state and what nutrients they lack.

IMPACT

Some of this research presents extremely complicated methodological problems, but it is important to attack these problems to provide information on the consequences of undernutrition and overnutrition in terms of their implications for individuals and for societies. Knowledge of this kind is an important component of nutrition education aimed at individuals and families. Governments must have some quantifiable basis on which to judge the consequences of existing policies and to choose among competing claims for the allocation of financial resources. Is it safe, for example, to defer a food distribution program in which 80 percent of the nutrient needs of most individuals are being met in favor of investment in a road-building scheme that promises to raise levels of living five or 10 years hence? In an affluent society the decision might be at what prevalence of obesity should insurance rates be restructured as a motivation to behavioral change.

RESEARCH CAPABILITIES AND COSTS

Compilation and analysis of existing data can be done in major research centers that have qualified staffs in the disciplines involved, such as nutrition, biostatistics, and epidemiology. Several U.S. universities would qualify. For some phases of the research, U.S. institutions would need to work in close cooperation with foreign centers that have accumulated relevant data and expertise. Methodology for the measurement of function can be developed in the United States or abroad. The clinical and field research must be conducted in those countries with populations falling into various deprivational states and in which there are competent investigators. There are few such research centers, and those need to be strengthened by

providing specialized training to the existing staff, augmenting equipment and facilities, training more nationals in the skills required, and exchanging academic and professional personnel so that scientists from the United States can both teach and learn.

Some of this research already has begun. New efforts could add a substantial amount of experience with animal models. In some instances, significant research results could be expected within three to five years after research has begun. The time gap between research results and implementation will depend on the issue, on the manner of financing, and on the degree of a country's political commitment. For countries that already have planners who are sensitive to the productive potential of nutrition interventions, the gap could be as short as a year or less before quantified functional relationships have an effect on design and location of government programs.

Presently, approximately \$3.5 million per year could be spent effectively in the United States on these research topics and less than half of that amount could be used beneficially overseas. This amount could easily double in three years if the U.S. nutrition community responds appropriately and if the preliminary results justify the enthusiasm and importance we attach to this research.

Profile 2

ENSURING THE QUALITY, SAFETY, AND ADEQUACY OF DIETS

No one can state with assurance what mixture of foods/nutrients constitutes a fully adequate diet for a person throughout the life cycle. Populations subsist on diets in which as little as 2 or as much as 50 percent of their energy is derived from fat and 8 to 20 percent from protein--with almost all or virtually none from animal sources--and in which the carbohydrate is mainly present as refined foods or as crude roots and cereals. The long-term significance of these differences is unknown. Important interactions exist between nutritional and nonnutritional components of foods, such as toxins or fiber, in the diet. Interactions of host factors such as nutritional status and health affect food acceptance and utilization. Some of these factors have been explored in animals but there has not been an adequate study of humans.

The available genetic pool of food plants and animals varies a great deal nutritionally. The nutrient and toxicant content of many crops can be changed significantly by agronomic practice as well as by breeding. Alteration may occur unintentionally due to changes in land and water management, especially fertilization and irrigation practices. Whether such changes in individual foods are beneficial or harmful cannot be determined without knowing more about the role of that item in the diet as consumed. Guidance on the ultimate effect on diet of such changes is necessary to prevent those that are potentially harmful and to encourage those that are beneficial.

The decision maker must be acquainted with the role of foods within the diet, i.e., which nutrients are provided at what levels, by what foods, consumed by what people at varying levels of nutritional state. In the context of a commonly consumed diet, what is the maximum safe intake of a particular food in terms of its nutrient and nonnutrient factors? What nonnutrient factors are present in the food supply of specific

population groups or strata (e.g., alcohol, mycotoxins, antitoxicants)? How do they interrelate with nutritional status? How does the processing and handling of foods affect the nutritional quality of the total diet as consumed? What is the minimum required intake of food classes? What other roles do specific foods serve in the population--traditional, religious, esthetic, status?

Information of this type should indicate, for example, that breeding cereal to improve lysine content is unlikely to improve the nutritional status of a target population, perhaps preschool children, if the problem is that too little food is available in general. It will be totally irrelevant if lysine is not limiting in the diet as a whole. Beliefs and customs may prohibit the use of cereal or adult foods to supplement the diet before a certain age. Or the basic problem may not be due to food supply at all but to knowledge of preparation and sanitation techniques. Even if a problem of lysine deficiency existed, such information still would be needed to evaluate alternative solutions--second cropping, subsidization of supplementary food production or distribution, fortification--in terms of resource and input requirements, yield, acceptability to the population, and probable effectiveness.

Significant relationships among levels of nutrients in the total diet should be considered. Correcting a first limiting deficiency can reveal an undetected second deficiency. A known example is the exacerbation of vitamin A deficiency to the point of blindness which occurred in young children when growth was accelerated by adding skimmed milk devoid of vitamin A to a diet that was precariously low in vitamin A. Taking a prospective case, shellfish culture might be an expeditious way to produce high quality protein, and shellfish are known to concentrate trace elements adventitiously. High intake of shellfish that have accumulated copper from the environment might adversely affect the need for zinc, while selenium-rich shellfish could be of benefit where the environment is burdened with cadmium.

Significant interactions also exist between nutrients and nonnutritious components of foods, factors that cannot be evaluated adequately without knowledge of the total diet and the nutritional state of the people. For example, healthy persons with an adequate diet may easily tolerate amounts of oxalate in a diet that for persons with tropical malabsorption and malnutrition may lead to overabsorption of oxalate with development of stones in the urinary bladder and to calcium deficiency with impaired skeletal mineralization. The malnourished person is thought to

be more susceptible to some environmental toxicants, certain of which are food-borne, as are some diseases.

The spectrum of problems within a diet can be illustrated by noting that excessive bulk in the weaning diet may contribute to nutritional failure in children who simply cannot eat enough of energy-dilute foods to meet needs. The malnourished, disease-ridden older child may also have so little appetite that recovery from disease and catch-up growth thereafter is restricted or impossible in the presence of a fibrous and energetically dilute array of foods. At the same time, lack of bulk in many Western diets may be associated with intestinal disorders such as diverticulitis and colon cancer.

In many instances, diet fortifications have been developed indigenously without scientific recognition of their crucial nutritional impact. Traditional practices, such as the use of plant ash or crude salt, "tempeh" preparations from soybeans and Rhizopus oryzae in Indonesia, the "toddy" of Nauru in the Pacific, yeast-leavened doughs, and lime-treated maize, make key contributions to the total diet and have been widely accepted by population groups. Study of such traditional food processes should focus on their nutritional contributions and should try to improve upon them (increasing yield and assuring safety) rather than replacing them with technological alternatives. Indeed, the highly processed, modified, and fortified U.S. diet should be examined from the opposite perspective as this diet, in many respects, is foreign to the evolutionary experience of the species.

Changes in nutritional status are always mediated by individual and eating group behavior. Therefore, more information is needed about the quantitative significance of the factors that determine consumer-level (individual and eating group) dietary behavior: income, prices, social and cultural determinants of food choices and food distribution within the family, local food production and distribution patterns, household size and composition, and relevant knowledge and attitudes. The effect of both unplanned and planned change in these factors on nutritional status should be assessed. A classic example in this context is the decline in breast-feeding, with its grievous consequences upon the health and nutritional status of infants born to the poor, and the counterproductive advertising of products for bottle-feeding. Generally, there is a need to know what pressures and circumstances lead to wastage of family resources that are needed to promote nutrition. Such assessment implies developing a methodology for monitoring changes and the effects of changes.

RESEARCH NEEDS

The purpose of this research is to define the nutritional quality and safety of diets as consumed in the household, to explore ways in which nutritional requirements and nutritional state affect food use and need, and to exploit opportunities for nutritional enhancement that result from alternative food strategies in the household. Such research will provide guidance to the decision maker with respect to agricultural production issues (goal setting for breeding programs, land/water/fertilizer management, animal production schemes, etc.); incentives to and regulation of the food industry; and evaluation of policies that could affect the availability of particular classes of foods to target populations and individuals. Success in developing behavioral models will allow the identification of intervention points that can be used to influence food consumption patterns. In particular, effective techniques and strategies must be identified that influence eating habits and thus nutritional status.

Two major areas of research have high priority. The first deals with the attributes of food composition and the methods required to determine what foods are eaten by whom and to what nutritional and health effect. The second concerns dietary behavior of persons and groups.

In the first area, a set of alternative, satisfactory patterns of all recognized nutrients in diets should be established for various age/sex/environmental groups, taking into consideration the interactions between nutrients and between nutrients and nonnutritious substances present in food against which intake patterns can be compared for adequacy. Considerations include energy density, fat and carbohydrate compositions, fiber, binding substances, pigments, toxic elements, and the like, as well as the nutrients per se. Questions must be settled regarding the long-term effects of diets differing in proportions and sources of fats, protein, and carbohydrates.

An inexpensive methodology should be developed to monitor short-run changes in food consumption patterns in populations. Household food consumption surveys could be modified to provide more information than they do now. There is a critical need for culturally appropriate and specific techniques for gathering valid and quantitative information on food consumption of individuals within eating groups. The development of new technology for accurate and rapid evaluation of dietary intake must be encouraged. There is a continuing need for fast, inexpensive, reliable methods

for measuring the nutrient content of diets-- particularly vitamins that occur in a variety of forms, both bound and unbound, and the trace elements--and nutrient availability from these diets as consumed by individuals. Techniques for storing and rapidly retrieving this information also will have to be developed, as will means of keying microsurveys into macro-surveys past and current.

In the second research area, household-level food procurement and handling options need to be identified and evaluated. The relationships among sociodemographic variables (income, family size and composition, employment of adults, ethnicity, social networks, information sources, knowledge, and attitudes) and household-level food strategies should be examined in a variety of situations relative to adequacy of the food supply (inadequate, marginal, abundant). These strategies involve questions of household economics, diversity of food procurement, social and cultural uses of food, and the epidemiology of good nutrition where that is the atypical situation.

Knowledge about the handling and distribution of food within the household is especially sparse. Research should identify the factors that determine intrahousehold consumption of food so that the ecological and economic efficiency of households can be raised, subject to achieving a satisfying and adequate nutritional intake. Studies should be designed to indicate which home processing, storage, and preparation techniques are nutritionally beneficial, and how these techniques can be preserved and diffused.

Changes in the dietary behavior of population groups have largely coincided with social, cultural, and economic events. Unplanned changes in dietary behavior should be studied for their impact on nutritional status of individuals in households so that the quality of diets can be maintained or improved in other areas undergoing similar changes in social structure or environment.

IMPACT

This research area, more than any other in the entire Academy study, addresses the concern that, whatever else, science should "do no harm." Change in food systems, planned or not, is inevitable. Both types of change are presently occurring in a near vacuum of information about the nutritional impact of the changed dietary intake. This research is needed to safeguard the quality and safety of that intake.

Neither new food products nor new agricultural technologies will have a significant nutritional impact

unless consumer-level decisions are made that facilitate improving nutritional status. Many such decisions will be made as more resources are placed in the hands of the least advantaged and hungriest people. Experience in the United States demonstrates that high incomes do not necessarily eliminate malnutrition. Without an understanding of why people eat what they do, attempts to eliminate the malnutrition that coexists with adequate resources to obtain a nutritionally satisfactory diet will be painful and an encroachment on human liberty at best, and simply ineffectual at worst. The effect of all nutrition research on human welfare will be increased as we learn more about implementing the results of this research.

High priority should be given to research directed toward populations and subpopulations that are significantly malnourished. However, long-range benefits may well justify expenditures to learn about behavior that maintains adequate nutritional status in the face of environmental and social changes, and determinants of dietary behavior in affluent populations. Food consumption patterns in these populations affect the food available to the rest of the world, often set the pattern for widespread changes in food habits, and determine the nutritional status and functioning of the affluent populations themselves.

RESEARCH CAPABILITIES AND COSTS

One of the first tasks is a thorough review of existing material as it relates to current issues in human nutrition and health. Simultaneously, original research should be commissioned. Wherever possible, advantage should be taken of existing national and international programs, such as the USDA Household Food Consumption Survey, to add items that agree with these objectives, but entirely new efforts will be necessary as well. To conduct successful research, the research must be multidisciplinary, involving social and nutritional scientists and statisticians. Because determinants of behavior and response to change are likely to be so culturally specific, both regional and local studies will be required to provide answers that are useful now in policy formation and that can be systematized and integrated into new theoretical concepts in the longer view.

Much of the research on nutritional adequacy of diets will be country-specific and region-specific, based as it is on local foods and food practices. However, the basic interrelations among nutrients and among nutrient and nonnutrient dietary components and host conditions will be generally applicable and could

be studied by any competent group of investigators in the United States. The land-grant universities, USDA, and other government and private food and nutrition research laboratories would be logical locations for research on diet composition since similar work concentrating on individual foods or nutrients is an ongoing activity.

Efficient utilization of resources for research must be balanced with the necessity for local data on which to base local policy. A certain amount of replication is desirable and necessary, but decentralization of research runs the risk of fragmentation unless considerable care is taken to coordinate efforts. Investigators working in similar conceptual areas in different countries should be able to confer and communicate. International workshops, perhaps on a regional basis, are an obvious means, but informal means also should be available. Adequate data storage and retrieval systems will be needed so that investigators can have ready access to a worldwide information bank, which would need to be updated regularly. Work on development of these systems could begin now in the United States, perhaps under the consortium discussed in the Introduction. However, an international agency with considerable experience and responsibility in the social science/nutrition area eventually should be responsible for coordinating the effort.

Sufficient funding must be available for a diversity of activities, perhaps an additional \$2 million per year at the U.S. national and international level, plus \$1.5 million divided among five to eight countries likely to be involved in specific topics in the early stages.³ Some of the country-specific research related to consumer-level decisions should be undertaken in conjunction with studies of interventions discussed in Profile 3 and would be jointly underwritten in that way. Similarly, much of the information on diets and individual food use would be required as part of the effort described in Profile 1 and the cost is partially allowed for in that research budget.

The timetable for results should be similar to that in Profile 1 for the basic general research: preliminary results based on reinterpretation and extension of present knowledge and research within three years, with almost immediate applicability to governments.

Profile 3

INTERVENING TO IMPROVE THE NUTRITIONAL STATUS OF SELECTED GROUPS

Evaluation is a neglected dimension of nutrition programming. This neglect holds for nutrition interventions in the United States as well as in the developing countries. If anything, more evaluation has been undertaken abroad than within the United States. In 1976, the federal government spent approximately \$7.8 billion on nutrition programs, most of which have not had a thorough, ongoing evaluation. When evaluations have been undertaken either in the United States or abroad, the approaches have generally been narrow, disparate, and of limited comparability.

Several factors explain the absence of evaluation in nutrition programs. Funds have been scarce to set up an intervention, let alone to evaluate it. And evaluation can be quite costly. Evaluating nutritional impact is a technically difficult task, which has been hindered by a lack of knowledge.

The result is a limited understanding of the effect of past investments in nutrition and the effectiveness of alternative interventions that might be considered in the future. Planning decisions are now made without information, or no decisions are made at all. The absence or limited nature of past evaluation efforts also places severe constraints on the data base from which improvements in evaluation methodology could be made. Consequently, the starting point for evaluation research is from ongoing and new nutrition interventions.

EVALUATION METHODOLOGIES

Research Program

A sequence of research topics is necessary to fill out the limited knowledge of how to evaluate nutrition intervention programs:

- Data collection systems. Design economical and manageable data collection systems that can be incorporated into ongoing interventions to generate the information necessary for program evaluation. Institutionalizing evaluation as a standard part of intervention design and operation is a start toward learning more about the effectiveness of intervention programs.
- Indicators of effectiveness (also see Profile 1). Interactive variables such as infections and nutritional status make it difficult to assess the effectiveness of intervention programs, and this problem should be addressed. Certain behavioral outcome variables (e.g., work and learning performance) in addition to biophysiological variables must be considered. Success in overcoming these and other measurement problems affecting the outcomes of nutrition interventions would contribute significantly to the eventual use of benefit-cost analysis techniques in this field. Evaluation difficulties arising from delayed manifestations of the interventions (e.g., improved learning ability) also must be studied. Justification of nutrition interventions should be based on issues of moral equity as well as on economic grounds, and work is needed on indicators and instruments for both.
- Treatment of multiple programs. The incremental, synergistic effects of combining two or more types of interventions require evaluation. It may be that nutritional status must be improved if a sanitation program is to be effective, and vice versa. There also might be an opportunity to reduce costs by combining data collection or delivery systems. This research is critical to designing optimal combinations and desirable sequencing of integrated programs.

The evaluation of nutrition intervention programs involves two basic questions: what to measure and how to measure it. Both present problems.

Intervention evaluation must examine the efficiency of the delivery system, the effect of receiving goods (e.g., food) or services (e.g., nutrition education) on the recipient, and the factors determining success or failure. The techniques for evaluating delivery system efficiency are known, but data collection systems are inadequate. This weakness merits attention, but the more serious problem lies on the program effect side.

Familiarity with the etiology of malnutrition and its physiological, psychological, social, and economic consequences is needed to determine the success or failure of programs. The discussions above and in

Profile 1 point out the need for improved indicators. Evaluation research should go forward with such indicators as are now available but should be structured to test the value of new indicators that might be proposed.

Discerning what outcome variable to measure is complicated particularly by the multiple factors that impinge on nutritional status. For example, disease affects food intake and nutrient absorption, and vice versa. Accordingly, anthropometric measures to evaluate a food intervention might indicate low impact, even though the intervention was being implemented adequately, if the population was seriously affected by illness. Similarly, the food intervention may have a positive effect on morbidity by increasing disease resistance or on mortality by supporting recovery processes. Thus morbidity or mortality, not simply the anthropometric variable, might be appropriate indicators. Furthermore, an intervention may generate behavioral changes in family spending patterns, breast-feeding, child care, community action, family planning, health care, school attendance, and so forth. All outcomes are relevant to evaluation but the interdependency presents a difficult problem in interpretation. Traditional indicators have not been adequate for the measurement of incremental, positive, negative, or synergistic effects of interventions.

Tracing through the chain of effects of an intervention illustrates an additional problem (see Figure 2). The sequential and multiple outcomes mean more variables to measure and greater elapsed time between the intervention and the manifestations. The time lapse could be many years, for example, preschooler feeding and subsequent productive performance as an adult. During this period the related and unrelated variables impinging on the outcome indicator may well be innumerable. Analyses that move backward on the chain reduce the elapsed time problem, but extrapolation techniques then must be used that have not yet been proven appropriate. Nutrition evaluation efforts to date provide little guidance as to what short-term behavioral phenomena to measure and what measurements to use to measure them.

APPLYING EVALUATION METHODOLOGIES

Direct Food Interventions

Research in this area should pull together the experience generated by many years of intervention programs and experiments (and conduct new experiments where needed) to assess the role and effectiveness of

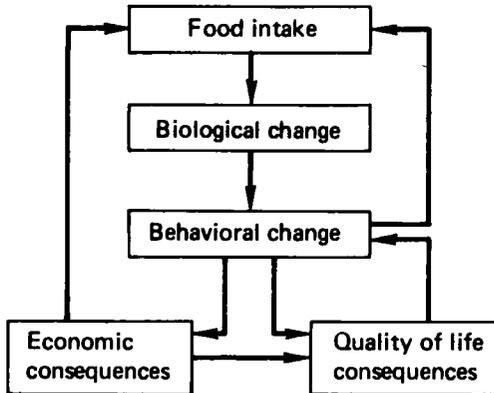


FIGURE 2 Chain of effects of a nutrition intervention.

different kinds of direct food intervention programs, and to identify factors that influence success and failure of such programs. The programs include:

- Direct feeding programs and "take-home" food distributions. This form of intervention through schools, health facilities, factories, and welfare agencies is by far the oldest, most prevalent, best known, and largest of all direct interventions.
- Multitiered pricing system. These direct interventions and experiments can range from government sales of staples at less than market prices in fair price shops to subsidies for food producers to consumer subsidies (via food stamps or coupons) which enable purchase of weaning foods, milk, or food in general in existing retail markets.
- Direct rationing of basic commodities. Such interventions are aimed at limiting the effect of high purchasing power on basic food prices and hence on access to basic foods for the poor.
- Nutrient supplementation. Many fortification schemes have been introduced both by legislation and by industrial initiative. There is little proof that many have been effective--exceptions are the addition of iodine to salt and vitamin D to

milk. Other schemes include dispensing vitamin-iron capsules to pregnant women, vitamin A to children, and so on. While these actions are individually effective, their ability to promote sustained improvement has not been adequately tested.

- Introducing foods new to specific cultural settings. Powdered milk has been introduced to the Bantus, margarine to the Turks, and age-specific processed foods such as Bal Ahar and Bal Amul have been widely introduced in India. Other examples exist that have proven to be failures. Interventions in the form of "new foods" are being proposed and experience with this form of intervention--successes and failures--needs to be carefully assessed.

Nutrition Education

Virtually every country can claim to have this form of intervention. Little is known, however, about effectiveness at the behavior level in contrast to knowledge imparted. Why is product advertising more persuasive than educational messages? What should be taught and to whom? Is education more effective if introduced at the family level, school level, or community level? By educators, peer group members, or leaders?

Health Environment Interventions

Health sector interventions have attempted to eliminate vectors of disease or to interrupt cycles of disease transmission by prophylactic immunizations. These programs are justified without reference to their nutritional impact. However, it can be argued that where populations are both malnourished and diseased, neither direct nutrition interventions nor health measures will be as effective alone as together. Immunization is not fully effective in malnourished children and iron supplementation cannot fully correct anemia if intestinal parasitism is rampant due to poor sanitation. Documentation would be useful in several areas:

- water supply, including regional or seasonal shortages of water, decentralized sources of water, or economically feasible systems to deliver a sufficient quantity of clean water at the household level (it is most logical to deal with sanitary waste disposal at the same time);

- intrauterine environment with respect to maternal malnutrition, particularly calorie deficits, intrauterine infection, or both;
- lactation and breast-feeding, especially the effects of quality, quantity, and duration of breast-feeding on the immune mechanism of the infant, nutritional status of mother and child, and fertility and contraception;
- delivery systems integrating nutrition, health, and family planning and the effectiveness of this concept.

IMPACT

The proposed research is fundamental to effective nutrition planning, which in turn is essential to efficiently allocate resources to achieve maximum program effectiveness. There will be an immediate payoff to planners in the short run. By refining current methodology as well as developing new indicators, instruments, and analysis procedures in the medium term, the entire decision making process is further sharpened.

RESEARCH CAPABILITIES AND COSTS

The recommended research requires both conceptual and field work, existing and new projects, short-run and longitudinal projects, and high-income and developing nation settings. This diversity necessitates that many institutions participate.

International and national nutrition research centers, or other appropriate centers, should receive special funding to further develop their capacities for an evaluation methodology which concentrates on research projects and operational interventions. Funding institutions must explicitly incorporate evaluation components as a significant part of the nutrition intervention programs that they finance. Technical assistance should be provided where necessary, including training of intervention operation personnel. Universities, voluntary relief agencies, relevant U.N. agencies (World Health Organization, the Food and Agriculture Organization, UNICEF), and private research and consulting institutions, as well as the bilateral and multilateral development agencies, are sources of expertise that can be drawn upon to develop methodology as well as to provide technical assistance.

In both the national and international setting it is essential to lodge research on implementation in a disinterested home. Donor countries and U.N. agencies

are limited in their willingness to issue research reports which may be interpreted as critical of governments for obvious reasons. Similarly, health or education agencies are not disinterested parties in assessing the effectiveness of nutrition intervention programs through health or education channels.

Much of the research on quantifying biological and behavioral outcomes falls into Profile 1. The additional budget necessary to ensure that the work is relevant for evaluation purposes need not be large. To start, the individuals and organizations interested in developing this research could probably spend \$1 to \$2 million per year productively over the next five years. Twice that amount could be spent after five years as the techniques of quantification become less experimental and more programs develop for evaluation.

The volume of funds needed for research on food-related interventions depends in part on the stage of development of methodological research. Assuming that the methodological research is funded and ongoing, it would make sense for perhaps a dozen such interventions costing about \$300,000 each to be instigated under this umbrella. Roughly half of these projects should be directed at analyzing specific ongoing intervention programs which are clear-cut successes or failures. The others should be looking somewhat more broadly for general lessons and at the role of new technology in intervention schemes.

New data and analysis systems for health environment interventions, even if added to planned or existing environmental interventions, will be expensive. It seems unlikely that more than the five outlined projects could be effectively undertaken with present human resources, and each could cost approximately \$500,000 per year.

Profile 4

NUTRITIONAL IMPACT OF GOVERNMENT POLICIES

Most government policies are formulated, implemented, and changed with little if any consideration or understanding of their ultimate nutritional impact. As a result, the nutritional status of needy groups can be affected quite inadvertently in a variety of ways ranging from highly beneficial to perverse. This profile seeks to establish a better understanding of the nutritional implications of policies dealing with food and agriculture, distribution and marketing policies, and general government policies.

NUTRITIONAL IMPACT OF FOOD SUPPLY POLICIES AND PRACTICES

Many of the nutritional consequences of food and agricultural policies occur by happenstance. Targets for food production programs usually are based on aggregate projections of demand, growth in per capita income, elasticities of demand for specific products, and population growth rates. Agricultural production also is shaped by export considerations, desire to minimize dependence on imports, industrial requirements for raw materials, and concern for price stability.

When supply strategies are formulated, the relationship between increases in food supply and the circumstances of the malnourished is seldom explicitly taken into account. Calculation of the aggregate (and potentially misleading) national per capita availability of specific foods or nutrients is ordinarily the closest attempt at considering nutritional need. Explicit measures to raise the effective demand of the poor are almost never taken. Nor are agricultural research efforts usually designed with an acknowledged concern for the nutritional content of output, especially of foods largely eaten by the poor.

Price supports, research policies, qualitative grading of crops, infrastructure investments, extension coverage, and so on can be used as specific means for bettering nutrition via agriculture. Whether the use of such tools on behalf of nutrition would be high cost or low cost is not known. But methodology presently used for aggregate agricultural sector analysis, and for preparing and implementing development plans, would permit a significant increase in knowledge about potential nutritional impact of various policies if the questions were asked at a disaggregated income level, the necessary data gathered and organized by such levels, and the analysis performed. Areas that should be included in the analysis would be expected changes in intake of energy, protein, and other nutrients, disaggregated by income groups and/or by age and sex, by region, and by urban and rural areas. At the moment it is easier to predict changes for urban groups than for rural groups, and for landless rural than for subsistence farmers. This research would evaluate nutritional impact at the point of access to food. Research in the earlier profiles provides guidance on how such access is translated into nutritional status and performance.

Research Program

Of the wide range of policies that affect nutritional status, several deserve priority:

- Production strategies. What are the effects on nutrition of such agricultural production policies as (1) concentrating on commercial crops versus subsistence crops; (2) promoting monoculture grain strategies versus highly integrated, small-scale "closed systems"; and (3) assisting more productive, large-scale farmers versus needier, small-scale farmers? Where do landless laborers fit into the strategy?
- Agricultural research strategies. What will be the nutritional impact of research on cash crops versus food crops? On foods consumed by the rich versus food staples of the poor? What are the nutritional gains/losses to the poor of seed breeding programs that concentrate on yield? What are the quantity/quality trade-offs of seed research programs designed to increase certain amino acid levels in major food crops? To what extent can research on different crop mixes and multiple cropping systems be designed for nutritional impact? What nutritional benefits to the poor may result from research on fish farming and

- aquaculture? From research designed to improve livestock? Can such research take into account the entire agricultural/nutritional system whereby livestock provides farm power, rural energy through methane conversion of manure, and food for rural and urban populations?
- Agriculture extension programs. What nutritional impact have these programs had in the past? What impact would result from reorienting extension services to different crops? To different clientele? To what extent could extension serve as a vehicle for educational programs linked to the agriculture/nutrition interaction?
 - Rural credit programs. Which crops are eligible? On what inputs can credit be spent--why on tractors but not on day laborers? In short, what will be the ultimate nutritional impact of rural credit programs? What changes could be made?
 - Food self-sufficiency. Is "food independence" the most effective way to achieve nutritional well-being? What is the nutritional potential of an indigenously produced diet? What are the nutritional advantages (if any) of such a diet relative to the economic costs of any comparative advantage foregone? Also at issue is the degree of food independence. Should a country strive to be self-sufficient in bread but not flour; in flour but not wheat; in wheat but not combines; in combines but not in diesel engines or diesel fuel?
 - Food aid. In what contexts can food aid make important contributions to nutrition? Are there situations in which the secondary production and distribution consequences outweigh the short-term gains? Would food aid be more effective in a strictly market context? For example, would P.L. 480 Title II food commodities normally distributed through special programs, e.g., school lunch and maternal-child health care programs, have a greater nutritional impact if they were sold through regular channels?
 - Resource use. Is there a conflict between dietary patterns of wealthy countries and adequate food supplies for poor countries? The natural resources needed to feed the average citizen in the United States are several times greater than those needed to feed adequately a citizen of India or China. Part of the difference is in the utilization of nonrenewable energy resources to fuel tractors, trucks, automobiles, and factories instead of the utilization of human energy and hence food energy of more labor-intensive systems. Another part of the difference is the large amounts of animal products consumed in societies as wealthy as the

United States or West Germany, animal products that are produced with large amounts of grain. Conversion of grain to animal calories and protein is not an efficient process relative to human requirements. Hence the resource intensity of affluent diets is greater than is nutritionally necessary.

The distribution/access issue exists within and between countries. The issue has both national and international dimensions because there are wealthy consumers with expensive diets in poor countries and poor consumers with inadequate diets in wealthy countries. In addition, evidence is strong that societies presently consuming large quantities of grain-fed livestock products would have substantial health benefits if they were to reduce such consumption. Research is needed to clarify and quantify such benefits and to examine the nutritional impact of the long-run changes in production and trade patterns that would result from markedly lower consumption of livestock products. For example, the redistribution of cropping patterns in the United States that would result from lowered demand for grain-fed meat and livestock products could lead to significant reductions in the amount of fertilizer presently used in the corn belt. Such reductions might mean easier access to fertilizer supplies and lower prices for the developing countries. Increased fertilizer usage, which, as indicated in Profile 2, should be examined for its indirect nutritional impact, would result and would increase food supplies in the poor countries themselves. Whether such a scenario has any potential relevance in the real world is problematical. But the issue of the resource intensity of U.S. agriculture and the diet it supports, in the United States and wealthy societies abroad, should not be dismissed lightly. It is an issue in which good research could cast a great deal of light while dissipating much of the heat.

NUTRITIONAL IMPACT OF FOOD DISTRIBUTION AND MARKETING POLICIES AND PRACTICES

Farmers do not produce nutrients, the marketing sector does not market or price nutrients (with the small exception of vitamin pills), and consumers do not purchase nutrients. It is no wonder then that traditional research on the food and agricultural sector has focused on increasing yields of crops, transforming crops into foods, and the purchase and

consumption of foods. Very little is known about how nutrition fares along the way.

Research Program

Marketing transforms a product in time, place, and/or form. Within this definition there are a large number of operations on a crop or food between harvest and consumption. Government policy (and nonpolicy) provides an environment for the marketing sector to perform these operations--transportation, storage, processing--and research is needed to determine the effects of variations in that policy environment on nutrition. The following topics provide a starting point for determining these effects:

- Price policy. What are the nutritional effects of (1) price supports for farmers who raise the basic crops; (2) retail subsidies of food grains in urban areas; (3) price subsidies for agricultural inputs; and (4) a subsidized distribution and marketing system for the basic food grains, e.g., subsidized food transport, as in China, to make food more accessible to the poor consumers?
- Marketing technology. Does the technology of marketing and distribution have important consequences for nutrition? Does it make sense nutritionally to remove nutrients from foods by processing and then to put them back in by fortifying? Can large firm size and modern marketing techniques, especially advertising, be channeled into nutritionally beneficial activities--promoting breast-feeding, adequate food supplements, and the production and low-cost distribution of high quality foods--instead of promoting bottle-feeding or soft drinks?
- Delivery systems. How are modern supermarkets different nutritionally from the traditional small markets? Should small traditional food stalls be encouraged or discouraged? What are the nutritional changes resulting from the increased popularity of fast-food chains?
- International trade. What are the implications of exporting cash crops or their by-products from poor tropical countries to richer temperate countries? Does the income advantage of such trade get translated into improved nutritional status? If not, should the trade itself be stopped (unilaterally by poor countries, by rich countries?) or can subsidiary food production programs be developed to circumvent the unfavorable nutritional effects of the trade?

- Grain buffer stocks. What are the implications for nutrition of successful multilateral negotiations on grain reserves and internationally available grain supplies? What are the nutritional ramifications for supplying countries, for receiving countries? (The impact on receiving countries will be determined largely by the quantities of grain consumed, and by whom, relative to amounts consumed in the absence of reserves, and what the opportunity cost substitutions would have been. The nutritional impact of supplying countries would have to be traced through the price impact, probably via the impact on livestock feeding and any ultimate changes in consumption of meat and livestock products. It is important for both groups of countries to study the particular groups in those countries who are mainly affected.) Which types of grains or other food products should be included in buffer stocks?

NUTRITIONAL IMPACT OF GENERAL GOVERNMENT POLICIES

A country's nutrition programs, food and agricultural policies, and international trade issues all work within the framework and constraints of a set of general government policies and procedures. Monetary and fiscal policies (especially taxes), interest rates, exchange rates, budget processes, the actions and roles of regulatory agencies, and even highway location and transportation infrastructure have their nutritional impact when the effects are traced step by step through the economic and social system. Much of this impact will have been uncovered by research described in Profiles 1, 2, and 3, but an effort should be made also to piece together the complete picture.

Research Program

Major research issues include:

- Development strategy. Some evidence suggests that many current development strategies are incompatible with nutritional well-being. Research to determine the relationship between development strategy and potential for nutritional change would be important in its own right as part of understanding long-run development processes. For the short run, such research could identify policy environments in which programs and policies for

consequential nutritional change stand a high probability of success and where they do not.

- Income redistribution policies. Guaranteeing adequate access to food is always an implicit, and frequently explicit, goal of income redistribution policies. But little is known about how and to what extent access to food and nutritional status change under the various instruments of income redistribution that lie within the constraints of political feasibility for different societies. Some of the most important topics to study would be land reform, progressive income taxes coupled to social programs, and investment in human resources of disadvantaged groups.

In this connection, it may be feasible to develop a "cost-of-adequate-nutrition" index. All-purpose cost of living indices are very inadequate for measuring the effect of substantial price changes where income distribution is sharply skewed, and hence consumption patterns vary widely. Research to develop a cost-of-adequate-nutrition index would determine what items would be representative of the diets of the marginally nourished population, and the potential uses governments might be willing to make of such an index for policy formulation.

We received a number of suggestions for the study of political change as a determinant of nutritional change, but we concluded that the research described here would be more useful if it focuses on the effects of policies and policy changes that are feasible within existing political institutions.

- The budget process. Many of the political priorities of a society are reflected in the formation of its national, regional, and local budgets. Where does nutrition stand in this process, both directly and indirectly? It is not easy to change budget allocations without a quid pro quo, but changes that favor improving nutrition are unlikely to happen without research that shows the actual nutritional effects of existing or proposed budgets. Some nutritional improvements may have very low price tags, either financially or politically. Without the research, we simply do not know.
- The policy process. Many policies that do not involve major direct budgetary considerations could have significant nutritional implications. Interest rates, for instance, may strongly influence the choice of technology used in industry, construction, and agriculture. The choice of technology is an important determinant of

labor absorption and hence of income distribution. Similarly, changing international fishing rights boundaries from 12 to 200 miles can be done administratively with a relatively small budget. What are the nutritional implications of such a change?

- Food and nutrition policy. Is it possible to finance and carry out research and implement research results in the face of existing, rampant nutritional ad hocery? Perhaps it is not research. Certainly it is a very different type of investigation from the research that has come before. But the questions remain: What are the components of a food and nutrition policy? Who should organize it, coordinate it, and carry it out? How much bureaucratic muscle will the agency need? How much money? What kind of people are needed and who can train them?

IMPACT

The failure of the Green Revolution to have a marked and visible nutritional impact except in certain very special circumstances and countries stems not from the Green Revolution itself but from the institutional and policy context in which it was adopted. Changing credit policies from favoring large to favoring small farmers, changing a farming strategy from tractor-intensive to labor-intensive, and changing land tenure so that cultivators have more or less equal land holdings would revolutionize the context of the Green Revolution for many countries, and would rapidly improve the nutritional status of the population presently most disadvantaged. The Chinese experience demonstrates that vigorously implemented government policy can eradicate the most obvious forms of hunger and malnutrition. The research question for concerned countries is what components are responsible for improved nutritional status and can they be transferred piecemeal? If they can, this research could solve the gross aspects of hunger and malnutrition in the short run for any country willing to make the effort and the policy changes.

On the international side, reducing consumption of resource-intensive livestock products by wealthy consumers may, in addition to freeing up resources for the hungry world, reward the former with better health. Consequently, legitimate analytical questions must be answered. Apart from quantifying the health benefits for the wealthy consumers, which have been estimated at over \$60 billion for the United States alone, the long-run nutritional impact on poor countries and on

individuals needs to be examined. The impact will be indirect, but large. For instance, if the fertilizer that generates just one-quarter of the U.S. corn crop were ultimately to be directed toward grain production abroad for direct human consumption, more than 50 million tons of additional grain would be available in the countries where it is needed. The numbers are large enough and the issues important enough to justify the funds for dispassionate, objective research.

Portions of this profile may not be "research" in the conventional sense. After the first methodological models have been worked out to provide both a theoretical framework and an empirical foundation for the connection between government policies and nutritional status, the rest largely will be routine analyses of the effects of policies. These analyses are not, thereby, less valuable to the country concerned. The political willingness to go forward with such research and analysis can be the critical first step toward building an awareness of nutrition into planning agencies. It is important to develop a number of successful models that show some of the alternatives available to a country bent on improving nutritional status. The research and analysis outlined here will be looking for and assessing those successful models and will place them in comparative perspective.

RESEARCH CAPABILITIES AND COSTS

The research called for is multidisciplinary in nature although the organizing principle is primarily economic. The principal investigator for this type of research should be an economist skilled in development planning and agricultural sector analysis and familiar with the nutrition problems of his or her country. The research team would require contributions from (1) nutrition scientists who are knowledgeable about the nature, extent, and location of nutrition problems; (2) agricultural scientists who are involved with the nation's agricultural research and extension program; and (3) political scientists who can translate national policy statements into their ultimate effects on individuals.

The logical home for such research will depend on national circumstances. The research arm of the national planning agency has distinct advantages in terms of data availability and familiarity with the planning process. Perhaps the best solution would be joint involvement with a high quality national university.

Research on national issues should always be done by national citizens if possible. Some have argued

that nothing is so important as justifying the use of foreign nationals as technical consultants, working directly for or under the aegis of various international or bilateral donor agencies. However, this view eliminates the possibility of promoting common interests between developing country needs and opportunities for young scientists and economists from the high-income countries to become professionally (and emotionally) involved in solving the food problems of poorer countries.

Given a willingness and some reorientation of interests, a number of logical homes exist for the international research, and some duplication and competition probably would be desirable. Certainly the International Food Policy Research Institute (IFPRI), AID and other bilateral assistance agencies, and the network of international agricultural research centers are competent and have existing mandates that would permit research and/or funding in the directions indicated.

This type of research is not expensive compared to that described in the preceding profiles, provided that many of the findings of that research are available for this work. This does not mean the research will be easy. Nutritional status is the end product of forces and factors from nearly all parts of the economy and the society. To understand the direction and magnitudes of all the interactions is impossible. Formal models that even attempt to approximate this situation will be extraordinarily complex and expensive to build. Since the major components will be built for other than nutritional research and planning purposes, research initiated under this profile should provide funds for an add-on capability for large-scale agricultural sector models to incorporate disaggregated nutritional effects.

Short-run results can be provided more cheaply by asking skilled observers of development processes to make rough judgments about nutritional effects of certain policies. These will be nonreproducible and will depend heavily on the skill and experience of the observer, but the results may well provide critical ballpark estimates that would be adequate for early stages of planning. Research funds to develop working guidelines for this type of analysis could significantly improve performance.

Given present constraints on the availability of data sets with appropriate variable specifications, of methodology for disaggregated impact assessment, and of skilled researchers, significant results from the complex modeling are likely to take 3 to 5 years. A team of five professionals with up to \$2.5 million could probably achieve a major understanding of the

international research questions in this time. Another team working on the development strategy and income distribution issues could, with similar resources, generate important results in the same time frame. Achieving an understanding of other national programs and policies could be done with smaller resources, but naturally these resources would be needed for each country individually.

Appendix A

SELECTION OF RESEARCH TOPICS

CONCEPTUAL APPROACH

Study Team 9 worked backward from the accepted goal of ensuring adequate nutrition to all individuals through the various limitations in our knowledge as to how the goals could be achieved. It was quickly obvious that much of what we still need to know does not involve fundamental issues in nutritional biochemistry but rather requires understanding policy processes, the economics and sociology of intervention projects, and broad interactions between public health and nutritional status. We decided that clarification of these issues, much of which could be either quickly done or short-circuited entirely with adequate political commitment to a well-fed population, were of high priority and well within our mandate.

In this manner, we recognized that certain kinds of action need not wait for research results. But we also realized that many governments remain unconvinced of the necessity or desirability of a full commitment to adequate nutrition and that the best form of persuasion in these cases would be research results that clearly demonstrated the functional significance in broad behavioral terms of malnutrition.

A major difficulty is that policy and methodological research are relatively nonquantitative (and hence unpersuasive to most planners) in the absence of the applied human nutrition research. Likewise, the results of applied human nutrition research will sit on a shelf unless we better understand how to implement them effectively, an understanding that can come only with research. Consequently, we concluded that the set of research topics needed to be treated as a single conceptual package. Picking one topic for funding while denying it to the others (unless funds for these were forthcoming from other sources) will run the risk of neglecting areas of knowledge that may be essential for

effectively applying research and, indeed, for reasonable confidence in selecting particular interventions. Perhaps more importantly, it is likely to prevent gains in crop and animal productivity (generated by the research topics of the other study teams) from having the desirable nutritional impact on vulnerable groups that is possible if better understanding of distribution mechanisms and ultimate nutritional requirements and outcomes can be achieved.

CRITERIA FOR TOPIC SELECTION

Criteria used to decide which topics were important enough to be included and which justifiably could be neglected included:

- How important is the problem that the research is designed to solve? What contribution will the research make to this problem?
- Can the research be done? Are the personnel available? Are the research institutions adequate if money is found? Will training programs be needed immediately to undertake research in developing countries over the next 5 to 10 years? Will the results from research at one location be specific or broadly transferable?
- Would the research present us with new knowledge so that the correct decisions can be made in the field of agricultural or nutritional planning and interventions?
- How long will the research take?
- Is the research topic, even though highly important by the above criteria, already receiving adequate attention by existing research groups? If so, we believe that omission from treatment in a research profile should not be viewed as downplaying the importance of a topic.
- We also asked at each stage of the discussion whether the particular research question was likely to be adequately treated by other study teams of the World Food and Nutrition Study. In this regard, we served as an ad hoc review committee, with members examining the nutritional consequences of research profiles of other study teams and passing findings, as appropriate, to Study Teams 10 (Interdependencies of Food, Population, Environment, and Energy) and 13 (Research Priorities). On certain topics we directed specific recommendations on priorities to relevant study teams.

Appendix B

THE MALNUTRITION PROBLEM

In low-income countries malnutrition is a problem of substantial proportions which contributes significantly to high mortality rates and to the generally poor level of well-being among the survivors. A recent World Bank study of calorie consumption during the mid-1960s estimated that 55 percent of the population in the developing countries (850 million people) had calorie-deficient diets in excess of 250 calories per day. The proportion of today's population may be slightly less, but the numbers are probably similar. Although increased food production has improved per capita food consumption in most countries, the consumption of the lower 40 percent of the population has risen only slightly, if at all.

Nutritional deficiencies affect all age groups, but the toll is greatest among the very young. The Pan American Health Organization identified malnutrition as a primary or contributory cause in 57 percent of all deaths in children aged one to four in Latin America. FAO estimates that as many as 30 percent of preschool-aged children in low-income countries suffer from second or third degree malnutrition (below 75 percent and below 60 percent, respectively, of standard body weight per age); an additional 40 to 45 percent of the children have first degree malnutrition (75 to 90 percent of the norm).

Of the nutrition problems found in low-income countries the most prevalent include protein-calorie malnutrition, iron deficiency anemia, and vitamin A deficiency. In most cases, these interact with infections and childhood diseases in ways that exacerbate both problems.

Protein-calorie malnutrition during the fetal period and in early childhood is associated with both physical and intellectual impairment. FAO reports that more than 300 million children are afflicted with grossly retarded physical growth. Small stature often reflects other subclinical disabilities and may be

related to a shortfall in performance. More than two-thirds of the children in many low-income countries suffer from iron deficiency anemia. A similar incidence of iron deficiency among pregnant women contributes to low birth weights and premature births. In some areas 70 percent of deaths in the prenatal period are of low birth weight. Vitamin A deficiency, common in up to half of the children in low-income countries, affects growth, vision, and the severity of other nutrition-related illnesses. At least a million cases of blindness in India are a direct result of inadequate vitamin A intake, and this estimate may be conservative and misleading since children blinded from diseases brought on by inadequate vitamin A often do not survive. In addition to every case of total or near-total blindness, 10 to 15 people are unable to see in dim light ("night blindness") and suffer other ocular manifestations of vitamin A deficiency.

IMPLICATIONS OF MALNUTRITION

The effectiveness of improved nutrition as a means of reducing the severity of childhood infections and of preventing forms of retardation, blindness, anemia, and other problems discussed above has been established for some time. This is of itself sufficient justification for investing in better nutrition. The significance of nutritional status, however, goes beyond human well-being although the relationships only recently have been advanced and as yet are less clear.

Education

Recent research suggests that returns on educational investments have been reduced by insufficient attention to nonschool factors, among which nutrition ranks importantly. Because malnutrition interferes with a child's motivation and his or her ability to concentrate and learn, one can conclude that it limits the potential payoff of an investment in education. Typically a malnourished child is listless, lacking in curiosity, and unresponsive to maternal and other stimulation; the mother herself is often a victim of nutritionally induced lethargy. If this were not a sufficient disadvantage, malnourished youngsters also fall behind because of their frequent bouts with nutrition-related illnesses. In four Latin American countries children missed more than an average of 50 school days a year because of illness; this constitutes as much as one-third of the scheduled school days. The frequently

absent, malnourished child often is unable to cope with the school situation and drops out. However, school performance is affected by a child's home and school environment, and nutritional improvement alone may not significantly better the learning capacity of the child disadvantaged in many ways. There is little doubt, however, that malnutrition contributes to poor performance, to the low aspiration to higher education levels, and to the substantial student dropout rate often found among the poorly fed portions of the population.

Family Planning

In many poor areas, where large percentages of children die before reaching a productive age, uncertainty and the overcompensation it induces are often assumed to be major factors in the bearing of large families, e.g., seven or eight offspring. Substantially lowering child mortality rates as a means of influencing birth rates is not sufficient of itself. Overcoming malnutrition, which is the prime contributor to child mortality, may be a powerful factor in lowering the population growth rate in the long run.

Productivity

Little study has been made of the relationship between malnutrition and productivity other than the effect of inadequate calories where the loss of productivity is clear. (Men living on 1,800 calories a day have been shown to lose 30 percent of their muscle strength and 15 percent of their precision in movement.) One could assume, however, that overcoming other nutrient deficiencies may overcome a debility that reduces a worker's productive capacity, return an absent worker to the active labor force, lengthen his or her working life span, and perhaps improve an individual's comprehension and retention of things taught. Such results increase the flow of earnings above what it would have been in the absence of improved nutrition and health.

Other Implications

A higher incidence of communicable diseases among poorly nourished people increases the exposure of these diseases to others. The poorly nourished worker (or the poorly nourished child when he or she enters the labor force) will be less likely to improve the living

standards and probably the future productivity of his or her dependents.

For societies that place a premium on social mobility, intellectual loss caused by malnutrition may be the strongest obstacle to attaining this goal. The chances a malnourished child has for advancement are greatly restricted no matter what else is offered by education or other means designed by policymakers to facilitate upward movement within a society.

People who are apathetic and physically drained by anemia or debilitated by frequent bouts with nutritionally-related diarrheas cannot enjoy a wide range of noneconomic goods that are not quantifiable in the national accounts. It is well-being more than income that determines whether a person has the capacity to enjoy the fundamental sources of satisfaction.

NOTES

1. The critically important relationship of population growth to food and nutrition is treated in the report of Study Team 10.
2. A recent report on past, current, and future directions of nutrition research for health, child development, performance, behavior, and life expectancy in the United States appears in the Report of the President's Biomedical Research Panel, Interdisciplinary Cluster on Nutrition, Appendix A; USDHEW Publication No. (OS) 76-501, 1976.
3. This assumes that ongoing research and large U.S. data collection systems can be modified to take into account issues raised here, for example, changes in questionnaires for household food consumption surveys. Otherwise an additional \$2 million per year would be necessary.

Report of Study Team 12

NEW APPROACHES TO THE ALLEVIATION OF HUNGER

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INTRODUCTION

...and hollyhocks that aim too high,
red into grey and tumble down,
late roses filled with early snow....

T. S. Eliot, "East Coker"

Study Team 12 was asked to take a "blue sky" look at the future; specifically, what can the United States do outside of the area of food production to help reduce hunger around the world? To answer this question, we looked at: the myriad possibilities for food use from harvest to eating, including losses of food nutrients after harvest and in storage; a society's definition of what is edible; how a society distributes income, food, and health services among its people; why people eat what they do and how diets change; and what has been and could be done in all these areas to improve nutrition and reduce hunger. We looked for both conventional and unconventional technology with long-term potential and for new social and administrative techniques.

Our report's analysis and discussion are based on two perspectives. First, behavior toward food is culturally determined. Second, and somewhat surprising to us, nutrition, hunger, and health are related not only to the food consumed but also to the quality of a person's life and thus to the quality of each society. As Knutsson (1973) states, "Nutrition is an integral aspect of the total context of our social and cultural reality." The nourishment of a child depends on psychological factors such as the quality of mothering as well as on food; an adult may be malnourished from a lack of meaning, purpose, and fulfillment in his or her life as well as from a lack of food. Techniques that increase the consumption of nutrients may change a society in ways that lessen its ability to "nourish" the individual and may cause a net decline in nutrition and health levels. On the other hand, an increase in the well-being of individuals may improve nutrition without an increase in food consumed. In short, food

and society interact to "nourish" the individual (Craviota and DeLicardie 1973).¹

We were asked to predict the effects of new technology on hunger and nutrition in future years. Given this holistic nature of well-being and nutrition, the introduction of new social programs will affect nutrition differently in each society. Without detailed studies of the programs and techniques of specific societies, we cannot pretend to estimate the effects of proposed research and new technologies on worldwide nutrition and social well-being. We will, however, recommend two instruments--quality of life indicators and nutritional impact statements--that could determine nutritional impact.

Our charge is to survey the social sciences to find research possibilities that promise long-term improvements. This study team, coming from widely different backgrounds, found that we had to base our discussions and analysis on four assumptions:

- Countries typically will seek improvement by reform and adaptation rather than by revolutionary social transformation.
- The social traditions and values of each people are of utmost importance. Thus self-help and self-reliance are fundamental; people must be free to make choices about national power, economic interdependence, levels of nutrition, and quality of life. But to do this, they must have a large variety of technological, economic, and political alternatives from which to choose.
- Relying primarily on technology to solve the problems of nutrition may result in greater misery and starvation over the next century. Moreover, it places inordinate expectations on science. We feel that the chances for successfully solving these problems are reasonably good if countries first define their overall economic, ecological, and environmental objectives and then utilize and evolve policy and technology in a tailored fashion that would help them achieve their national goals.
- There are no simple causes or nor simple solutions to problems of nutrition and hunger, nor are there solutions that can come readymade from other countries. Effective change will require a great deal of experimentation and local innovations, and will happen slowly.

Today Americans are presented false alternatives about world hunger. On the one hand, it is argued that the plight of the poor is not our fault or responsibility, and a policy of isolationism is urged. On the other hand, it is argued that the United States

must relieve suffering and hunger in the poor countries, and international activism is advocated. We feel that the first alternative leads to moral and political bankruptcy, while the second alternative is impossible since we cannot control the population and food policies of other countries. The proper course is to differentiate U.S. responsibilities and opportunities from those that the developing countries must bear.

In these terms, we will develop three themes. First, how much food is available and how well it is distributed are important but are by no means decisive in determining the direction in which change occurs. Some countries that seek to help their poorest people by providing basic education, simple health services, and productive possibilities do better at improving the overall quality of life and nutrition than do countries that concentrate mainly on general economic growth or simply on food distribution programs.

Second, there are no Northwest Passages via technology or administrative techniques or foreign aid to alleviate hunger markedly. Expanded technological choices, improved understanding of the consequences of these choices, and village and urban community development programs would help immeasurably to bring improvement. But only the individual developing countries can make the interdependent decisions on population and environmental controls, food production, and income distribution that will basically determine their futures.

Third, if the United States is serious about improving world nutrition, then U.S. responsibilities and opportunities lie in building an international economic order in conjunction with other nations that allows developing countries to choose their own futures in a manner that takes cognizance of population and environmental limits.

Thus this study team, which at first set out to examine promising new means of feeding people, later found itself emphasizing research that would allow nations to be more self-reliant and to increase their well-being by making tough choices from a broad range of policies within a favorable international economy for which the industrial and energy-rich countries must bear the greatest responsibility. Prosaic, but full of promise for a truly "blue sky" future.

WHAT IS NUTRITION?

Food alone does not mean growth and health. There are societies in which the calories consumed are at or below minimum standards and yet where people are

vigorous and healthy, even into very old age (Leaf 1973).² Conversely, infants may stop growing physically when deprived of love and human contact even if they receive "adequate" nutrition (Gardner 1972).³ In effect, we do not know, except for basal metabolism, how many calories are needed for people to live their daily lives. There is not yet any satisfactory way to specify the characteristics of good nutrition for people within a social setting, much less to quantify the full meaning of this objective (Giffit et al. 1966:188, Scrimshaw 1976).⁴

Calories, proteins, and other nutrients are indispensable, but how successfully a society creates a good life for its people is also nutritionally important. During the Second World War, food availability went down in the United States while the overall health of the population improved. Although health was probably somewhat improved by reduced "overeating," it also appears that a sense of purpose or meaning in a person's life can compensate for a decline in food consumption. Perhaps the body makes more or less efficient use of nutrients depending on a person's psychic state at the time. Perhaps the social setting of the individual makes a difference to his or her nutrition and health. If nutrition, health, and well-being interact with one another, then nutrition cannot easily be isolated as a separate object of study (Bettelheim 1960, Craviota and DeLicardia 1975, Giffit et al. 1966:187-193, Knutsson 1973, Leaf 1973).⁵

Nutritionists concentrate on the metabolics of food intake. They attempt to define the optimum or minimum amounts and types of diets that are required to achieve and maintain health throughout the span of human life. Based on their work, international and national agencies have devoted a great deal of effort to defining the causes of malnutrition in terms of specific quantitative deficiencies of calories, proteins, and other nutrient elements. In effect, they seek to establish a minimum nutrient level for populations. This is based on the assumption that there are clearly definable levels (Giffit et al. 1966, Scrimshaw 1976).

The effort to identify the nutrient level that will produce optimum health and dietary efficiency for a population reflects the influence of the experimental sciences. With this background, nutritional work has progressed considerably in understanding the metabolic aspects of nutrition and in conquering diseases caused by gross malnutrition. But there has been no comparable success in understanding how and why a population is well fed (Payne 1976).

The ideal of an all-purpose optimum or minimum diet makes sense when one seeks to achieve a specifically

defined and measurable target, e.g., the efficiency with which certain kinds and quantities of food can be converted into energy or into an increase in weight for a specific person under specified conditions. But it is not possible to define an optimum or minimum diet for human beings in a social situation. Not only do individuals vary in the physiological and biochemical requirements needed to carry on identical functions, but they have manifold and diverse preferences embedded in different cultural patterns, which in turn are shaped by climatic, geographic, social, political, and economic priorities and constraints (Purnin 1973, Hegstead 1974).

In these terms, reducing malnutrition is not a technical problem of developing superabundant grains or a magic bouillon cube, or of using Madison Avenue techniques to transform our bad eating habits into good eating habits. Substantial and lasting improvement comes by improving the entire context within which nutrition takes place. Policy choices involve complex trade-offs. Before examining these choices, it is useful to place nutrition within its cultural setting.

FOOD, CULTURE, AND CHANGE

Food as It Is Culturally Defined

The diets that people have traditionally accepted have been determined by the particular environment in which they live and the historical and cultural choices they make about acquiring, distributing, and consuming food. Neither physical nor cultural environments determine diet absolutely, but findings reveal (N. W. Jerome 1976, unpublished data, Department of Human Ecology, University of Kansas Medical Center) that they establish a framework of dietary choices, goals, and limits that cannot be ignored.

Some foods offer prestige (white bread and polished rice), others offer security (milk in the United States, rice in much of Asia), while still others provide a sense of group identification ("ethnic foods"). Beliefs about the intrinsic value of foods frequently are associated with critical periods in the life cycle--pregnancy, lactation, infancy, illness. Some foods are avoided because of religious taboos. Neither orthodox Jews nor Muslims will eat pork; Hindus typically are vegetarians; until recently Catholics would not eat meat on Fridays. Food acts as a boundary marker of identity. Culture always works to define what will be eaten and indeed what society calls food.

African elders will likely surprise their European informants when they complain of "not eating in days." It would be wrong to imagine that our African elder is starved. Only fufu or ugali is thought to give the sensation of a tight, full stomach which is the sign of a satisfying meal (Uchendu 1970).

Not only in sub-Saharan Africa but elsewhere, outside observers are likely to underestimate the quantities of food consumed because only certain items are identified and culturally defined as "food" while other consumables are treated as mere snacks without food value. They also may miss the full range of diversity that is available to people even in poor areas. For example, an authority on West Africa points out:

The cultural load of the Western-trained scientist tends to obscure and obstruct perspectives when staples such as manioc or plantain, admittedly low in protein count, are analyzed without reference to accompanying soup ingredients which make them not only more palatable but richer (Uchendu 1970).

This also occurs in Southeast and East Asia where fish pastes and sauces, usually produced locally by rather primitive methods of fermentation, are used as inevitable accompaniments to rice, not only as condiments but as valuable sources of protein (NRC 1974).⁶

This phenomenon of unrecognized food is often accentuated during the so-called "hungry season," the preharvest period when stocks of the preferred staples are exhausted. During this phase people find it necessary to shift to socially less desirable foods and are likely to feel a strong sense of deprivation even if their caloric intake has not declined a great deal. But the "traditional hunger for 'preferred staples,' which tends to be pervasive, is sometimes conveyed in the idiom of starvation (Uchendu 1970)."

Experts have an ethnocentric bias in their perception of the relationship between food intake and activity level. Western societies and Westernized elite groups in the developing countries eat three meals a day and divide their days into fixed periods of work, leisure, and sleep. Deviations from such schedules tend to be interpreted as physiologically unfavorable to good health. In many of the developing countries, large numbers of people eat only one meal a day. Moreover, they frequently interrupt their work with brief spells of sleep. These patterns typically

are attributed to inadequate diet and a consequent lack of energy. On the contrary, they may represent a long-standing and quite different cultural organization of working and eating which permits people to function fairly effectively at relatively low levels of calorie intake under differing climatic conditions (Hegstead 1974).⁷

Measurement and Culture

If the cultural aspects of food cause detailed local studies to underestimate the nutrients consumed, the errors may be compounded in aggregative measurements. There is increasing evidence that broad statistical surveys understate consumption partly because they do not, and possibly cannot, capture all items that are consumed by all social groups. For example, sophisticated nutritional surveys have been conducted in India. While they report the consumption of dominant food grains, they understate or do not report the consumption of many nonfood grain items--socially unacceptable meat and poultry, greens, fruits, root crops, and others--some of which are important items in the diets of poorer groups. It has been estimated that this may result in a 10 to 34 percent understatement of what is available for consumption. A recent study in the Indian state of Kerala showed an even more extreme situation: calories consumed were 44 percent higher than the official estimates (Gaven and Dixon 1975, United Nations 1976).

This is not to minimize the enormous and widespread extent of hunger and inadequate calorie intake, but to underline the cultural complexity of dietary patterns and the difficulty of measuring all the elements that are relevant.

Dietary Changes

Changes in diet occur in two ways, neither of which is chosen necessarily because it has specific nutritional advantages. First, there are shifts in dietary patterns within a society. No new food is introduced, but changes occur as (1) people shift from one region to another, (2) people respond to climatic and environmental changes, (3) the proportion of people in urban as opposed to rural areas changes, (4) women increase their participation in the labor force in ways that are incompatible with existing dietary habits and labor-intensive methods of food preparation, (5) more people compete for available resources, and (6) rising incomes (or falling costs) permit the lower classes to

emulate the dietary patterns of the upper classes and move up a status food ladder. (Such shifts up the prestige food ladder account for a good deal of the food pressure that is being encountered in many parts of the world today.)

The second type of dietary shift takes place when people adopt new foods. Examples include the shifts from rice to tapioca in Kerala, and from ghee to vanaspati everywhere in India. Items such as sliced white bread, new alcoholic beverages, carbonated soft drinks, substitutes for breast milk, and processed weaning foods currently are being adopted where they have never been used before. Some items seem to adapt easily because they "fit" well into a society, as in the swift incorporation of the New World chili into Asian agriculture and cuisine. Some are taken up because they ease the adjustment to occupational or locational changes as when women move to towns, take up work outside the home, and find it convenient and possible to adopt commercially prepared foods. Some foods gain status because they are consumed by domestic or foreign elites. Nevertheless, the mechanisms by which diets change are not well understood. It is evident that advertising alone will not necessarily change diets. Clearly, relative price and income levels play a crucial role. This is especially true for the very poor whose price elasticity of demand is likely to be quite high. Thus the introduction of processed foods even with high nutritional value often has been unsuccessful because they are too expensive for the poor (Berg and Muscat 1973:247-274, Call and Levison 1973:165-197).

Controlling Dietary Change

There always has been and always will be dietary change, but critics often have stressed the negative effects of uncontrolled dietary change: traditional cultures are undermined; diets become less well balanced and less nutritious; and a dependency on less secure or nutritious sources of supply is created. Such criticisms at best give only one side of the story. Sometimes change has brought about a worsening of nutrition, but change also has brought about manifold improvements. While trade creates insecurity in the form of a dependency on food imports, it creates at the same time insurance against local crop failures through access to foreign supplies. And, while new crops have improved nutrient yields, they also have magnified the impact of environmental threats, as with potatoes in Ireland in the nineteenth century.

Is it possible and desirable to direct dietary change to achieve better nutrition? It would seem that diets can be affected directly, given sufficient economic, dietary, and cultural understanding of the specific people in question. In parts of Africa, banana juice is used as a weaning food. This is unsatisfactory nutrition and results in disease and death. In the rich countries, overconsumption of sweets and fats and underconsumption of bulk foods also cause disease and untimely death (Blythe 1976). Clearly need exists for changes in diets.

Yet recognition of need does not confer the authority to change the diets of others. This raises a profound question: Who has expert knowledge on what is a good diet and who should exercise this knowledge given deeply held values on the freedom, integrity, and responsibility of the individual? Furthermore, some research suggests that individuals may choose nutritious diets for themselves if left alone. This is an important point and research, study, and understanding are needed to determine if it is possible to specify situations in which diets should and should not be changed and how this should be done. (See Research Direction 5, "How to Change Dietary Habits and Food Consumption Patterns.")

TOWARD A NEW DEFINITION OF NUTRITIONAL SUCCESS

What Is Nutritional Success?

Since the end of the Second World War it has generally been assumed that progress, including improved nutrition, could most readily be achieved by rapidly expanding the total output of goods and services. It also has been assumed that rapid growth of the Gross National Product (GNP) would generate the resources needed by the poorest countries to attain a full, rich life. Furthermore, it has been argued that efforts to increase consumption immediately, particularly of the poorest classes, would be self-defeating by reducing the resources available for investment and thus slowing future growth.

This view of the development process has been questioned increasingly during the past decade. Per capita incomes have risen quite slowly in most poor countries because population growth has absorbed much of the increased output. Even where per capita incomes have risen substantially, the poorest of the poor sometimes have suffered a decline in income. Whether or not this has been widespread, it is nearly certain that there has been a relative widening of inequality in the developing countries, with some significant

exceptions. At best, the poorest groups have made insignificant progress. Income inequality, market imperfections, the lack of organizational capacity, and inappropriate social goals have combined to falsify the expectation that the "trickle down" mechanism works, or works rapidly enough, to be either politically or ethically acceptable (Adelman 1974, Adelman and Morris 1973, Chenery et al. 1974, International Labor Office 1976, Joy 1973).

Not only have policies oriented to rapid growth of GNP not moved significant amounts of resources toward the very poorest groups, but because GNP does not reflect many of the essential elements of a humane existence, societies that have found ways with limited resources to provide the basic underpinnings for such a life have not been credited with these achievements. Berg and Muscat (1973:28) have eloquently described some of the characteristics of a decent human situation. They suggest that the poor, despite their economic deprivation,

have the potential for enjoying a wide range of non-economic goods--nature, love, friends, good talk at the coffee or tea stall, the joy of children. These enjoyments, independent of economic status, include some of the major sources of satisfaction in life, satisfactions which by their nature are not marketable services and are not quantifiable in the national accounts when the economist totes up the per capita availability of goods and services for personal "consumption." But those who are apathetic and physically drained by nutritional anemia or debilitated by the seemingly constant bouts with nutritionally related diarrheas cannot really savor these satisfactions. It is well-being, not income, that determines whether a man, rich or poor, has the capacity to enjoy these most fundamental sources of human satisfaction. Well-being is the primary requisite, the sine qua non, that determines the utility men derive from all other forms of consumption, whether measurable or not. The developing economies are not likely in the near future to provide a very much wider range of material goods to those in lower income levels.

If well-being is the objective--if it is not only rising GNP but also a rising quality of life that is important--then measures must be devised that more adequately reflect the quality of life: for example, declining general and infant mortality rates, improved

health and longevity, and increased access to opportunity. Admittedly, these measures do not capture all the elements in the chemistry of well-being, but for all the qualifications that need to be kept in mind, they capture important elements of a desirable quality of life. On the face of it, low life expectancy, high death rates, high infant mortality, and low literacy rates all limit human and social potential. They are particularly offensive when they are experienced unequally by the rich and the poor.

If relying primarily on increased GNP to enhance the well-being in the people of the developing countries is not effective, would a large increase in food consumption prove effective? Stated differently, do average calories consumed and the quality of life indicators vary up and down together? Somewhat surprisingly the answer seems to be, not necessarily. Countries with the same quality of life indicators consume very different quantities of calories per day. The life expectancy in Sri Lanka is approximately the same as in the United States, yet the average number of calories consumed in Sri Lanka is only around 2,200 per day compared to approximately 3,300 in the United States. Although this example is suggestive and not conclusive, it tends to corroborate a broader conclusion. An increase in calories consumed vitally affects quality of life indicators at very low levels of calorie consumption, but above a certain level increased calories have a lesser effect on the quality of life. Above this fairly minimal level of calorie consumption, other factors such as health and personal well-being apparently play a larger role in shaping the quality of life.

How Is Nutritional Success Achieved?

Paradoxically, it appears that the best way to improve nutrition may be indirectly, by improving general well-being rather than by concentrating on increasing food consumption. If this is true, then we should expect that out of all countries some should demonstrate relatively high well-being without high per capita GNP or caloric consumption. And, in fact, Tables 1 and 2 show a few such cases.

Using the quality of life measures introduced above, we have selected five thresholds by which to indicate "success": (1) a life expectancy at birth of 60 years or more; (2) a death rate of 11 per thousand or less; (3) an infant mortality rate of 60 per thousand live births or less; (4) a literacy rate of 60 percent or higher; and (5) a birth rate of 32 per thousand or less. These measures are somewhat

Table 1. Quality of life achievements of selected countries, early 1970s

	Population mid-1973 (millions)	Per ca- pita GNP 1973 (in 1973 \$)	Average daily per capita calorie consump- tion (1969-71 average)	Life ex- pectancy; years at birth (1973 or latest available)	Death rate per 1,000 popu- lation (1970- 75 ave- rage)	Infant mortality per 1,000 live births (1973 or latest available)	Birth rate per 1,000 popula- tion (1970-75 average)	Literacy rate (1973 or latest available)
<u>Poor countries that reach all five quality of life thresholds^a</u>								
People's Republic of China	799.3	270	2,170	62	10.3	55	26.9	25 ^b
Cuba	8.9	540	2,700	70	6.6	29	29.1	78
Grenada	0.1	330	n.a.	63	7.8	32	27.9	76
Mauritius	0.9	410	2,360	66	6.8	46	24.4	61
South Korea	345.0	400	2,520	61	8.8	47	28.7	88
Sri Lanka	13.5	120	2,170	68	6.3	45	28.6	81
Taiwan (Republic of China)	15.0	660	2,050	69	5.0	26	24.0	85

<u>Weighted average performance of all other poor countries</u>	1,533.8 ^c	182	2,124	50.4	17.0	133	43.0	36
Poor countries with a per capita GNP less than \$300	1,321.4 ^c	136	2,078	48.3	17.6	136	43.0	34
Poor countries with a per capita GNP of \$300-\$699	212.4 ^c	474	2,412	63.6	13.9	115	43.09	43
<u>India</u>	600.4	120	2,070	50	15.7	139	39.9	34
Kerala State ^d	21.3 ^f	(e)	2,337	61	9.4	58	31.5	60 ^f
<u>Weighted average performance of all countries with a per capita GNP of \$2,000 or more</u>	964.5 ^c	3,872	3,175	71	9.2	20.2	16.9	97
<u>United States</u>	210.3	6,200	3,330	71	9.4	17	16.2	99

^aA poor country is defined as one with an average per capita GNP under \$700. Quality of life thresholds include life expectancy at birth of 60 years or over; death rate of 11 per thousand or less; infant mortality of 60 per thousand live births or less; literacy of 60 percent or more; and birth rate of 32 per thousand or less.

^bThis is most certainly a gross understatement. By all reports, China has probably achieved a much higher literacy rate.

^cTotal population.

^dData for Kerala from United Nations (1976).

^eKerala per capita income is variously estimated at 75 to 95 percent of the all-India average.

^f1971 figures.

Table 1. Continued

Sources: Population estimates for mid-1973 are from the Population Reference Bureau, Inc. (1973); per capita GNP figures for 1973 are from the World Bank Atlas (World Bank Group 1975); average daily per capita calorie consumption figures for the 1969-71 period are from the U.N. World Food Conference (United Nations 1974); life expectancy, death rate, infant mortality, and birth rate figures are from the Population Reference Bureau, Inc. (1975); literacy figures are from the U.S. Agency for International Development (1973) and from the 1974 UNESCO Yearbook. We had the assistance of the Overseas Development Council in compiling these materials.

arbitrary and they are certainly not ultimate standards, but they establish levels of performance considerably above those in many societies today.

The 28 nations with high per capita GNPs in 1973--\$2,000 or over in 1973 dollars--typically have achieved the satisfactory quality of life thresholds as just defined. All but one have a life expectancy of 60 years or more. All but seven have death rates below 11 per thousand and six of the exceptions marginally miss because of their relatively old average age structure. All the nations but one have infant mortality rates below 60 per thousand and virtually all have reduced the figure to less than half this number. All but two have birth rates of 32 per thousand or less, with the great majority below 20 per thousand. And all but two have literacy rates over 95 percent. The two major exceptions to the general rich country pattern are the Libyan Arab Republic and Kuwait.

There is a greater dispersion in the 33 countries with middle-range per capita GNPs, \$700 to \$1,999. While 16 achieve all of the standards, five countries have not reached any and another 12 miss one or more. And, not surprisingly, the overwhelming majority of the 81 poorest countries--those with an average per capita GNP below \$700--have failed to attain any of the five basic thresholds.

But, as mentioned, a few of the 81 poorest countries have achieved the same relatively high well-being as the 28 richest countries in terms of the quality of life thresholds. Table 1 shows that China, Cuba, Grenada, Mauritius, South Korea, Sri Lanka, Taiwan, and the Indian State of Kerala, each with a per capita GNP of less than \$700, have been successful by the above standards. All except China have literacy rates above 60 percent. (All observers agree that China's literacy rate has been grossly understated.)

These quality of life indicators have specific advantages. A rise in GNP or average calorie availability can hide distributional effects since improvement may apply only to a small group. Improvements in the quality of life measures are not as likely to be significant unless the gains are widely shared among the population because the possible range of dispersion is smaller for these variables. The birth rate indicator appears not because it is in itself a measure of the quality of life, but, because as suggested later, it seems to reflect popular attitudes and behavior as well as the distribution of other social benefits.

It is possible to combine these individual measures, which behave differently in different countries, into a single composite index that will permit easier international and interregional

Table 2. Physical quality of life index (PQLI) and other selected indicators for countries of the world early 1970s^a

Countries	PQLI ^b (early 1970s)	Population 1973 (millions)	Average per capita income, 1973 ^c	Average daily per capita calo- ric consumption 1969-71 ^c
<u>Countries grouped by average per capita income</u>				
Poor countries (below \$700, 81 countries)	49	2,405.1	218	2,147
Below \$300 (47 countries)	48	2,134.2	186	2,113
\$300-\$699 (34 countries)	57	270.9	477	2,420
Medium-income countries (\$700-\$1,999, 33 countries)	73	414.8	1,101	2,697
High-income countries (\$2,000 and over, 28 countries)	96	964.5	3,872	3,175
World average (142 countries)	63	3,784.4	1,246	2,470

Selected countries

People's Republic of China	59 ^d	799.3	270	2,170
Cuba	86	8.9	540	2,700
Grenada	80	0.1	330	n.a.
Mauritius	75	0.9	410	2,360
South Korea	80	34.5	400	2,520
Sri Lanka	83	13.5	120	2,170
Taiwan	88	15.0	660	2,050
India	41	600.4	120	2,070
Kerala State	69	21.3	(e)	2,337
United States	96	210.3	6,200	3,330

^aFrom sources cited in Table 1.

^bBased on equally weighted summation of life expectancy, infant mortality, and literacy indexes, using method described in report.

^cData for groups of countries weighted by population (See Appendix).

^dChina PQLI is relatively low because of the exceptionally low literacy rate that is used in Table 1.

^eKerala per capita income is variously estimated as ranging between 75 and 95 percent of the all-India average.

comparisons. We use a composite physical quality of life index (PQLI), based on three of the indicators used in Table 1: life expectancy, infant mortality, and literacy. Each indicator was ranked on a scale of 1 to 100. Using life expectancy as an example, we took the most favorable figure achieved by any country in 1973 (74 years in Denmark) as 100 and the most unfavorable figure in 1950 (28 years in Guinea-Bissau) as 1. All countries were then ranked within this range. The same procedure was used for infant mortality and literacy. A composite PQLI was calculated, giving equal weight to the three individual indicators (see Table 2).*

As we have noted, each of the components is more sensitive to the way quality of life benefits are distributed within a country than is per capita GNP. It is true that the data are very crude and that there are very wide margins of error. The concept of the PQLI is also very rough at this stage. Nevertheless, there is little reason to believe that the main conclusions to which the data point are wrong. Some countries which are very poor and have low calorie consumption levels have been able to achieve quite high quality of life levels.

The People's Republic of China is a widely cited example of a nation that has successfully improved its average nutrition despite its slow growth of per capita GNP. Lacking detailed analysis,* we accept visitors' descriptions that these nutritional results have been achieved in two ways. First, a great deal of attention has been devoted to stabilizing agricultural output against the vagaries of the weather cycle. This has slightly increased the per capita availability of foodstuffs. Simultaneously, the Chinese have established an effective national public distribution system that permits them to guarantee minimum food requirements within the limits of what is nationally available (Swamy 1973, Perkins 1975). In addition, the Chinese have spread a network of simple public health and educational facilities throughout the country. All of this has been made possible by a political elite dedicated to the welfare of the poorest groups and willing to utilize China's centuries-old administrative apparatus as well as political coercion, options not available in most of the very poor countries (Chopra 1975, Chenery et al. 1974).

Cuba, with a PQLI of 86, has followed a similar path, but under somewhat more favorable circumstances (Chenery et al. 1974).

South Korea and Taiwan, with PQLIs of 80 and 88, are countries in which there have been both substantial improvements in quality of life indicators and rapid growth in per capita GNP. The two nations are

frequently cited as GNP success stories with average annual per capita growth rates between 1960 and 1973 of 7.1 and 6.9, respectively (Chenery et al. 1974), but in 1973 both still had low per capita GNPs. Nevertheless, South Korea has done as well or better than 13 of the 33 countries with per capita GNPs in the \$700 to \$1,999 range. And Taiwan has exceeded or equaled the PQLI performance of 27 of these countries. South Korea and Taiwan created widespread health and educational facilities along with land reform and other improvements in the rural areas. In addition, both are instances where foreign interventions on a massive scale, by the Japanese since the end of the nineteenth century and others after the end of the Second World War, were very important.

By contrast, Sri Lanka and the Indian state of Kerala, with PQLIs of 83 and 69, have made impressive progress in terms of the quality of life measures, but without large increases in per capita GNP or major political changes. Since World War II, changing balances of political forces within the two regions favored the spread of service programs and land redistribution in rural areas. Sri Lanka, after the Second World War, placed major emphasis on literacy programs and more recently on food distribution and health programs in the countryside. These programs were financed first by taxes on foreign-owned plantations and more recently by taxes on domestic elite groups. In Kerala, in addition to the hundred-year history of rural education and land reform programs in parts of the state, the more recent public health, education, and food distribution programs apparently have had a major effect on the quality of life. Moreover, the dietary shift from rice to tapioca allowed the poor to maintain or even slightly increase their calorie intake despite inflationary pressures and increasing population density on the land (Marga Institute 1974:273, Chenery et al. 1974, United Nations 1976).

Despite the variety among all these countries, there is a common theme: nutritional success in these countries is not the direct result of increases in per capita GNP or of increases in average calorie consumption, but of overall improvements in the way social resources are used. For example, there are relatively small differences in calories consumed among the developing countries and yet there are major differences in their quality of life measures. Success seems to be associated with the fact that these countries have treated nutrition as part of an integrated program, as only one aspect in the solution of the needs of the very poor. They have used general programs that have concentrated on local development.

Public health, education, labor-intensive technology, and effective administrative techniques have combined to yield a fairly high quality of life. How well the experience of these countries can be generalized with respect to other countries is an important area for research.

WHAT HAS BEEN DONE?

In contrast to the above discussion of indirect nutrition programs, many countries and international organizations have used food distribution programs to improve nutrition directly. It is important to look at this experience before making further research recommendations.

Food from Abroad

The need to increase the availability of food may be met through imports. However, there are many problems with this strategy. Attempts by the poor countries to obtain food by commercial imports have invariably fallen afoul of overwhelming balance-of-payments difficulties except where the countries were able to develop a strong and stable export sector. Ex gratis contributions by foreign countries are palliatives. And even if permanent aid arrangements could be made, they are demeaning and imply a return to that degrading colonial dependency from which most poor countries have only recently emerged. Generally, neither buying nor begging from abroad offers a way out.

Domestic Regional Specialization

The market mechanism has advantages that the developing countries do not always appreciate, but it cannot always be relied upon to improve nutrition. One limitation is that development policies that encourage regional specialization of food production and exchange have less of an effect on improving food consumption in deficit areas than economic theory predicts. One Indian study, consistent with historical evidence from some developed countries, suggests that in a large economy the market mechanism appears to be inadequate to equalize food availability among regions (United Nations 1976). Given income differences and transport costs, people are more likely to depend on locally grown food. This suggests that to narrow the nutritional differences among regions, some priority

may well have to be given to programs that directly increase food output in deficit areas. In the face of weak interregional transfer mechanisms, planned production gains from regional specialization cannot be assumed to spread nutritional benefits to the whole population. (See Research Direction 3, "Should National Food Production Policy Stress Regional Specialization Based on Resource Advantage?")

Public Distribution Systems

Major attempts at dietary improvement have involved direct food distribution programs. The most all-embracing of these have been broad public systems, e.g., fair price shops and various food stamp schemes, which attempt to distribute food to large segments of localized populations at controlled, below market prices. Efforts to subsidize the poor with some minimum level of nutrition have had only a limited effect. In most developing countries, successful distribution can only be achieved in urban areas. The poorest of the poor--subsistence farmers, landless laborers, and rural nonagricultural workers--are seldom reached. However, China, Sri Lanka, and Kerala have introduced broad, apparently successful distribution systems that cover rural as well as urban populations (Chenery et al. 1974; Marga Institute 1974:253, 290; United Nations 1976). Such exceptions stand in contrast to most developing countries where distribution programs fail as the frail administrative structure buckles under the complexity of programs and the weight of fiscal and political forces.

Feeding Programs for Specific Groups

Programs of targeted nutritional intervention have concentrated directly on groups suffering high nutritional risks, such as expectant and nursing mothers, school children, and infants. School feeding programs have been among the earliest and best established distribution efforts. They have been particularly attractive to national policymakers and foreign aid donors. Children are a deserving group and schools provide a readymade distribution system. Of course, only those who attend school regularly benefit from a feeding program, and, in the absence of free, compulsory schooling, the very poor children are not reached. For example, the school feeding program in Kerala seems to have been more effective than elsewhere in India because of its extensive primary school system. But, under the best of circumstances these

programs still do not reach all who suffer high nutritional risk. Americans have been in the forefront in urging these various feeding programs, yet they have not been very successful.¹⁰

These feeding programs encounter enormous difficulty delivering nutritional benefits to specific groups within societies. Western values, which aim to protect women and children first, run counter to the operative values in most traditional societies. In many poor countries, food goes first to those who are working outside the home and earning the family living, or to those who have social status, usually adult males. However unpalatable we may find this behavior, it is both economically and socially rational to invest in the person who is currently productive rather than to allocate resources to children who may die and can be replaced. Well-meaning attempts at targeted food distribution which override local values frequently fall short of their objectives.

Even with the best intentions, governments have great difficulty reaching, and even more difficulty helping, the poorest of the poor who are the most malnourished (e.g., agricultural laborers and subsistence farmers, who are generally unorganized and extremely difficult to reach). To pursue programs for these people, a governmental commitment and adequate resources are required. Unfortunately, there is a tendency to assume that once this commitment has been made, an impact automatically follows. These worthy efforts must work at the district and village levels through powerful groups who often distort the original objectives of these programs by diverting benefits to themselves. Sometimes programs are successful as pilot projects because they employ their own delivery systems which require specialized administrative skills. But such programs are too expensive to be sustained by poor societies. For example, voluntary agencies charged with administering P.L. 480 food distribution have devoted more than 20 years to building the storage, transportation, and delivery arrangements necessary for food to reach the malnourished. Despite all this experience and effort, it is still difficult to get food to the truly hungry. For example, Project Poshak, a CARE study of a carefully designed large project in India, found that reaching landless laborers still presented formidable problems surmountable only at prohibitive costs (Gopaldas 1975, also see Pyle 1976).

The more alienated a group is politically, economically, and socially, the more difficult are the managerial and administrative problems of reaching them. Under such circumstances, governments and outside agencies often tend to centralize delivery efforts even more. Apart from the extra drain on

resources, centralization weakens self-reliance and works against self-help and local development activities. The success of systems that deliver services depends on the involvement of those who are served, and follow-through is a major requirement for success. It requires self-investment behavior on the part of the recipient. Yet most aid program designs require complex and centralized administration to get the food through to the people, thereby diminishing the self-reliance that is necessary for successful follow-through. This follow-through capacity must be built into programming from the very start of a project. Discovery of means to do this in ways which avoid too much and too little control is a priority objective. (See Research Profile 4, "Management Systems.")

Disease and Nutrition

It is frustrating to attempt to increase nutritional efforts, whether concentrated on specific "at risk" groups or on the more general population, when epidemic and endemic diseases are present or water supply or sanitation deficiencies undermine the dietary efficiency of food consumption (Bengoa 1973:103-128, Craviota and DeLicardie 1973:3-21, Scrimshaw and Gordon 1968).¹¹

The problem of choosing the best policy paths to reduce hunger and improve nutrition has confounded planners and administrators, and for good reason. Direct nutrition policies, like those just reviewed, are confronted with major difficulties. Less direct approaches which involve health and environmental improvements may be at least as effective in improving nutrition while they produce other benefits as well. How should a policymaker choose among general strategies and specific programs to improve nutrition? Of course, there are situations in which groups are required to perform work for which they have inadequate energy or where disease is specifically related to nutritional deficiencies. Here, clearly, the remedy is improved diet. There are other situations in which disease control is an obvious first priority. The vastly more common situations, however, are those in which the policies that would improve nutrition at the least cost to the country are difficult to define. Nutritionists usually will urge policymakers to improve diets; public health experts will stress improved medical programs; economists will argue for greater savings and more growth; a political party may call for assistance programs for the poor. But very little is known about the complex relationships among general nutrition, disease, economic growth, and welfare. It

is tempting to suggest that developing countries ought to undertake all programs, but the recommendation that everything be done is not helpful. Research is sorely needed to find ways of making better choices. (See Research Profiles 1 through 4.)

WHAT CAN BE DONE?

Development at the Local Level

While international exchange is likely to be beneficial, efforts to improve the nutritional condition within the developing countries are most likely to succeed if they operate as much as possible within the structure of local values and institutions. People will be more responsive to opportunities if they are offered in ways that do not excessively disrupt existing ways of doing things. This is particularly true of the poor majority who have had little if any exposure or familiarity with foreign institutional and organizational arrangements and whose poverty leaves them little margin for experimentation. Effective solutions therefore must be based on and sustained by the desires and values of the people where they are, in the villages and neighborhoods.

China, Sri Lanka, Kerala, and a few other countries appear to have developed such programs. Their largely rural programs apparently have improved the quality of life and nutrition without large increases in per capita food production or GNP. In addition to successful rural programs, Taiwan has had large increases in agricultural output and GNP.

What are the desirable characteristics of rural strategies? Some countries have sought to direct benefits only to their neediest people. Other countries have initiated programs that bring benefits to all the people in a region. These programs are designed so that the poor cannot easily be excluded from them. We believe this latter strategy has much to recommend it. For example, sanitation, eradication of communicable diseases, and provision of potable water supplies attack major causes of sickness and death and also reduce nutritional losses from the food consumed. These are major burdens to the poor. While such programs help the better-off, they do so only to the extent that they also help the poor.

A second desirable aspect of village-based programs is that they are able to concentrate on an expressed need of the people in a particular area--maternal and child care, personal and public health, literacy, roads, land reform, or family planning--and subsequently can extend interests from the expressed

concerns to new concerns, understandings, and choices as the people gain confidence in those they work with and in the results. Such programs have the best chance of introducing needed changes while using local institutions and values, thus preserving much that is valued in the culture.

Health is an excellent entry program in the above sense. When villagers understand that marasmus is not visited on their children by evil spirits, they gain a confidence in themselves and the local health programs that can be used to gain further cooperation in other related areas such as food use or family planning. As Giffit, et al. (1966:219) state:

Bringing about some improvement in the most urgently felt needs may be the more successful route to better nutrition, both through changes in food consumption due to increased income and through increased receptivity of the audience to other subjects, such as nutrition, once the needs they perceive as more basic are met to a reasonable degree.

In addition, improved nutrition and health at the village and community level may well play a crucial role in population growth. Societies develop specific fertility patterns through cultural reinforcements, including the fostering of high birth rates in societies in which high death rates prevail. Development policies that concentrate on raising per capita GNP do not change demographic incentives in any specific way over the short run. Nor do family planning programs directly change them. But there is also evidence that improved nutrition plays a major role in reducing infant and child deaths. And there is evidence that as child mortality declines people realize fairly quickly that they need to have fewer births to achieve the desired family size (Taylor 1973:76-79, Ridker 1976). Although the precise explanation is not known and may turn out to be quite complex, it is striking that all of the seven countries and states discussed previously that have achieved nutritional success also have reduced their birth rates to below 32 per thousand. (See Research Direction 6, "Infant Mortality and Fertility.")

Basic literacy programs also seem to play an important role in the seven countries and Kerala; all of them except China and Mauritius have attained literacy rates above 70 percent. Apparently, literacy programs are important because they increase sensitivities to new possibilities, widen the range of skills, and, perhaps most importantly, educate the women, often for the first time. This investment in

women and the accompanying expansion of their opportunities has been a vital factor in the success of development efforts, nutritional improvement, family planning, and child care programs. (See Research Direction 7, "Women and Nutrition.")

The developing countries are handicapped by their limited technical, administrative, and management resources that impose formidable constraints on large-scale implementation of even the best conceived programs. It is desirable, therefore, to use strategies that require a minimum of scarce resources and make maximum use of what is plentiful, that is, strategies with a labor-intensive and rural bias.¹² Rural development probably can keep social overhead costs below those required in urban centers. The income generated will support more food consumption in the localities where it is produced and will help vitalize local institutions. (See Research Profile 2, "Learning from the Successful Poor Countries," and Research Direction 3, "Should National Food Production Policy Stress Regional Specialization Based on Resource Advantage?")

Using local values and institutions as touchstones for development policy makes economic sense. However, village-based programs of this sort can work only if the national government puts forth policies that support them, and supplies the resources they need. It is easy to define and even to fund such programs in national capitals, but exceedingly difficult to get the right resources, people, and flexibility to make them work in the rural areas. Many educated people believe that the good life can only be found in urban areas. The connective tissue between the central bureaucracy and the periphery, which might be called middle management, is part of the follow-through that is essential to the implementation of programs. Government can do a great deal to strengthen middle management by recruiting much of their talent from the rural areas and by using compensation and advancement policies to encourage personnel to remain in those areas. Research on these practical aspects of self-investment by villagers and appropriate incentive schemes at a slightly higher level is badly needed. (See Research Profile 4, "Management Systems.")

Greater Choices and the National Role

Today, national governments make the key decisions that shape the future: more exports or greater self-sufficiency, reduced hunger or improved roads, more production incentives or distribution of services, greater use of capital or of labor-intensive

technology, centralized or decentralized administrative systems to carry out social and economic policy. The room for choices at the village or community level is defined by these national choices, which in turn are determined by overarching governmental decisions to seek greater national power and wealth or to attempt to improve the well-being of the majority of its people.¹³

It is our conviction, however, that policies are undesirable if they benefit present generations at the expense of the opportunities of future generations.

Given the basic national strategy chosen, how do the subsidiary decisions enumerated above affect nutrition? Alan Berg, Robert Muscat, Nevin Scrimshaw, and others have brought this question to the attention of public officials and development planners. We suggest the development of nutritional impact statements as a means of formulating improved answers to this tough question. Such statements will at first be fumbling and rudimentary, but as they are improved they will force attention on theoretical, administrative, and statistical gaps in our knowledge. National and international lending and assistance organizations should require the preparation of nutritional impact statements for preinvestment and feasibility studies. The policy process will be improved as greater recognition is given to the consequences of decisions in terms of health, nutrition, and well-being. Most importantly, this technique lends itself to "learning by doing." (See Research Profiles 2 and 3, "Learning from the Successful Poor Countries" and "Nutritional Impact Statements," respectively.)

A choice of development strategies presumes a choice of means, including technological alternatives. Yet technology now "on the shelf" tends to come in capital-intensive forms developed for use in industrial nations. Choices for greater self-sufficiency, or choice of smaller scale or labor-intensive production will be foreclosed if the appropriate technology, management techniques, and research are not available. For example, energy research and development in the industrial countries has stressed large-scale production and regional grids to the exclusion of small-scale, energy-generating technology which could be much more useful for developing countries. It is clear that incentives must be provided that will actively encourage innovation of technology more appropriate for developing economies.

National food grain production policies in the developing countries have been greatly affected by research decisions made by the developed countries based on their knowledge, skills, and needs. The emphasis given to research on and the development of

improved strains of wheat, rice, cocoa, and groundnuts was generally consistent with dietary and export preferences in many poor countries. Such crops were often important in terms of hectares cultivated, and they also were the prestigious food grains and exports toward which the poor and the producers tended to shift whenever possible. But this concentration on increased production of the improved yield varieties for domestic use or export led to the relative neglect of crops that in the past had been widely produced and consumed, particularly by the poor (Call and Levinson 1973:176-177; CGIAR, TAC 1973; Dwyer and Mayer 1975:570).

Policymakers should examine more seriously the possibilities of increasing the productivity of socially "inferior" but potentially more productive crops and unrecognized food resources. There is evidence that specialization in cash and export crops drives out the historic crops of tubers and pulses as well as the garden plots of vegetables and other foods often raised by women for direct family use. Thus unbalanced production may unbalance nutrition and diets. Specialization also diverts technological attention toward increasing market crop yields and away from food resources that are not utilized because they cannot be preserved or protected against pests. For example, breadfruit in the Caribbean is often lost as food because there are no techniques to harvest and preserve it. (See Research Direction 2, "Minimizing Food Waste and Disappearance.")

In addition, the concentration of research on internationally marketable crops ignores the relative nutritional advantages of the so-called "inferior" crops. For example, in India tapioca and even potatoes produce many more calories per hectare than do rice or wheat. An index of yields of calories per hectare across India for an average of the years 1969-70 and 1970-71 shows rice 100, wheat 113, potatoes 217, and tapioca 610.¹⁴ The comparison is not entirely fair. Rice and wheat are grown over vast regions while potato and tapioca production is concentrated in fairly small areas. Nevertheless, the relationships are sufficiently striking to suggest that penalties have been paid because Western-oriented bias has influenced decisions shaping research, technical possibilities, and agricultural programs. It is argued that shifts to rice, wheat, and maize are improvements because people prefer these grains. The argument ignores the fact that much of the shift to these "prestigious" staples has resulted from the concentration of research on these grains, which lowered their prices relative to other grains.

It is clear that a wider range of more appropriate technological choices is needed by the developing

countries, choices that are more consistent with their factor advantages and disadvantages. Nutritional impact statements would help define the needed technological choices on a project-by-project basis. However, it is also necessary to develop the new technologies. The creation of institutes for nutritional self-reliance in individual countries or for groups of compatible countries would be a major new step in this direction. Such institutes would define local nutritional needs, establish goals, analyze policy choices, and examine consequences within the framework of national planning by making use of nutritional impact statements. They would specify needed technology and apply existing knowledge to meet that country's or region's particular needs as well as improve indigenous technology. If such institutes are to preserve a practical focus, they should engage in basic research only to a limited degree. Such research, which is inordinately expensive, is needed and should be carried out in existing centers for basic research and financed largely by the richer countries. (See Research Profile 2, "Learning from the Successful Poor Countries.")

This emphasis on local solutions also is relevant to crises caused by drought and flood. People who live in drought-prone or flood-prone regions often have traditional mechanisms to cope with them, for example, planting drought-resistant varieties; storing food, feed, and water; accumulating jewelry; and using migration patterns for both people and cattle. Use of these mechanisms tends to even out consumption and production over the weather cycle. At the national and regional level, risks from weather cycles probably can be reduced by applying insurance concepts. However, it is important in both famine relief and insurance schemes to design policies that take traditional procedures into account (Morris 1974, 1975).

Finally, the role of the state requires both forcefulness and restraint. Forcefulness is essential in designing strategies and methods of implementation that get the job done. All too frequently (and not just in the developing countries) programs enrich the local elites and bureaucrats, with hardly a trickle down to the people. However, China, Cuba, Taiwan, and Singapore are examples of governments that have excelled in this sense of forcefulness.

Restraint also must be practiced by national and provincial levels of government. The ultimate value of local development programs will be destroyed if higher levels of government do not leave room for local initiative, ideas, participation, and ultimately responsibility. Moreover, a policy of restraint recognizes the need to economize on one of the scarcest

resources of a poor country, administrative ability. (See Research Direction 4, "Sociopolitical Obstacles to Program Implementation"; and Research Profiles 2 and 4, "Learning from the Successful Poor Countries," and "Management Systems," respectively.)

Greater Choices and the International Setting

Specific and general policy changes at the local and national level to improve nutrition and reduce hunger will have to be carried out within the context of an international environment that can assist or impede their progress. We believe it should be a prime U.S. obligation, along with other rich nations, to help develop a dependable and expansive international economic environment within which the domestic policies of developing countries can yield optimal results. Such a policy, affecting our contributions to international research activities and to the general shape of international economic arrangements, if successfully carried out, may well be the best way for the United States to contribute to worldwide nutritional improvement. (See Research Direction 9, "The International Economic Environment.")

We have already suggested that broad-gauged nutritional solutions--those that effectively lower infant and general death rates and improve length and quality of life--depend primarily on the efforts made by poor countries themselves. Policies that concentrate on rapid economic growth have not produced benefits to the poor rapidly, if at all. They are becoming ethically and politically unacceptable. Alternative strategies are needed that can produce equity as well as growth. These alternative strategies depend to a very large extent on labor-intensive, self-help policies. While they can produce many more benefits per unit of input, they require greater dependence on local techniques and institutions and indigenous conceptual systems. Thus there are severe limits to the scale of the direct bilateral foreign assistance we are accustomed to give. Developmental strategies that are more explicitly focused on distributive equity and nutritional well-being possess limited capacity for absorbing direct resource transfers from rich countries.

But the sustained improvement of nutritional status in poor countries along these alternative lines depends on technological innovation that will increase productivity. Here U.S. assistance can be substantial. Many poor countries still lack any large capacity for basic research and development. Some have an ability to conduct varying types of research but nowhere near

the amount or at the level of sophistication from which they could clearly benefit. The United States, of course, has an enormous research capacity and the other study teams stress how that capacity can be used. Even so, there is a tendency to overestimate the benefits of current research that can be turned to the advantage of developing countries and to underestimate the research reorientation that may be required. Here words of caution are called for.

We have stated that developing countries will make the most progress with technical solutions that are consistent with their relative factor advantages. While these will vary somewhat from region to region, typically countries will do best with innovations that are labor-intensive, and that economize on scarce capital and organizational skills and use sparingly those resources that have to be imported. These are not the directions of the standard research and development activities in highly industrialized countries like the United States. Our research has been shaped by quite different factor price ratios, directed toward the needs of our system where capital is relatively cheap and labor is the scarce commodity. The processes and equipment we develop tend to be capital- and energy-intensive and to economize on relatively costly labor. This is a general and persistent bias in the pattern of our research and innovations. This is not a recent phenomenon; it has pervaded our economic history since the beginning of our colonial history (Rosenberg 1972). And the threat of future increases of energy prices does not appear to be sufficient to change this overwhelming emphasis.

Scientists and technologists do not work in a vacuum; they are shaped by the values and incentives of the societies to which they belong. American scientists and policymakers and those from other industrial societies tend to choose research problems and develop their technical implications along lines that reflect their societies' relative factor requirements. Western scientists and technicians as well as Western policymakers, accustomed to thinking of science and technology as neutral, are prone to underestimate the weight and pervasiveness of these influences. Consequently, we have not been sufficiently conscious of the fact that the research we do--so appropriate in terms of factor costs in our system--may have very different and less favorable economic and social consequences in developing countries, particularly if greater equity and increased opportunities for the poor are important objectives.

We have not been sufficiently conscious of the fact that our research, and the innovations that flow from it, can have dramatically different effects on rich and

poor economies and on rich and poor groups. For example, the new strains of rice and wheat, the so-called Green Revolution, have not produced proportional gains for rich and poor cultivators in developing countries. These breakthroughs benefited inordinately the larger producers because they had greater access to credit, fertilizer, water, and knowledge; they were not "rich-poor" neutral.

We must recognize that in poor economies, access to these resources is very limited. Any technologies that require greater use of such inputs will tend to benefit the small groups that have access to them. Policy and research decisions on novel technologies should always take into account the degree to which alternatives are "rich prone," "poor prone," or neutral so that research choices can be made that are consistent with our announced concern that the flow of benefits should increase equity. For example, genetic research on wheat might favor strains with a special potential for biological nitrogen fixation rather than those requiring nitrogen fertilizer. This would clearly diminish the dependence of poor countries on capital-intensive sources of fertilizers and simultaneously reduce the dependence of poor cultivators on formal sources of credit.

A similar problem of research direction involves the choice of protecting corn either by developing tougher husks or by using pesticides. The Brazilian strains of hard, flinty maize are relatively resistant to boring insects because the ears are protected by heavy, closely appressed husks while the dent corns of the United States are lightly husked to aid machine harvesting and must be protected by pesticides. The development of Brazilian strains would seem appropriate for many areas of the world, reducing the need for pesticides which have to be bought in the market and favoring the substitution of labor for scarce capital. In such cases, the needed research is of little interest to the industrial countries where labor is costly and credit is easy to come by, but it would be of great importance for cultivators in poor countries.

If U.S. research capacity is to help developing countries, we will need a broader sensitivity to the distributive effects of technology development and use decisions. We will have to be more appreciative of the specific needs of these countries and what appropriate solutions are, solutions which, most likely, will not benefit our own economy. To meet the needs of poor countries, research in the United States will have to emphasize different productive factors and different products and will have to take into account quite different cost relations. This is not likely to take place in our private sector. We will have to set aside

special research funds for these purposes which do not generate any great promise of direct benefits to us.

A possible solution lies in the internationalization of this research, placing it in regional centers that can be more directly responsive to the needs of developing countries. The Consultative Group on International Agricultural Research could play an active role in recasting research priorities so that they will be more in line with the specific requirements of the developing countries. This group, sponsored by the Food and Agriculture Organization of the United Nations, the United Nations Development Programme, and the World Bank, has created research capabilities in several areas of the world and is already financing a large amount of research.¹⁵

In association with other nations of the world, the United States is participating in redefining the international economic order. Such redefinition involves arrangements for liquidity, anti-inflation and countercyclical policies, international reserves, a workable regimen of exchange rates, rules for tariffs and trade, provisions for technology and managerial transfers and foreign investment, regulation of multinational corporations, expanded soft and hard credit and foreign assistance, and means for stabilizing and determining commodity and energy prices and for stabilizing export revenues of primary producing nations. The agenda is awesome, yet if carried to fruition such efforts will provide the developing countries with a wide range of choices and opportunities so that they can, to a considerable degree, determine their own futures.

Placing emphasis on U.S. action in the international sphere strikes many as too abstract and perhaps too passive a role for the United States. They feel that this country, with its affluence, should do more to help directly alleviate worldwide poverty and hunger. Whatever may be the merits of a more activist, country-oriented approach, it should not be concluded that the international approach advocated here would be somehow easier or less costly for the United States or other industrial countries. Such policies to create a favorable international environment would require us to open up our markets to greater imports from developing countries, which will place a major burden on the industrial countries to redeploy workers and capital into different, more productive activities.

Further, international cooperation should involve the use of the insurance principle to deal with the specific risk of weather instability. Insurance schemes that set premiums according to the drought and flood risks faced would make it difficult to protect the poorest groups in any situation. An alternative

might be an International Weather Crisis Insurance Corporation that would set national premiums in relation to the capacity to bear risk as determined by per capita GNP rather than by risk incurred. Such a scheme, especially if linked to the domestic weather crisis program already suggested, would effectively transfer resources from the rich countries to strengthen the poor countries at one of their most vulnerable points. (See Research Direction 1, "Coping with Weather Instability.")

In some of the successful poor countries--Sri Lanka and Kerala are obvious cases--the changing configuration of political groups has made it possible to adopt many of the policies that have resulted in dramatic improvements in the quality of life indicators. Yet in most countries the structure of political power is unfavorable to policies that tend to increase the share of social benefits that go to the poorest. The rich countries could look into creating a system of international economic incentives designed to encourage nations to choose policies more likely to meet the basic human needs of their poorest groups. There are great obstacles, but too little attention has been paid to this possibility (Grant 1976). (See Research Direction 8, "International Incentives to Encourage National Programs of Redistribution.")

The research objectives described are predicated on a U.S. foreign policy that delineates as much as possible the responsibilities of the United States and the other high-income nations as well as those of the developing nations. This policy will not reduce the commitment of U.S. resources to the task of nutritional improvement; rather it will redirect and require an increase in them.

Only broad public understanding and support will enable the government of the United States to initiate and carry out such a policy in the years ahead. We believe this opportunity and burden will be accepted by the American people only if they can visualize these actions as truly part of a beneficent vision of the future, and as a continuation of the libertarian and helping role that the United States has accepted out throughout its history. This revisualization of U.S. foreign policy is by far the most important task for U.S. foreign policy leadership relevant to world hunger.

If our world food and nutrition policy is to be successful, it must depend on three elements--public support, responsiveness, and restraint. Public support can be strengthened if we make genuine efforts to involve U.S. citizens more directly and knowingly in these international efforts. If we are prepared to find ways to break down generalized descriptions into

specific quotas of participation for regions and localities, we would not only generate a healthier involvement in U.S. foreign policy but also would increase--as similar techniques did in the Second World War--the sense of purpose for the individual citizen in our mass society.

Responsiveness is defined in terms of working with other nations to build a cooperative international economic order that will help all countries make those choices that will equitably meet the needs of their poor groups. In many cases, this will require the United States to modify the support, implicit and explicit, that it has given to governments which stand against improving the welfare of large groups of their people. Responsiveness does not mean that the United States will provide its international assistance indiscriminately. International cooperation requires the working out of rules and guidelines that will help specify when governments are entitled to external assistance, and when because of lack of performance they are not so entitled.

Improving the nutritional status of the world's poorest people is a task that must be approached by us with the greatest sensitivity. To the extent that the United States can play an effective and creative role, our good intentions must be muted by humility and the exercise of great restraint. Our problem is not merely a matter of adequate determination on our part. We must sensitively understand the different choices that developing countries are going to make, different because of their history and values, and different because of the specific structure of their poverty. Unless we recognize these differences in the research policies we adopt, we run the risk of involving ourselves in another abortive crusade to solve a neatly defined problem that turns out to be only a shadow of the complex reality. And that risk is great. Each failure costs dearly. We can cause considerable harm to developing countries, garner their resentment, and disillusion our citizens. But if sensitive and correct choices are made, we can contribute richly to the international effort that can end world starvation and malnutrition.

RESEARCH RECOMMENDATIONS

The proposed research is listed under (1) research profiles which constitute the major research proposals to come out of our report, and (2) research directions which, while covered more extensively and appropriately in the research proposals of other study teams, are

illustrative of some of the elements of our research concerns.

Research Profile 1

QUALITY OF LIFE INDEX

RESEARCH NEEDS

Why Is Research Needed?

Neither per capita GNP nor caloric intake appears to be a satisfactory measure of nutritional impact, particularly in the very poor countries. Tables 1 and 2 indicate that there are a few very poor countries that have attained life expectancies, death rates, infant mortality rates, and literacy rates that compare favorably with those achieved in countries with very much higher per capita GNP and much higher per capita levels of caloric consumption. This supports the conclusion that nutritional success can be defined in terms of the quality of life. How then can we measure the quality of life so that there is a yardstick against which to judge the success of nutrition policy?

Overall development and nutrition improvement programs in the developing countries are necessarily a melange of programs and policies. Most programs are directed at specific targets so that the effects on the overall target, quality of life, are suboptimal. Emphasis on specific indicators such as GNP, physical output, and value of exports inevitably produces quite different results than if emphasis were placed on the more holistic goal. Yet today there is no such operational and country-specific overall goal available, which makes it very difficult for policymakers in either the developing or donor countries to evaluate the contributions of separate programs to overall development goals. Progress against partial measures, such as GNP or exports, does not translate easily into progress toward greater well-being. Given the partial quality of GNP, a broader composite measure is needed that will summarize different rates of progress in various fields as contributions to the quality of life, particularly of the very poorest groups.

There have been attempts to create such a composite measure, but they suffer from one or more of the following defects:

- Some are tied too closely to per capita GNP measures.
- Some are based on the assumption that developing countries must inevitably follow the same lines followed by the developed countries. Such indices are culturally biased and fail to recognize the possibility of alternative paths of development based on new technology and different values.
- Some set targets (as in the case of nutritional standards) that seem to be ethnocentric or classbound.

The development of a measure that avoids these defects and that serves as an indicator of general performance and progress toward meeting basic human requirements is essential if development is to be freed from a concentration on physical output and consumption. Such a quality of life index (QLI) would require a composite index of components that are meaningful in most countries. This means that several conditions must be met:

- Each component should express quality of life results without significant ethnocentric, class, or development theory biases.
- Each component should not be ambiguous with respect to distributional effects, as is clearly the case with GNP.
- The unit definition of the QLI must be appropriately sized to reflect reasonable increments of change, and it would be desirable if it were stable over time so that serial changes could be expressed.
- Each component should be easily and economically obtainable and require a minimum of data. The components should directly and simply determine the composite so that operational estimates of QLI levels and changes can be carried out.

Table 2 incorporates the preliminary results of investigations into the development of a form of the QLI carried out by the Overseas Development Council, which is labeled the "physical quality of life index (PQLI)" (see Appendix). These efforts hold promise for making available an index in the very near future which, although primitive in form, is capable of meeting most of the conditions specified above. The research recommended is based on the assumption that the important work on the PQLI is carried to fruition

by the Overseas Development Council. These indices should be published along with applications to historical data and cross-sectional comparisons between countries. Then an international conference, or series of regional conferences, under the auspices of the United Nations or World Bank could be held so that policymakers and development program administrators could participate in an examination of the uses, applications, and explanations of these QLI results and their potential contributions.

The work specified in this profile is to develop, define, and test a next-stage QLI that is refined to the point that countries can use it as a standard of performance.

What Research Is Needed?

A number of lines of research, all of which will be abetted by the ongoing use and experimentation with the PQLI described above, will be required. Conceptual issues will have to be further resolved, including: defining the QLI unit, examining the underlying assumptions, specifying the kinds and forms of indicators to be used to capture particular qualities, determining the sensitivity of the QLI to change and the weighting of the individual components, etc. This kind of theoretical work is appropriate for academic team efforts.

The behavior of the QLI is another important line of research. Statistical, historical, and applied analyses are needed to explore changes in the QLI over time, between countries, within regions, and in covariance with other variables (such as GNP, birth rate) and sampling factors.

A third line of research would relate the levels and changes of QLI to the experience of specific countries (especially the seven successful poor countries) and to the choice of specific development policies. (See Research Profile 2, "Learning from the Successful Poor Countries.")

IMPACT

The development of QLIs will provide a sensitive measure for policy decision making. Such a measure will enable national policymakers and foreign donors to establish realistic and practical expectations for progress (see Research Profile 3, "Nutritional Impact Statements"). In addition, such a measure would enable governments to better cope with the suboptimization problems of programming (see Research Profile 4,

"Management Systems"). The PQLI could be placed in use in selected countries within one year. Fairly soon thereafter, it could start, little by little, to change the policy discussion and actions within and between the governments. Use of the QLI would help economize resources by pointing out the systemic effects of mixtures of policies and suggesting alternate and less expensive changes. This could lead to identifying the specific statistical information that is needed and would enable countries to concentrate their immediate efforts on obtaining statistical improvement in a rather limited range of data.

We estimate that it will take between three and five years to develop the refined QLI. Once developed, it could be put into use as a tool of policy analysis very quickly. It is difficult to estimate what gains may be brought about by its use, but clearly the QLI would substantially improve development policies as they affect the quality of life.

The probabilities of success are quite high since many countries are looking for such an indicator and would surely use it if it were available. Preliminary investigation suggests that the QLI also could be developed to measure the effect of poverty programs in the United States, and to highlight the effects of various programs, differentiated by region, economic sector, and social group.

IMPLEMENTATION

Research on the refined QLI should be conducted along three lines--conceptual, statistical, and historical. Conceptual work can most easily be done in the United States or Europe but will depend on considerable support from academic institutions and official agencies in the developing countries. The historical analysis, the examination of the specific policies that have permitted a few poor countries to achieve an out-of-line quality of life, must be conducted in the countries themselves.

A number of countries have divisions within universities, government agencies, or independent organizations that are well equipped to conduct the statistical and historical analyses required. For example, the Marga Institute in Sri Lanka and the Centre for Development Studies in Trivandrum, Kerala State, India, would be appropriate partners in both the statistical and comparative historical research phases. Similar organizations or groups of independent scholars probably exist in other countries.

The budget to develop a good quality of life index within a four-year project would have to be allocated

along the following lines. First, a conceptual and comparative statistical analysis would require three activities: design time (one U.S. scientist-year at \$50,000), a literature search (one-half U.S. scientist-year at \$25,000), and fieldwork (two U.S. scientist-years at \$100,000 and 12 foreign scientist-years at \$180,000). The total cost for this part of the project would be \$355,000.

A comparative historical analysis to test indices would require fieldwork (12 foreign scientist-years at \$180,000 and four U.S. scientist-years at \$200,000). The total cost for this part of the project would be \$380,000 and the total cost for the entire project would run \$735,000.

Research Profile 2

LEARNING FROM THE SUCCESSFUL POOR COUNTRIES

National policy frequently deals with nutrition as either a cause of health, an effect of production, or a standard for diet preparation. Our report seeks to place nutrition in the role of an interactive variable within the overall social and environmental setting. The quality of life indices discussed in the first profile will open a perspective on nutrition, food, and production as elements of a total life situation rather than as discrete goals standing alone.

RESEARCH NEEDS

Why Is Research Needed?

We have identified seven successful poor countries and states and have reviewed their approaches to providing for the well-being of their people. It appears that nutritional success in these countries is only to a limited extent the result either of increases in per capita GNP or of increases in average calorie consumption. Rather, success seems to be associated with the fact that these countries have treated nutrition as part of an integrated program, as only one aspect in solving the needs of the very poor. Their nutrition policies have been imbedded in general programs of local development that include public health, educational, and other programs that combine to yield a favorable quality of life. Moreover, most of these countries have made use of technology and administrative techniques that typically are labor-intensive.

What Research Is Needed?

The research proposed is needed to reappraise and redefine the concepts of social and economic development. The initial phase would examine the experiences of the successful seven countries and states highlighted by our quality of life indices and would reexamine conventional development in light of the experiences of the seven states in juxtaposition to the history of the developed economies. The second phase would find ways of using this altered perspective of development within the policymaking and development programming of the developing countries, possibly through regional conferences and the use of the nutritional impact statement program described in Research Profile 3, "Nutritional Impact Statements."

IMPACT

If the hypothesis described above were confirmed, even in part, it could mean that: (1) improved quality of life and nutrition could be achieved more surely and perhaps more rapidly at less cost than by the conventional path of relying primarily on increasing GNP, (2) population growth rates could be reduced more predictably and in a shorter time than is now the case, (3) less pressure would be placed on the world's energy and physical resources as countries would be able to accept a lower economic rate of growth, and (4) economic development theory would be broadened to encompass psychological and social interactions and goals.

IMPLEMENTATION

The primary task is to test existing knowledge of the contemporary history of certain countries against a number of alternative explanations or possibilities. Because new research is not the prime object of this project, the subject would lend itself to discussion in a scholarly journal. For example, an issue of DAEDALUS, published by the American Academy of Arts and Sciences, could bring together a compendium of articles on the subject of nutrition and the quality of life in selected countries. Experts would be invited to consider nutrition, health, and well-being of a people within the overall setting and history of the particular country or state. This may include examination of previous studies and monographs as well as study of the political, social, and economic history of the country or region.

Author(s) for each paper would be asked to (1) view the country or state in terms of the hypothesis and understandings stated earlier and in the report of Study Team 12; (2) look for possible corroborations or refutations of the hypothesis; and (3) suggest lines of future research that might illuminate the overall relationships between quality of life and nutrition and health, as well as their causes in particular countries and in general.

The honorarium for each author should be set high enough to encourage the authors to rethink and restudy the area of their essay. Perhaps an honorarium of between \$1,000 and \$2,000 per author would be appropriate. Also, funds should be provided to finance research assistance. Total funding for this project would likely be the following:

Authors (32)	\$ 32,000 to \$ 64,000
Research assistants (16)	80,000 to 128,000
Project director	10,000 to 15,000
Printing and publishing (estimated)	<u>50,000 to 100,000</u>
TOTAL COSTS	\$172,000 to \$307,000

This research effort should result in a provocative look at seven areas and peoples in respect to nutrition, development, and quality of life. If there is merit in the hypothesis, many suggestions will be made by the authors for more specific research and for policies that look promising.

Research Profile 3

NUTRITIONAL IMPACT STATEMENTS

RESEARCH NEEDS

Why Is Research Needed?

Today, in many countries, nutrition is viewed largely from a narrow, technical point of view. It is said to be the result of eating the right nutrients and calories and of having good health. This perspective is invaluable up to a point, but there is an urgent need to develop a broader frame of reference for viewing nutrition. Nutrition is an integral part of well-being and health; the individual, in this sense, is nourished by society as well as by food. Research is needed on a country-by-country basis to tell us which causal sequences are important in this broader understanding of nutrition. Such knowledge does not exist today in any generalized theory, and certainly not on a country-by-country basis.

Government decisions affect nutrition and well-being in a variety of ways. Much of our report is devoted to illustrating how development choices and policies have inadvertently and seemingly randomly altered the course of the developing countries.

Given the unintended and sometimes deleterious consequences of many policies, a new tool for making policies must be broad enough to recognize that which is "good" in what already exists, and to respect a people's right to choose how they want to live. Such an instrument must be powerful enough to anticipate the consequences of proposed policies, to suggest means for conserving existent "goods," and to maximize desired benefits. And, because such a tool does not exist, it must be open-ended; that is, it must contain in its design a capacity to improve through use. Thus we recommend research to lay the groundwork for the development and use of nutritional impact statements.

What Is a Nutritional Impact Statement?

A nutritional impact statement (NIS) is a tool that would help governments make good choices concerning nutrition, health, and well-being in terms of choosing effective or efficient means toward these goals. The NIS is also a tool that a particular country could use when relating a planned action in either the private or public sector to its nutritional consequences for that country.

As one illustration of the possible application of a NIS, a steel mill is planned for construction in a certain country. But a NIS shows that a dense concentration of population will be required in a particular region. The NIS shows that land use will become specialized in an area that formerly was devoted to subsistence farming. It is likely that the quality of diet in that area will deteriorate as foods that previously had been produced locally disappear from the market. Some families will be displaced and will move to the cities while other families will obtain only seasonal employment. Increased foreign exchange earnings from steel production will be used to import middle-class consumer goods into the cities, if no change in tariff rates takes place.

The NIS could help inform the public and could act as a catalyst for public and political discussion. Because of the NIS the plans might be changed to increase the good effects and to reduce the undesirable effects.

The NIS would be important in several ways:

- It would inform government and private sector decision makers about well-being and nutritional consequences.
- It would expand knowledge concerning the social and economic choices that are available to a country.
- It would force and illuminate public discussion of nutritional and regional choices.
- It would emphasize that the objectives of a country may be both economic, in terms of growth and income, and social, in terms of population and nutrition as expressed in quality of life indices.

The essential aspect of the NIS is that it seeks to identify functional relationships in terms of nutrition, health, well-being, technology, and economic, sociological, and other spheres as iterative loops so that both the cause and effect of actions can be seen and understood in terms of feedback. This contrasts with the linear model of causation that is used today in much development and nutrition planning. Admittedly, the development of the NIS is a most

difficult and uncertain task. However, because such an instrument has not been attempted previously and because even moderate progress would return enormous benefits, we believe major research efforts should be invested in developing the NIS.

What Research Is Needed?

Research and development are needed in at least three areas. First, a nutritional impact theory must be developed for understanding the effects of specific programs and policies (nutritional, social, and economic) on the dietary behavior and quality of life of specific populations and subpopulations. This will require applied interdisciplinary research. The nutritional status survey techniques may provide a starting point. These must be converted to quality of life indicators (indicators comparable to those used in this report) to define a baseline. The theory must go on to predict the consequences of various policies in terms of nutritional status and quality of life (partially covered in Research Profile 2, "Learning from the Successful Poor Countries").

Second, talent and organization are needed to perform NIS work and to assimilate and digest the knowledge gained about nutritional impact theory. Universities, the private sector, and government agencies are likely settings for this type of work.

Third, incentive structures and strategies need to be developed to finance NIS studies and provide for their use after they have been developed. Although a NIS ultimately could be imposed as a requirement of foreign aid and investment, this should not be done until adequate debate on the design alternatives for nutritional impact statements has been carried out.

IMPACT

The effects of nutritional impact statements may be felt fairly quickly in some countries and slowly in others as knowledge and techniques are built up. But the work is experimental and developmental and no results are assured. The aim is to carry out enough country and regional trials to see if the concept is practicable and useful.

Overall, the benefits of success in this area are high, if only because the current decision making framework is so largely dominated by narrow physical output considerations. Even rudimentary nutritional impact statements may stall some foolish projects or

alter others so that nutrition and long-run well-being is not sacrificed for "progress."

Most of this research would have to be carried out by scientists from the developing countries with Western scientists leading and assisting in the international component of the research.

IMPLEMENTATION

Several countries and regions should be selected for study to experiment with specifying and developing the role of the NIS. One phase of the research would cover the present literature and research to find the causal nutrition pathways that may be generally applicable in a large number of countries, drawing primarily on the research suggested in Research Profile 2, "Learning from the Successful Poor Countries," and by Study Team 9. Funding is needed to establish a center for NIS studies on a major university campus to bring together knowledge from the life and social sciences, which is now badly fragmented, and for the creation of a journal specifically directed at NIS issues, and for regular conferences to bring together scholars, practitioners, and policy analysts to discuss and debate NIS theory and practices.

The country studies should be headed by research units staffed primarily with local scientists. A research institution or university with a vested interest in a discipline or outcome should not be asked to carry out the research since an openness toward nutritional concepts and their broad social and economic determinants must constitute the heart of the investigation.

The research should be phased so that the country studies do not get going full force until the international phase of the research is well along.

We estimate that the international component of the research will require two years for basic work and three years for follow-up. Funding might be as follows:

4 U.S. scientist-years	\$200,000
4 foreign scientist-years	80,000
8 U.S. research assistant-years	140,000
6 foreign research assistant-years	60,000
Journal and conferences for five years	<u>300,000</u>
TOTAL COSTS	\$780,000

The country and regional studies might be carried out in three countries and one region (such as Africa) over a period of five years and would require:

2 U.S. scientist-years	\$100,000
20 foreign scientist-years	400,000
20 foreign research assistant-years	200,000
Support cost and travel	<u>40,000</u>
TOTAL COSTS	\$740,000

Total project costs would run to approximately \$1,520,000. Foundations, the U.S. government, and international organizations would seem likely sources of funds for this project.

Research Profile 4

MANAGEMENT SYSTEMS

RESEARCH NEEDS

Why Is Research Needed?

Research Profiles 1, 2, and 3 are designed to provide countries with new knowledge and new applications of knowledge in order to improve policy choices for nutrition goals and to secure a priority role for nutrition in national goals. Yet time and again the efforts and the resources devoted to economic development and improved welfare are wasted as plans fail.

We believe that programs fail because of shortcomings in one or more of the following areas related to management design:

- Programs are designed without a built-in follow-through capability, and hence end up as short programs that cannot be sustained.
- The administrative structures created to carry out programs are too costly and complex for the resources and abilities of many countries.
- Programs are not designed to make use of local talents or induce the participation of people in the villages and neighborhoods, and, indeed, national projects often appear to local communities as rites of fealty alien to their needs and imposed upon them by a distant power center.
- The key crossover between policy goals and local benefits rests with middle management, which is generally either the last and least element in planning or an overweight patronage drain on the system. The failure of middle management to perform separates the operating personnel from their source of direction, support, and supply. Its motivation is directed toward the bureaucratic center and away from field performance.

- Finally, a multifront attack on nutrition and well-being calls for a fundamentally different style of management, a style trained to respond to quality of life rather than to quantity of expenditures or physical output.

The large number of program failures around the world, including in the United States, makes it vitally important to examine good management systems. Thus we suggest a study that would examine the important question: How can countries learn to improve implementation so that what is intended actually happens? A study of this nature is crucially important to develop management systems that measure success and failure against broad social and economic objectives, such as quality of life measures. In an analogue of business management theory, we are proposing research on program management that promises to shift it from the current "short-run profit maximization" style to a "long-run total return on investment" mode based on a far more sophisticated "accounting system" denominated in quality of life units.

What Research Is Needed?

The research project should be divided into three phases. Its effects should be felt almost immediately.

International

As much program implementation experience from the developing countries as possible should be distilled in respect to failures and successes, with particular attention paid to the five dimensions described above: follow-through, cost and simplicity of design, local participation and use of local personnel, middle management, and goals.

This phase could best be done in three parts and would require about two years:

- An international expert in program implementation and administration would write a short monograph indicating his or her views on why nutritionally-oriented programs fail in execution.
- Experts who are broadly versed in planning and program execution in their own countries would be invited to an international conference of perhaps 10 to 12 countries. Each expert would comment on the monograph and provide examples and descriptions of successes and failures in executing projects.

-- Three experts would be selected to write up the results of the conference.

The costs of the international phase are projected as follows:

1. Monograph on program management

6 U.S. scientist-months	\$25,000
Travel and support	5,000
Publication	<u>2,000</u>
TOTAL COST	\$32,000

2. International conference

Conference facilities and room and board for 24 participants for four days	\$ 5,000
Travel	12,000
Transcriptions and reports	<u>3,000</u>
TOTAL COST	\$20,000

3. Project report

2 U.S. scientist-months	\$ 7,000
4 foreign scientist-months	8,000
Travel and per diem	<u>3,000</u>
TOTAL COST	\$22,000

TOTAL COST OF INTERNATIONAL COMPONENT	\$74,000
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Country Applications

During the second phase of this research, the findings in the first phase would be applied to project management systems in selected countries. This phase would take three to five years to complete. Five countries would be chosen on the basis of their commitment to improving their management systems for executing programs.

The purpose of this applied phase is to examine the experience of the five countries in executing projects in terms of the information garnered in the international phase of this research design, and to determine how this country-specific and worldwide experience can be utilized to improve management design and project implementation. Selected government or private sector programs should be redesigned, taking into account both the country and international experience, and the design for each project included in

a short pamphlet telling why the management of the project was shaped as it was.

The overall supervision of the projects could be carried out by the United Nations or World Bank, which also would directly supervise the country project directors or work through a regional organization such as the Association of South East Asian Nations (ASEAN).

The country project directors would monitor the projects and would assess them against both stated program objectives and the particular implementation difficulties that the project management was designed to overcome. The intention is not for a costly and quantitative assessment, but rather for a qualitative appraisal by the country project director who would be outside the formal structure of the government.

The costs of the country applications component, assuming five countries and three projects per country, would be:

Five country project directors at one-half time salary for five years, which is equivalent to 12-1/2 foreign scientist-years	\$250,000
Research assistants on same basis as above, 12-1/2 years	125,000
In-country support for travel and reports	<u>75,000</u>
TOTAL COST	\$450,000

Final Review

The project would be concluded by a conference to examine the original monograph on project management with respect to the experience gained from the second phase. Each country director would provide conference participants with pamphlets on each of the projects as previously described. And the question, "Why do well-conceived projects fail in execution?" would be examined against all the project evidence. Each of the five country directors would present their experience, which would then be tested against the experience of the officials attending the conference. Finally, a monograph would be published summing up the findings of the overall project.

The costs of this final component of the project would be:

Conference costs for 36 participants for three days	\$ 5,000
Travel costs for 36 participants (one-half of fare to be paid by individual countries)	8,000
Costs of conference transcribing, etc.	4,000
Writing of final monograph: 6 U.S. scientist-months	25,000
1 foreign scientist-year	<u>20,000</u>
TOTAL COST	\$ 62,000

A summary of costs for Research Profile 4 looks as follows:

International	\$ 74,000
Country application	450,000
Final review	<u>62,000</u>
TOTAL COSTS	\$586,000

Research Direction 1

COPING WITH WEATHER INSTABILITY (See Study Team 5 Report)

WHY IS RESEARCH NEEDED?

No matter how many irrigation systems are built, more than half of the world's agricultural output will continue to be dependent on the vagaries of rainfall. This weather instability imposes enormous costs, particularly on the poor countries. Drought and flood not only cause great direct losses of output in an afflicted region, but they also force the national economy to provide relief assistance. Thus physical and human resources are diverted from current operations and long-run development programs. Also, international assistance often responds to these crises in an unplanned way.

The people who live in regions that have unstable weather conditions have developed indigenous mechanisms that help them cope with the consequences of that instability. However, these mechanisms are often ignored, thereby causing national governments and those who give foreign aid frequently to move too quickly and to put too many resources into the afflicted regions and into inappropriate programs that typically do not benefit the most affected groups. Policies that can increase the rationality of national and international responses to drought and flood crises will help avoid the vast waste of resources that now occurs with each crisis.

WHAT RESEARCH IS NEEDED?

Weather disasters can be treated as risks and uncertainties susceptible to insurance-type analysis and solutions. Crop insurance schemes exist in many high-income countries, but poor countries are unable to apply such programs because farmers and agricultural laborers are too poor to bear the premium costs.

Differently conceived insurance schemes, both on a national and international scale, probably can substantially ease these difficulties.

Weather crises usually do not affect a whole country at once, and it should be possible to calculate the degree of weather-induced output fluctuation that the country normally encounters. National budgets could incorporate allocations for such actuarially anticipated disasters, thus spreading risk across the country in ways that would minimize disruption to current national operations and development schemes. Research on such a proposal would need to examine a host of operational issues specific to each country including, among others, the role of existing indigenous mechanisms, the problems of developing effective crop-reporting systems, the administration of allocated assets, and the types of relief that would most effectively mesh with long-run development objectives.

But there is also a need for an international scheme based on the same insurance principle of risk spreading. We recommended previously the establishment of an independent International Weather Crisis Insurance Corporation (IWCIC) to cover these contingencies and to provide protection against occasional disasters that are too great to be handled by afflicted countries. Research must be directed toward the organization and functions of such an enterprise, with all the actuarial and financial obligations implied. Special attention should be given to designs that would provide greater protection for the very poor countries. For example, national premiums might be set in relation to capacity to bear risk as determined by average per capita income, while benefits could be paid out in ways that benefited poor countries more than better-off ones. Clearly, research would be needed to determine how to link the various national insurance schemes with IWCIC in ways of mutual support.

WHAT DIFFERENCE WILL RESEARCH MAKE?

Properly designed domestic and international insurance schemes will improve the average availability of food, reduce immediate human suffering, and strengthen the entire development process. The greater security and stability provided by such a scheme will allow individuals within poor countries to be more experimental and innovative than they now can afford to be.

Research Direction 2

MINIMIZING FOOD WASTE AND DISAPPEARANCE (See Study Team 6 Report)

WHY IS RESEARCH NEEDED?

We noted previously that there is an enormous local wastage of foods. Potential foods are not used because satisfactory methods of preparation have not been found; some have only limited use because they cannot be preserved; others are lost because of inferior preservation and inadequate preparation against pests. Much more food could be available to local people if local, labor-intensive methods of preparation, preservation, and protection could be developed or improved.

WHAT RESEARCH IS NEEDED?

There are many sophisticated techniques of food preparation, preservation, and protection that are available or that could be developed. These are usually too costly to benefit poor people and they are typically very capital-intensive, which imposes great financial burdens on the poor countries. Research is needed to develop simple, inexpensive, small-scale techniques that can be used by relatively unskilled people. Apart from programs to develop entirely new solutions, techniques should be sought that can be transferred into new environments.

WHAT DIFFERENCE WILL RESEARCH MAKE?

New and improved techniques of food preparation, preservation, and protection would substantially increase food supply available for consumption, particularly among the very poor. Many of these new techniques would ease the particular problem of food

shortages during the so-called "hungry season" that often precedes the harvest.

Research Direction 3

SHOULD NATIONAL FOOD PRODUCTION POLICY STRESS REGIONAL SPECIALIZATION BASED ON RESOURCE ADVANTAGE? (See Study Team 7 Report)

WHY IS RESEARCH NEEDED?

Economists generally favor a food production strategy that concentrates the application of scarce inputs in areas where technical conditions are the most favorable. In India, for example, the Intensive Area Development Program concentrates the use of new seed strains, fertilizers, and pesticides in areas where irrigation is available. While this policy makes sense in terms of obtaining the most rapid short-run increases in total national output, evidence cited previously indicates that the benefits of these increases, measured in terms of calories consumed per capita, do not spread to deficit regions. The market mechanism for interregional transfers does not always seem to work well and nutritional disparities among regions sometimes worsen rather than improve.

Some scholars have concluded from this situation that future policies will have to stress a much greater role for public systems of food distribution to offset the weakness of the market in the short run. Since this is administratively costly, countries also will have to undertake long-run programs to establish a much greater degree of regional self-sufficiency in food grain production. This argument poses a challenge to one of the most widely accepted principles of economic development. While the problem relates only to countries where regional specialization makes technical sense, this still affects a very large proportion of the poor countries and poor people of the world.

WHAT RESEARCH IS NEEDED?

We have to determine the extent to which the hypothesis is correct that the market mechanism has failed to offset the technical advantages of regional specialization and that such specialization has led to a widening of per capita nutritional disparities among regions. To the extent that the "market failure" hypothesis is true, research is needed to determine whether improvements in the working of the market--such as reducing transport costs and market imperfections--might still be a better way in which to move than to increase regional autarky in food production.

One difficulty with the current discussion among scholars and policymakers is that cereal production and consumption data are used as a surrogate for everything that is consumed. Research is needed to consider the possibility that items of local consumption that are not included in consumption surveys offset the regional per capita differences in calorie consumption that show up when only the major national staples are counted. Research that improves consumption statistics, particularly to yield more accurate estimates of regionally specific food items consumed, could have rather substantial effects on production policy.

The clarification of this complex issue would lead research in three directions. If the "market failure" hypothesis is proven false, it would reduce doubts about the advantages of regional specialization and would strengthen these commonly accepted principles. Research could then concentrate on ways to make the interregional transfer mechanism work better. If the "market failure" hypothesis is shown to have substance, it would require that more research be devoted to eliminating deficiencies in public distribution systems. More research also would be needed on policies that encourage greater regional autarky.

If improved consumption data that take into account regionally specific food items show that these neglected items are of real or of potential importance, this would lead to research on the possibilities of reallocating food production resources, but in ways probably different from those that flow from the "market failure" hypothesis. Research that concentrates on greater output of regionally specific food items still could seek to take account of the advantages of regional specialization. Research would devote more attention to the process by which increased consumption of regionally specific food items could be encouraged. (Such investigations would overlap with the research suggested in Research Direction 5.) If improved statistical analysis suggests that large components of nutritional intake in the form of

regionally specific foods are not being recorded, it also will force us to reconsider much that is said about nutritional deficiencies in the poor countries.

WHAT DIFFERENCE WILL RESEARCH MAKE?

It is not possible to estimate the nutritional benefits that might result from this research proposal, but in some cases they could be quite substantial. If regionally specific food consumption turns out to be actually or potentially significant, it could lead the developing countries to undertake national food policies that reallocate resources for development and production to take these possibilities into account. If improved statistical data reveal that neglected food items are important in the diet, this may require reexamining nutrition policy along lines that will favor greater emphasis on short-run fluctuations in food availability and also on complementary village development policies.

Research Direction 4

SOCIOPOLITICAL OBSTACLES TO PROGRAM IMPLEMENTATION (See Study Team 7 Report)

WHY IS RESEARCH NEEDED?

We have noted that programs specifically targeted to benefit the very poor often fail because such groups are difficult to reach, and because local vested interests can divert the benefits of such programs to their own advantage. Unless ways can be found to cope with these difficulties, direct efforts to help the poor will be discontinued and policies will have to concentrate on the more general and indirect programs that have proven to be, at best, very slow to produce results.

WHAT RESEARCH IS NEEDED?

Successful pilot projects, which have been able to deliver their intended benefits to poor groups, have usually depended on an enormous, costly administrative effort which cannot be sustained in full-blown programs. Research based on past experience is needed to develop and experiment with a wider array of alternative delivery systems, ranging from programs that are to a large degree centrally controlled but at the same time are administratively decentralized to types that depend on local organization and self-help capacities.

To reduce administrative costs in centrally directed programs, local people must be used on voluntary, part-time, and full-time bases. A sine qua non of all research on this problem must be a concern with developing incentive structures tailored to support and reinforce the objectives of specific programs. This relates to Research Profile 4, "Management Systems."

There are many situations in which the distribution of local political power makes it difficult if not

impossible to reach the very poor with the usual centrally directed programs. Under such frequent circumstances--and assuming that a revolutionary political solution is unlikely--two other approaches need to be tested: nonexclusionary and self-help programs. The first requires that serious attention be devoted to developing programs that produce a flow of benefits from which it is extremely difficult to exclude the very poor. Programs of this nonexclusive sort are likely to produce benefits to better-off and poor groups in varying proportions. Research will have to develop policies that can transfer larger proportions of benefits to the very poor. For example, we ought to examine the possibility of redirecting famine relief policies in ways that would produce long-run benefits for the poorest groups.

Of course, all programs should be designed with the intent of strengthening local initiative. This is why so much attention must be devoted to developing effective incentive systems as integral features of all programs. These systems are particularly important in the development of schemes designed to encourage very poor groups to participate in self-help programs. It also is probably correct to suggest that all programs that seek to strengthen local initiative should stress the use of institutions already familiar to the participants. If self-help and local initiative are stressed, great care should be taken to design schemes that do not merely convert local institutions into agencies for the administration of central decisions. This means that a great deal of research must be focused on the possibilities of using existing religious, cultural, and social arrangements to achieve nutritional and developmental objectives.

Research must keep two other principles in mind. First, the most effective programs probably will be those that do not set inordinately high standards. For example, a program that seeks to increase an average diet of 1,900 calories per day by 10 percent within a fixed period may be much easier to organize and achieve than one that sets out to provide a medically acceptable, balanced diet minimum of 2,400 calories plus adequate proteins and nutrients. Too many programs in the past have been designed to provide very high quality solutions which invariably impose greater administrative and economic burdens than programs directed at poor groups can be expected to sustain. This leads to the second principle, that programs are not successful unless pilot schemes can be easily replicated.

WHAT DIFFERENCE WILL RESEARCH MAKE?

If effective programs of direct nutritional impact or nonexclusionary and self-help programs can be devised, we will have come a long way toward overcoming the major barriers that have made current efforts so ineffective. Effective programs will overcome the distributional bottlenecks. They also will create a framework within which production increases can be accelerated.

Research Direction 5

HOW TO CHANGE DIETARY HABITS AND FOOD CONSUMPTION PATTERNS (See Study Team 9 Report)

WHY IS RESEARCH NEEDED?

The report makes clear that no society consumes everything that has a nutritional value. Moreover, food itself is defined differently by every culture. Religious and secular taboos are the bases for excluding much that could be nutritionally useful. For example, Muslims and Jews refuse to eat pork. Americans do not eat dog meat. Social status induces uses and nonuses of food based on criteria quite unrelated to nutritional values, as in the growing substitution of formula milk for breast-feeding or the shift to rice and wheat from other food grains. In periods of rapid population growth and socioeconomic change, old foods may become difficult to obtain. New nutrient sources are needed to expand on or replace existing ones. Thus food habits and the ways they do change or could be changed are very pertinent to determining nutritional policy.

WHAT RESEARCH IS NEEDED?

A series of research problems can be identified:

- How does changing the market price affect food habits? While this research would concentrate on social and cultural limitations to price as a mechanism for affecting food choices, it is nevertheless true that the market has sometimes influenced choice in the face of strong social and cultural preferences. The shift from rice to tapioca in Kerala is a recent example. Research is required into situations where the market has and has not had an effective impact.

- How do rising incomes, changing values, and the cultural diffusion of status affect food choices? Emphasis should be placed on predicting the influence of such changes on nutritionally-oriented social policy.
- How are alternative foods utilized during crises? Recurrent crises such as drought or flood and nonrecurrent crises such as wars may make preferred and sanctioned foods temporarily unavailable. Do people ignore food taboos in such instances and "discover" new food sources? Are there specific patterns of alternative food use in regions and countries regularly afflicted by crises? Do such changes persist beyond the crises? For example, during the food shortages in Japan in the 1940s caused by war and the subsequent American occupation, a great many new foods were introduced. Which of these persisted in the Japanese diet? Which did not?
- How can people cope with the tendency for many traditional foods to disappear as an effect of specialized production for national and international markets? While this expanded production may produce higher national incomes, it also may result in poorer nutrition for some groups because of changes in what they produce and therefore have available for their own consumption. Research is needed to determine how extensive this phenomenon is and how to respond to these nutritionally adverse consequences.
- What specific cultural barriers block effective food usage? The availability of food must be distinguished from its use. For example, who gets food within families is affected by beliefs and values that determine the order in which men, women, and children eat, the amounts they should get, and what is considered proper food for various members of the family. In parts of Africa, meat is considered to be inappropriate for children, and in many societies it is considered to be inappropriate for women. In other words, research is needed to determine the use of food at the point of consumption--"at the table"--to assess the ultimate possibilities of food use changes.

Research should be conducted along three lines. First, an inventory of past diet studies should be compiled. Despite many individual accounts of change, no single survey of the literature exists. Second, dietary changes that currently are occurring should be evaluated. And third, experiments should be conducted by introducing change influences into a community while using another community as a control population.

WHAT DIFFERENCE WILL RESEARCH MAKE?

Research would develop generalizations that policymakers could use to achieve changes in existing food-use patterns where they are needed to increase available supplies of nutrients or to reduce uses that are inappropriate to proper nutrition. It also would enable policymakers to anticipate and respond in nutritionally appropriate ways to changes in food consumption patterns produced by economic, social, and cultural changes.

Research Direction 6

INFANT MORTALITY AND FERTILITY (See Study Team 9 and 10A Reports)

WHY IS RESEARCH NEEDED?

We have suggested that improved nutrition at the village and community level may play a crucial role in reducing population growth. There seems to be some positive relationship between policies that reduce infant and child mortality and a tendency for the general birth rate to fall. The implication is that high birth rates insure couples against a high rate of infant deaths and that as mortality declines, parents can produce a smaller number of children to achieve the family size they desire. In itself, however, this would have no clear restraint on population growth unless the preferred size of family also declines.

It has been suggested that improved child survival rates lead to more family planning and, consequently, to a decline in fertility. The data are often ambiguous and in many of the studies the direct relationship between child survival and a declining birth rate is rather slight. In effect, this is only a hypothesis and demographers are not certain that the link exists or that it works in the way suggested.

WHAT RESEARCH IS NEEDED?

Research must trace out the complex relationships implied by this child survival hypothesis. For example, if families desire a number of sons to provide economic support and to insure lineage continuity, we would expect to find that female children would be discriminated against within the family. A finding of higher early childhood mortality among females than males would suggest that in such a society efforts to reduce the need for sons or improve the value of daughters might be as important a mechanism for improvement as direct efforts to reduce mortality.

There are great regional and local variations in attitudes toward males and females that must be explained if we are going to design programs that will effectively reduce the birth rate. To what extent are differences and changes in fertility attributable to biological factors rather than social factors? Do changes in rates of child survival affect family planning?

WHAT DIFFERENCE WILL RESEARCH MAKE?

If the child survival hypothesis is confirmed, it would strengthen the argument for the village development policies suggested in the report. In any event, a clearer understanding of the relationship between infant mortality and actual and preferred family size would provide a much more solid basis for designing family planning programs.

Research Direction 7

WOMEN AND NUTRITION (See Study Team 7, 10, and 10A Reports)

WHY IS RESEARCH NEEDED?

In most societies, women control the selection and preparation of food. Their role includes providing the primary nutrition, hygiene, health care, and education for children. In most rural settings, women also plan and plant the family garden plot. What is not clear is how the role and skills of women affect and are affected by the various approaches to nutrition indicated in this report.

WHAT RESEARCH IS NEEDED?

First, the potential of women must be recognized in all the research profiles and directions, e.g., women in the successful poor countries; women's roles in reducing food waste, exploiting wasted food resources, and protecting and improving diets; the potential use of women as community workers whose direct dealings with the welfare of women and children may be seen as legitimate and unthreatening, therefore averting the bottlenecks of local power structures. Second, women need to be considered independently because there are large gaps in our understanding of how women have been differentially affected by nutrition programs and how they have specifically affected the results of such programs. Third, women need to be considered, both individually and as a cultural subgroup, as a resource to be utilized in the achievement of nutritional success, as defined in this report.

WHAT DIFFERENCE WILL RESEARCH MAKE?

Women are deeply involved at the grass roots with the nutritional problems and potential solutions

considered in this report. Women have major control over the most nutritionally at risk groups, infants and children, as well as nearly total control over their prenatal health. Thus affirmative results from this research will have major effects worldwide and will reinforce the research results of other research profiles.

Research Direction 8

INTERNATIONAL INCENTIVES TO ENCOURAGE NATIONAL PROGRAMS OF REDISTRIBUTION (See Study Team 10D Report)

WHY IS RESEARCH NEEDED?

The ability of some very poor countries to improve substantially their quality of life seems to be based on a variety of policies, including educational, public health, and food distribution as well as various amounts of land reform. Whatever the specific mix, the policies have involved rather difficult redistributions of power, sometimes leading to violent political upheavals. In other instances, they were achieved with less bloodshed, seemingly because of complex changes in the distribution of power among social groups. Incentive schemes provided through various international agencies and foreign countries--e.g., concessional interest rates or tariffs--have induced some developing countries to undertake programs that they otherwise would not have. Most poor countries have sociopolitical structures that are not favorable to development programs that would provide nutritional and other benefits specifically to their poorest groups. Is it possible to break the bottlenecks in these countries by creating internationally supported incentives that are sufficiently attractive to enough powerful groups to reduce reluctance to adopt such programs? Virtually no attention has been paid to this as a general policy.

WHAT RESEARCH IS NEEDED?

Research is required to determine what kinds of large-scale, internationally funded incentive schemes are needed to induce powerful groups in the poor countries to support basic need programs for their poorest groups. What would be the cost of such incentive programs to the developed countries that

would have to fund them? Each scheme would have to include methods for validating successful progress.

WHAT DIFFERENCE WILL RESEARCH MAKE?

Obviously, there are some countries in which no conceivable system of externally funded incentives would be sufficient to overcome the solid opposition of vested interests. There are other situations in which the incentives required would be greater than even developed countries would be prepared to finance. The ethical problems posed for the developed countries are examined in Research Direction 10, "U.S. Responsibilities and the World's Poor."

However, there are many developing countries in which sociopolitical structures are much less monolithic and in which effectively designed incentive schemes could stimulate some important policy shifts towards meeting the basic needs of the very poorest groups within self-determined national strategies. We cannot estimate the benefits that would flow from any successful international incentive scheme; those would depend on the level of program funding and the nature of developing country response. But one proposal¹⁶ estimates that it would take only 25 years for virtually any poor country that participated in the suggested scheme to achieve the quality of life already attained by the successful poor countries identified in this report.

Research Direction 9

THE INTERNATIONAL ECONOMIC ENVIRONMENT (See Study Team 10C Report)

WHY IS RESEARCH NEEDED?

The poorest countries have a choice: continued slow and halting progress or more rapid progress through involvement in the international economy. However, their choice is meaningful only to the extent that the international economic system provides real alternatives and possibilities. In association with other nations of the world, the United States is helping to redefine the international economic order. Such a redefinition involves many trade and financial arrangements; the agenda is awesome. Yet, if completed, such efforts will provide the developing countries with a wide range of choices and opportunities so that they can to a considerable degree determine their own futures. What do such futures hold? How will the quality of life be affected?

WHAT RESEARCH IS NEEDED?

At present, many studies are being carried out by the Tinbergen group, the Trilateral Commission, the ILO, the Aspen Conference, and others. There are many possible economic orders that could result based on the needs of the developing and high-income countries. It would be particularly valuable for an international group of economists and political scientists to develop overall sketches of several of these possibilities. They would then evaluate the potential impact of these possibilities on the nutrition and quality of life of the poor countries and of the poorest groups within those countries.

WHAT DIFFERENCE WILL RESEARCH MAKE?

The success of international negotiations from 1976 to 1979 will depend on many factors and will require many countries with conflicting interests and ideologies and differing economic and political power to compromise and choose some common ground. A "map of the territory" would help in the search for this common ground. The difference made by this research may be its contribution to the success (or failure) of these negotiations to create a new international economic order which would provide developing nations with effective choices for their own futures.

Research Direction 10

U.S. RESPONSIBILITIES AND THE WORLD'S POOR (See Study Team 10D Report)

WHY IS RESEARCH NEEDED?

We realize that this subject is already a major topic of research, but this research direction is included to strengthen existing efforts and also to draw attention to the important effects this work has for nutrition. Our report has emphasized the roadblocks in bringing aid to the poor. Earlier it was noted that reliance on increased GNP is not the only or the most effective way to enhance the well-being of people in the developing countries. Also, it was pointed out that neither buying nor begging food from abroad is a viable alternative. In the face of weak interregional transfer mechanisms, we concluded that planned food production gains from regional specialization cannot be counted on to nutritionally benefit the whole population in a developing country.

We also have noted that in most developing countries general food distribution or subsidy programs are feasible only in urban areas and even then often fail. Targeted feeding programs, which appear so cost-effective on paper, also fall short of their objectives as they collide with local values and structures or sag under the weight of their own centralization or fail to promote the local self-reliance necessary for follow-through success. However, in the introduction to this report, we looked at what can be done if responsibilities and opportunities were carefully delineated and placed, including those appropriate for the United States. We also noted the necessity for public understanding and support within the United States and presented the dilemma facing Americans today. In the American democratic process, such dilemmas are resolved by public debate. It is time for this deliberative process to decide the limits of U.S. responsibility and resource commitment to the poorest of the poor in this interdependent world. We recognize

that many other groups already have begun such deliberations, e.g., the Tinbergen Group, the Aspen Interreligious Consultation, the Trilateral Commission, the ILO, and others.

WHAT RESEARCH IS NEEDED?

American public debate is best when it is well informed, both conceptually and factually. Political scientists, sociologists, foreign policy experts, economists, nutritionists, and others should join together to examine the alternatives. Questions such as whether or not the United States should control, entice, or discipline the behavior of other nations toward the welfare of their poor need to be conceptually and factually framed. For the purposes of this report, however, the debate needs to examine U.S. actions and restraints in terms of their impact on nutrition and quality of life, not just economic impact.

WHAT DIFFERENCE WILL RESEARCH MAKE?

The results are unpredictable; they could be large or small. But in our future world, the United States has no choice but to be part of either the problem or the solution--its size, power, prominence, and idealism require it. It is worthy of science in a democratic state to contribute to the informed debate of major issues.

Appendix

PHYSICAL QUALITY OF LIFE INDEX (PQLI)
AND OTHER SELECTED INDICATORS FOR
COUNTRIES OF THE WORLD, EARLY 1970s

Country	Population, mid-1973	Per capita gross national product, 1973 (\$)	Per capita average daily calorie consump- tion 1969-71	Physical quality of life index (latest data available)
<u>Low-income countries</u>				
<u>(below \$300)</u>	2,134.2	186	2,113	48
1. Afghanistan	18.3	90	1,970	19
2. Bangladesh	83.4	80	1,840	33
3. Benin	2.9	110 ^a	2,260	23
4. Bolivia	5.0	230	1,900	45
5. Botswana	0.7	230 ^a	2,040	38
6. Burma	29.8	80	2,210	51
7. Burundi	3.9	80 ^a	2,040	23
8. Cameroun	6.2	250	2,410	28
9. Central African Republic	1.6	160	2,200	18
10. Chad	4.0	80	2,110	20
11. People's Republic of China	799.3	270 ^a	2,170	59
12. Egypt	36.9	250	2,500	46
13. Equatorial Guinea	0.3	260	n.a.	28
14. Ethiopia	26.8	90	2,160	16
15. The Gambia	0.4	130	2,490	22
16. Guinea	4.2	110	2,020	20
17. Haiti	5.6	130	1,730	31
18. India	600.4	120	2,070	41
19. Indonesia	132.5	130	1,790	50
20. Kenya	12.0	170	2,360	40
21. Khmer Republic	7.8	81 ^{ab}	2,430	41
22. Laos	3.2	100 ^{ab}	2,110	32
23. Lesotho	1.1	100 ^a	n.a.	50
24. Malagasy Republic	7.5	150	2,530	44
25. Malawi	4.8	110	2,210	29
26. Mali	5.5	70	2,060	15
27. Mauritania	1.3	200	1,970	15
28. Nepal	12.0	90	2,080	25
29. Niger	4.2	100	2,080	14

Country	Population, mid-1973	Per capita gross national product, 1973 (\$)	Per capita average daily calorie consump- tion 1969-71	Physical quality of life index (latest data available)
30. Nigeria	59.6	210	2,270	25
31. Pakistan	68.3	120	2,160	37
32. Philippines	42.2	280	1,940	73
33. Rwanda	3.9	70 ^a	1,960	27
34. Senegal	4.2	280	2,370	22
35. Sierra Leone	2.8	160	2,280	29
36. Somalia	3.0	80 ^a	1,830	19
37. Sri Lanka	13.5	120	2,170	83
38. Sudan	17.4	130 ^a	2,160	33
39. Tanzania	14.3	130	2,260	28
40. Thailand	39.9	270	2,560	70
41. Togo	2.0	180	2,330	28
42. Uganada	9.3	150	2,130	33
43. Upper Volta	5.7	70	1,710	17
44. Western Samoa	0.2 ^{adj}	250 ^a	n.a.	86
45. Yemen, Arab Republic	6.2	100 ^a	2,040	27
46. Yemen, People's Republic	1.4	110 ^a	2,070	27
47. Zaire	18.7	140	2,060	28
<u>Lower-middle</u>				
<u>(\$300-\$699)</u>				
	270.9	477	2,420	57
1. Albania	2.3	460 ^a	2,390	76
2. Algeria	15.5	570	1,730	42
3. Angola	6.1	490	2,000	15
4. Cape Verde Islands	0.3	340 ^a	n.a.	46
5. Republic of China	15.0	660	2,050	88
6. Colombia	23.7	440	2,200	71
7. Congo	1.0	340	2,260	25
8. Cuba	8.9	540 ^a	2,700	86
9. Dominican Republic	4.8	520	2,120	64
10. Ecuador	6.7	380	2,010	68
11. El Salvador	3.8	350	1,930	67
12. Ghana	9.9	300	2,320	31
13. Grenada	0.1	330	n.a.	80
14. Guatemala	5.6	500	2,130	53
15. Guinea-Bissau	0.6	330	n.a.	10
16. Guyana	0.8	410	2,390	84
17. Honduras	3.0	320	2,140	50
18. Ivory Coast	4.6	380	2,430	28
19. Jordan	2.6	340	2,430	48
20. Republic of Korea	34.5	400	2,520	80
21. Liberia	1.2	310	2,170	26
22. Malaysia	11.8	570	2,460	59

Country	Population, mid-1973	Per capita gross national product, 1973 (\$)	Per capita average daily calorie consump- tion 1969-71	Physical quality of life index (latest data available)
23. Mauritius	0.9	410	2,360	75
24. Morocco	17.4	320	2,220	40
25. Mozambique	8.2	380 ^a	2,050	23
26. Nicaragua	2.2	540	2,450	53
27. Paraguay	2.7	410	2,740	74
28. Peru	14.9	620	2,320	58
29. Rhodesia	5.6	430	2,660	43
30. Swaziland	0.5	330 ^a	n.a.	36
31. Syrian Arab Republic	6.8	400	2,650	52
32. Tunisia	5.6	460	2,250	44
33. Turkey	38.6	600	3,250	54
34. Zambia	4.7	430	2,590	28
<u>Upper-middle</u> <u>(\$700-\$1,999)</u>	414.8	1,101	2,697	73
1. Argentina	25.3	1,640	3,060	84
2. Bahrain	0.2	900	n.a.	60
3. Barbados	0.3	1,000	2,380 ^c	88
4. Brazil	101.3	760	2,620	68
5. Bulgaria	8.7	1,590 ^a	3,290	94
6. Chile	10.4	720	2,670	77
7. Costa Rica	2.0	710	2,610	87
8. Cyprus	0.6	1,400	2,670	87
9. Gabon	0.5	1,310	2,220	21
10. Greece	9.1	1,870	3,190	91
11. Guadeloupe	0.4	1,050 ^a	n.a.	85
12. Hong Kong	4.5	1,430	2,370 ^c	88
13. Hungary	10.4	1,850 ^a	3,280	92
14. Iran	31.1	870	2,300	38
15. Iraq	10.8	850	2,160	45
16. Jamaica	2.1	990	2,360	87
17. Lebanon	3.1	940	2,280	80
18. Malta	0.3	1,060	2,820	89
19. Martinique	0.4	1,330 ^a	n.a.	88
20. Mexico	56.2	890	2,580	75
21. Panama	1.6	920	2,580	81
22. Portugal	9.8	1,410	2,900	79
23. Reunion	0.5	1,210 ^a	n.a.	74
24. Romania	21.0	810 ^d	3,140	92
25. Saudi Arabia	8.4	1,610	2,270	29
26. Singapore	2.3	1,830	2,430 ^c	85
27. South Africa	21.7	1,050 ^e	2,740	48
28. Spain	34.2	1,710	2,600	94
29. Surinam	0.4	870	2,450	85

Country	Population, mid-1973	Per capita gross national product, 1973 (\$)	Per capita average daily calorie consump- tion 1969-71	Physical quality of life index (latest data available)
30. Trinidad and Tobago	1.1	1,310	2,380	88
31. Uruguay	3.0	950	2,880	88
32. Venezuela	11.9	1,630	2,430	80
33. Yugoslavia	21.2	1,060	3,190	85
<u>High-income</u>				
<u>(\$2,000 and over)</u>	964.5	3,872	3,175	96
1. Australia	13.3	4,350	3,280	96
2. Austria	7.5	3,510	3,310	95
3. Bahamas	0.2	2,320 ^a	n.a.	87
4. Belgium	9.8	4,560	3,380	95
5. Canada	22.5	5,450	3,180	97
6. Czechoslovakia	15.0	2,870 ^a	3,180	95
7. Denmark	5.1	5,210	3,240	98
8. Finland	4.8	3,600	3,050	95
9. France	52.3	4,540	3,210	97
10. Democratic Repub- lic of Germany	16.3	3,000	3,290	96
11. Federal Republic of Germany	59.4	5,320	3,220	95
12. Iceland	0.2	5,030	2,900 ^c	99
13. Ireland	3.0	2,150	3,410	96
14. Israel	3.1	3,010	2,960	90
15. Italy	54.9	2,450	3,180	94
16. Japan	107.3	3,630	2,510	98
17. Kuwait	0.9	12,050	n.a.	76
18. Libyan Arab Republic	2.1	3,530	2,570	42
19. Luxembourg	0.4	4,940	3,380	96
20. Netherlands	13.4	4,330	3,320	99
21. New Zealand	3.0	3,680	3,200	96
22. Norway	4.0	4,660	2,960	99
23. Poland	34.0	2,090 ^a	3,280	94
24. Sweden	8.2	5,910	2,810	100
25. Switzerland	6.5	6,100	3,190	98
26. U.S.S.R.	250.0	2,030 ^a	3,280	94
27. United Kingdom	57.0	3,060	3,190	97
28. United States	210.3	6,200	3,330	96

Country	Population, mid-1973	Per capita gross national product, 1973 (\$)	Per capita average daily calorie consumption, 1969-1971	Physical quality of life index (latest data available)
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Summary

(Weighted averages)

I. Below \$300 (47 countries)	2,134.2	186	2,113	48
II. \$300-699 (34 countries)	270.9	477	2,420	57
III. \$700-1,999 (33 countries)	414.8	1,101	2,697	73
IV. \$2,000 and over (28 countries)	964.5	3,872	3,175	96
World (142 countries)	3,784.0	9,246	2,470	63

^aTentative estimate.

^bU.S. Agency for International Development, Office of Financial Management, Statistics and Reports Division, Gross National Product: Estimates for Non-Communist Countries for 1973, No. RC-W-137, July 1975. Tentative estimate.

^cLatest available figures on per capita daily calorie consumption from U.N. Statistical Yearbook, 1972.

^d1972 figure.

^eIncludes data for Namibia.

Source: Population figures from 1973 World Population Data Sheet of the Population Reference Bureau, Inc. GNP figures from World Bank Atlas: Population, Per Capita Product and Growth Rates, 1975. Base year is for 1972-1974. Except where noted otherwise, per capita daily calorie consumption figures are from U.N. World Food Conference (1974) Assessment of the World Food Situation: Present and Future, and represent a 1969-1971 average. POLI based on equally weighted summation of life expectancy, infant mortality, and literacy indexes. Life expectancy and infant mortality figures represent latest available data from the Population Reference Bureau while literacy figures are latest available data from UNESCO Yearbook, 1974.

We had the assistance of the Overseas Development Council in compiling these data.

NOTES

1. The words "nourish" and "nutrition" are used in this report in a broad and encompassing sense. See also Leaf (1973), Gardner (1972), Giff, et al. (1966), and Scrimshaw (1976).
2. In this provocative study of the factors that lead to a long life, the author places emphasis on the elderly being physically active and playing a meaningful social and economic role in the life of their community. Diet and genetic factors are examined but are of secondary importance. "People who no longer have a necessary role to play in the social and economic life of their society generally deteriorate rapidly."
3. "It appears to have been the enrichment of her environment, not of her diet, that was responsible for normalization of growth."
4. The state of a person's emotions affects and is affected by the condition of his physical body. An interaction of the two always occurs....[There are] effects of malnutrition, a physiological stress, on behavior and mental state. Conversely, psychological stress can influence the function of the physical organism as it makes use of the nutrients in food (Giff et al. 1966).
5. Craviota's work has focused on the parent-child relationship as critical in malnutrition, more so than the income, education, or any other characteristics of the parents. Watts (1976:390) stated that:

The results showed conclusively that malnourished children were likely to come from homes where there was less stimulation--be it breadth of experience, available play materials, stability of adult contact, or whatever....The mothers of the malnourished had a different--poorer--relationship with their offspring.

They were quite simply less responsive towards them. And those children had it tough in both ways. Inadequate home stimulation not only created an intellectual environment ill-suited to mental development, but was also a feature of precisely those homes in which the child was most likely to suffer food shortage with all its retarding effects on that same development.

6. Also see Luyken, et al. (1964) concerning the fact that eating leaves of certain plants contributes significantly to the protein value of the diet.
7. Also see Morris (1976).
8. The death rate has not been included in the composite index because it is not adjusted for age distribution. Moreover, its effects are expressed in both life expectancy and infant mortality. The birth rate was excluded because a low level of births is not in itself a measure of well-being. It is a cultural preference. (The quality of life index is the product of work now underway at the Overseas Development Council, Washington, D.C., and we are grateful to the Council for permission to use these still preliminary results. For a version based on somewhat later data, see Sewell 1977:147-171.)
9. The China data, although probably not reliable, are used in Tables 1 and 2 as rough orders of magnitude since they are consistent with other sources and impressions of visitors. The reported literacy rate of 25 percent appears low on the basis of other reports.
10. I have two objections, then, to massive food distribution programs. First, they may be inefficient in achieving their objectives. Second there is danger of their [food programs] being used to divert attention from the basic problem of insufficient income and food and toward ineffective but flashy palliatives. While 30 percent of the population in a low-income country may need major nutritional assistance, a nutrition program is likely to reach only a small proportion of them. It may make the rich feel good that they are doing something for the poor, when what is really needed is for the rich to go along with the kinds of development programs that will expand employment, incomes, and consumption of the lower income classes. However, the latter course very often involves much more

substantial social, political, and economic change than the rich are willing to tolerate and certainly more than is involved in most of the nutritional programs put forward. Economic development frequently excludes a substantial proportion of the population. The most serious incidence of malnutrition occurs in this group of very low-income people whose incomes are not increasing. The very social, political, and economic forces that often exclude the poor from participating in rising incomes are likely to exclude them from participation in special nutrition programs, particularly if those programs emphasize the delivery of food. Thus, without change in power structures, the programs justified by the tragedy of the poor may benefit only the rich (Mellor 1974).

Also see Oftedal and Levinson (1973).

11. Rural Indians...carry a heavy load of intestinal parasites, worms and various kinds of bacteria and protozoa, and these things are obviously living on the same food that the people live on; some estimates indicate that as much as 15 percent of the actual food intake among people in poor countries may not go for human benefit (R. Revelle, International Conference, Massachusetts Institute of Technology, Cambridge, Mass., October 19-20, 1971).
12. The most acute problem if we have to establish priorities, lies squarely in rural areas. Taking a global approach, according to International Labor Organization figures, the number of adult workers in the developing countries (not including China) is about one billion now, extrapolated to 1.25 billion by 1980. Of these, 100 million or so are unemployed now and an additional 250 million will be idle by 1980. Over 70 percent of these are and will be dwelling in rural areas. Although the problems of urban life and the stresses of massive migration from the village to the town merit serious attention, the pressure of figures alone argues for greater priority to a global strategy toward rural development. On a more positive note, the rural area is and

- will continue for decades to be the main source of national income. To combat malnutrition we need to place more money in the hands of the housewife, and this can result only from increasing job possibilities and incentives. We need a global strategy aimed at an integrated rural development approach with clear priorities accorded to breaking the vicious cycle that creates malnutrition-- at the farm gate and within the village domain. What is advocated here is not a romantic dream or an individual's idea. Such attempts are already operational and showing promising results (Nour 1973).
13. For different countries, the point of divergence between the requirements of growth and distribution lies at different distances down the economic road....when choice cannot be any longer delayed, which path will a country choose? I suggest the answer will depend upon whether discontent or nationalism prove the stronger force in a given society (Chopra 1975).
 14. Calculated from data in United Nations, Table 10, page 29 (1976). Also see deVries, et al. (1967).
 15. The Consultative Group on International Agricultural Research (CGIAR) is a flexible and activist means for applying both basic and applied research to specific objectives such as farming in tropical soils and development of improved seed varieties. It is an outgrowth of the work of the Rockefeller Foundation and the Ford Foundation on the famous improved rice and wheat varieties. CGIAR is now financing nearly \$70 million of research in approximately 12 centers around the world. There are now eighteen members including Nigeria, the first developing country to join, and two Mideast OPEC (Organization of Petroleum Exporting Countries) countries as well as international and regional organizations.
 16. J. P. Grant, President, Overseas Development Council, Washington, D.C., in an unpublished paper, "The New International Economic Order and the World's Poorest Billion: A Fresh Approach?," presented to the Washington Center of Foreign Policy Research, November 4, 1976.

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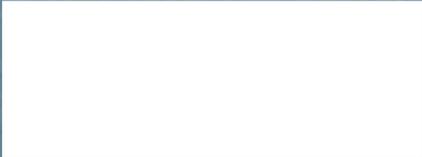
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