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9. ABSTRACT

To improve the planning and execution of nutrition programs in Tamil Nadu, India, the Tamil Nadu Nutrition Study was initiated in late 1970. Its objectives were to describe and analyze the nutrition system, to identify points for intervention to achieve significant changes in survival of children, and to propose specific action programs. The work plan included conducting pilot studies relating to three sub-systems: agricultural production, food processing and distribution, and consumer behavior. The findings included the following: About half the families in Tamil Nadu are receiving less than 80 percent of their calorie needs. Groups requiring special attention are the weaning child, the pregnant or nursing mother, and the adolescent female. The cultural constraints on food consumption behavior are profound. Improved nutrition can be provided to target groups not only by improved income, but also by improved food delivery systems and appropriate nutrition education of family decision-makers. Family planning programs will not succeed until improved nutrition significantly increases the current survival rate of children (to age six) of 555 per 1,000 live births. The comparable North American and European figure is 960. The Tamil Nadu Study succeeded in developing a system of analytical methodology specially suited to nutrition planning. The beginning of a State data base has been achieved.

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SIDNEY M. CANTOR ASSOCIATES INCORPORATED

VOLUME I

TAMIL NADU NUTRITION PROJECT

**AN OPERATIONS ORIENTED STUDY OF
NUTRITION AS AN INTEGRATED SYSTEM
IN THE STATE OF TAMIL NADU**

**Haverford, Pa. 19041
July 6, 1973**

PREFACE

"An Operations Oriented Study of Nutrition as an Integrated System in the State of Tamil Nadu" (familiarily known as the Tamil Nadu Nutrition Study) was a most timely project. It was a rational and logical outgrowth of the work undertaken by the team assembled for the contract, known officially as AID/nesa-399 "Assistance to India for Nutritional Foods Development", which had been functioning in India from September of 1968 as part of the staff under the general direction of Alan Berg, Chief of the Food and Nutrition Division of USAID/INDIA. *

The international climate of food and nutrition intervention in developing countries during this first contract period was dominated by an air of crisis of doomsday proportions. It was a situation in the process of being called to world attention. Although the subject had been discussed repeatedly by isolated workers, it needed a dramatic setting to communicate it effectively and aspects of the USAID program did just that. Emergency dried milk distribution from U. S. and world sources was giving way to cereal and vegetable protein mixtures (CSM and comparable products) because of the disappearance of dried milk—a situation which emphasized and confirmed the prevailing idea that population growth was outrunning food production. India was particularly affected because of the Bihar drought and a succession of poor harvests. Therefore, the idea of a Division of USAID exclusively directed to problems of food and nutrition appeared to put the subjects of hunger and malnutrition in a proper perspective.

To those newly introduced to developing country problems of food and nutrition, the dominating background experience which was recorded related to clinical pediatric field work. This had established the protein deficiency disease of children, kwashiorkor, and its accompanying calorie deficiency disease, marasmus. To a degree, the concomitant cultural food behavior as well as poverty had been pointed to as factors in the persistence of these diseases among children.

From the standpoint of intervention schemes, specific attention had been called to children's foods generally and weaning foods in particular. The direct use of oilseed protein flours (soya, cottonseed, peanut, etc.), was

* Prior to 1968, S. M. Cantor had served in a consulting capacity to USAID/INDIA/FAN during two trips to India, December 1966-January 1967 and June-July 1967.

being practiced to a limited extent and was being widely encouraged as low cost but good quality protein. The introduction of food technologists into the developing country food picture, which was intensified at that time, stimulated interest in vegetable protein processing and product development. The stimulation, however, carried with it developed country practices and ideas, i. e. , fortification of staples by protein and amino acids, simulated animal protein foods, beverage reinforcement by proteins, and advanced marketing practices including mass media advertising techniques.

The effect of this familiar Western-style frontal attack was strongly reflected on developing country food and nutrition programs and tended to dominate the approach to improve them. The net result was an attack on protein deficiency in many countries over a broad front, submergence of child feeding problems to needs of the general population and concentration on the preparation of nutritionally improved foods which were to be distributed in a developed country style although subsidized and delivered through networks established by voluntary agency practices. The problems of adaptation to local conditions with an understanding of local cultures while acknowledged, received relatively low priority beyond addition of simple flavorings by local people attempting to utilize strange products in their own style. This situation might be summarily described as the period of the "shotgun approach" to developing country food problems.

The need for an orderly and systematic examination of a food system which could isolate and describe optional interventions in sufficient detail to examine them for effectiveness and thus provide the basis for authoritative planning of a nutrition program had been in the minds of Indian planners, both Federal and State as well as USAID experts for some time. They had been watching the India nutrition experiments closely while more or less convinced that nutrition as a component of planning for national development carried obvious values, but values difficult to prove.

The initial impetus for a more systematic approach to nutrition planning was furnished in a memorandum on the subject by Dr. Robert Muscat of AID, dated 18 February 1969. About the same time Alan Berg asked the contractor to give consideration to "The economics of malnutrition" and to suggest methods of approach. The contractor's response was to propose a field investigation by Mr. S. H. Chafkin, President of American Technical Assistance Corporation, the contract's official adviser on

economic matters. Mr. Chafkin, armed with Dr. Muscat's memorandum and briefing by Mr. Berg, produced a report entitled "Possible Nutrition Strategies in India" (April 23, 1969) which included a suggestion for investigating a "state nutrition mini-system."

In the next few months, the Chafkin report was widely circulated and discussed in both AID circles and in the Government of India. By late December of 1969, it was concluded that just another nutrition survey was not called for, that any project worth carrying out should be addressed specifically to planning and national development and that such a project needed to incorporate operational components, the results from which could provide feedback to planning implications drawn from the data.

Concurrently, a site was selected for the study. It had been generally agreed that a South Indian state, where the specific problems of infant malnutrition were accentuated, was to be preferred. On a visit by Cantor and Chafkin planned to examine a number of southern sites, the first stop, Madras, proved to be the last. (It must be recorded that this result was predicted by Dr. V. Kurien, President of the Dairy Corporation of India and Director of the National Dairy Development Board, who recommended the Madras visit.) There it was concluded that Tamil Nadu offered several advantages. (1) The State had what appeared to be an effective ongoing child feeding program, one of the first such in India; (2) the enthusiasm for the project demonstrated by TN officials promised not only sympathetic observation but active participation and cooperation, (3) The TN Government had the beginning of an interdepartmental nutrition coordinating group consisting of representatives of the Departments of Agriculture and Food, Health and Family Planning, Rural Development, Education and Finance and Planning, all under the chairmanship of the Secretary of Social Welfare. The recognition that all these departments had nutrition components in their budgets and that the project could be identified as the working group for the coordinating effort, promised not only a dynamic and understanding atmosphere but also full and useful operational participation. Such indeed proved to be the case for, in many ways, the study team became a part of the TN Government's pioneering efforts in state level planning. The added continuous interest of the Central Government, through frequent visits from the local representative of the Food Department as well as the direct link with central planning furnished by the TN planning authorities, were invaluable.

The final project plan was submitted to the Indian Government on 10 March 1970 and approved for action in early September 1970. By that time, Mr. Paul Cifrino had succeeded Alan Berg as Chief of Food and Nutrition

of AID/INDIA and his interest in the project is reflected particularly in the "Take Home Food Test" which in several respects was conceived by him.

The unfortunate events surrounding the Bangladesh War (1971-72) created a severe trial to progress of the project since they interfered with communications between the field effort and the data organization and analysis underway in the contractor's home office. Unhappily, they made much needed conferences impossible at a particularly critical time and attempts to maintain telegraphic communication as a substitute failed. It was this difficult period which emphasized more than any other factor the somewhat over-ambitiously drawn work plan of the project. Nevertheless, while all the objectives of the study were not achieved, a great deal of progress was made and a firm base for the continuity of a nutrition planning effort was established.

It was during this most difficult period that Paul Cifrino's tour as Chief of USAID/FAN came to an end and he was succeeded by Mr. Daniel Shaughnessy. Mr. Shaughnessy's interest and intervention were instrumental in keeping the project going to the time of its scheduled completion and for this, the project team is particularly grateful.

It was stated in the beginning of this preface that the TN study was a timely project. It was timely because of the concentration of international events and efforts in nutrition, because of the gathering interest of planners and economists in nutrition (as so aptly described in Alan Berg's book "The Nutrition Factor"), and because of the intensive interest of the Indian Government and the Government of Tamil Nadu. But it was also timely for the contractor whose group effort was being directed at achieving a rational basis for nutrition intervention as well as a style of intervention that recognizes the need for total dominance of local culture and food behavior if the intervention is to be successful.

The results of the project demonstrate this philosophy without question. Beyond this, the contractor is gratified to have participated in a project which fulfills the highest purpose of international assistance, i. e., to help initiate an ongoing effort—an institution building effort—which promises to continue to expand, and by expanding proliferate its influence.

**Sidney M. Cantor Associates, Inc.
Haverford, Pa.**

July 6, 1973

ACKNOWLEDGMENTS

The preface to this report records the sequence of events which generated the Tamil Nadu Nutrition Study. Many individuals, in addition to those named, were involved and all are hereby acknowledged and thanked for their contributions and support. The following list is undoubtedly incomplete and we hope that our sins of omission will be forgiven by those that we miss but cherish no less.

Government of India

Dr. P. K. Kymal	Executive Director of the Food and Nutrition Board, Department of Food, Ministry of Food & Agriculture
Mr. K. P. Mithrani	Secretary, Department of Food
Mr. R. Balasubramanian	Former Joint Secretary, Department of Food
Mr. G. C. N. Chahal	Joint Secretary, Department of Food
Dr. R. N. Datta	Deputy Technical Advisor, Food and Nutrition
Mr. C. Subramaniam	Former Minister of Planning
Mr. Ashok Mitra	Former Secretary, Planning Commission
Mr. B. Venkatappiah	Member, Planning Commission
Mr. K. V. Natarajan	Ch. Nutrition and Social Planning, Planning Commission
Mr. O. K. Moorthy	Dir., Department of Social Welfare

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Government of Tamil Nadu

Mr. S. Venkitaramanan	Secretary, Department of Finance and Planning
Mr. S. P. Ambrose	Home Secretary (Former Secretary, Social Welfare)
Mr. J. A. Ambasankar	Secretary, Health and Family Planning Department
Mr. K. Diraviam	Secretary, Department of Food
Mr. D. K. Oza	Secretary, Social Welfare
Mr. M. G. Rajaram	Deputy Director, Planning Commission

USAID/India

Mr. Howard Houston	Minister Director
Mr. Leonard Saccio	Former Minister Director
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Ms. Ann Fitzcharles	Chief, Food and Nutrition
Mr. Charles Puttkammer	Chief, Nutrition
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AN OPERATIONS ORIENTED STUDY OF
NUTRITION AS AN INTEGRATED SYSTEM
IN THE STATE OF TAMIL NADU

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OVERVIEW

The Tamil Nadu Nutrition Study was initiated in late 1970 by agreement of the Government of Tamil Nadu, the Government of India and the USAID. It was an outgrowth of a long period of planning which was concerned with organizing an approach to food and nutrition intervention to displace narrowly defined projects by broadly based programs logically related to socioeconomic areas. To provide the context of such planning, it was necessary to perform a "systems analysis" of a discrete area. Tamil Nadu was selected because of its government's recognized multidepartmental interest in nutrition. Organizationally, the interdisciplinary project team which incorporated economics, econometrics, biology, nutrition, food technology, sociology, anthropology, engineering and systems dynamics, became the research arm of the Tamil Nadu Government's interdepartmental working group on nutrition.

The objectives of the project were to: (1) "describe and analyze a nutrition system", (2) "identify points in the system for intervention to achieve significant changes in survival of children", (3) "identify points which can sensibly relate nutrition to socioeconomic areas, such as national development, family planning, and the quality of life", (4) "limit the analysis to those parameters most relevant to proposed solutions", and (5) "propose specific action programs related to the solutions."

The derived work plan of the TN Nutrition Study incorporated collections of primary and secondary data in the field, as well as the conduct of selected operational pilot studies relating to three subsystems covering more than 70% of the economy of Tamil Nadu: (1) the agricultural production subsystem, (2) the food processing and distribution subsystem, and (3) the consumer subsystem.

The consumer subsystem dominated the data collection and analysis effort (a data base of nearly 5000 families was organized in four rounds of data collection) because the study, as conceived, was marketing oriented, i. e., action is initiated by careful assessment of the nutrition status of the population in terms of target groups, and, in turn, translated into needs. To deliver the needs, a detailed knowledge of the consumer's behavior in social, cultural and economic terms is essential. Thus, the emphasis on multidisciplinary investigation. To facilitate the multidisciplinary activity and maximize the accomplishment, an effective combination of U.S. and Indian subcontractors and consultants was organized. These included the Indian Institute of Public Opinion Ltd., New Delhi, the Operations Research Group of Baroda, Data Systems, Ltd., of Bangalore and the Sri Avinashilingam Home Science College, Coimbatore. American

subcontractors were American Technical Assistance Corporation, Washington, D. C., and Symbionics, Inc., Waltham, Mass. Field work was centralized with the American Technical Assistance Corp., as CANTOR/ATAC in Madras, Tamil Nadu; data analysis and methodology development were conducted at the home office of the contractor, Haverford, Pa., and at the USAID Computer Center in Washington, D. C.

Findings

At a median figure of 80% calorie needs met, approximately half of the families in Tamil Nadu are above this line and half below. The under-nutrition in the state is most significant. However, contrary to popular ideas, the major deficiency is calories not protein. Generally speaking, protein need met is significantly higher than calorie need met.

Principal target groups requiring special attention are the weaning child, the pregnant mother, the nursing mother, and the adolescent female. For measuring survival and generally improving the quality of survivors, the needs of these groups must be met and their food behavior modified to relate to biological functions and requirements and away from traditional practices. The latter are often counterproductive to survival. The cultural constraints on food behavior are profound and the improvement of nutritional status is seen as essentially a problem of behavioral change.

Nutritional status of the target groups is not truly income related because of intrafamily food distribution. This appears to operate on a self-imposed two-dimensional assessment of need (the "silhouette hypothesis") and not a recognition of growth and biological requirements. This single factor is probably responsible for the bulk of infant morbidity and mortality in Tamil Nadu.

Rural/urban, education, caste (jati), employment, income and other critical variables relating to nutritional status were studied and are important but in terms of ultimate food behavior, culture dominates. This, despite the fact that a significant number of people know something about protein, vitamins, and minerals.

The answer to improved nutrition among these target groups is thus not only improved income. It involves food delivery systems, appropriate nutrition education of family elders who are the decision makers, and a supply and proper identification of supplementary food (survival food) for infants. Equal attention must be provided the other target groups if the "process of human reproduction" is to be improved.

To modify the dominance of the culture in the policy direction of a greater survival rate, the State must see that the weaning child is fed. A "Take Home Food" delivery system, although a family-food subsidy also, does appear to provide the needed reinforcement to the weaning infant to help insure survival. Already planned Child Development Centers, providing a "package of services" in addition to food is an approach to the answer. A realistic, least cost assessment of the "package" contents requires further investigation.

Planning implications have been covered in great detail since planning assistance was a major objective of the project. The geographical variations in nutrition status offer opportunities to locate planned Child Development Centers on a priority basis. The "movement" of calories and protein from production to consumption on a statewide basis which was studied offers suggestions for interventions to eliminate rural/urban differences.

While increased production of food is critical, "nutrition directed" food production is not as important now as just more food of the same kind the population is now consuming. At all levels, more food in grain equivalent forms is required as part of a "reach the target" scheme. Consumption of homegrown and widely available leafy vegetables could eliminate much of the vitamin and mineral deficiency problem.

State or joint sector production of supplementary food, using indigenous rough grains, appears to offer opportunities for intervention, particularly if it can be coupled with a means of countering maldistribution. Thus, "Take Home Food" delivered through Centers is feasible but subsidized distribution through petty shops and shandys (weekly markets) also offers opportunities for testing new networks in the ongoing study.

Comparable analysis of the production and distribution subsystems was not completed because of time limitations. The implications, however, are clear as indicated above and the continuing work can refine the subsystem interactions which are necessary for more finely structured planning. Such refinement will help sharpen interventions and reinforce the implied gross relationships which are clear and reflect on state and national priorities.

The most critical linkage in the system is concluded to be that between nutrition improvement and family planning. Since survival of infants as well as their quality improvement is an accepted goal of Tamil Nadu nutrition programs, the implications of a successful program must be clearly understood. Bringing the survival to age 6, which is now 555 per 1000 live births (this study), up to the composite North American and European figure

of 960 creates major demands for infrastructure expansion. An estimated annual growth rate of 4 to 5% is required. Increased survival of infants must thus be equated with family and parental security and this must be taught with sufficient intensity and credibility to make family planning a reality. The alternative, in the face of a commitment to nutrition improvement, is an even more critical situation than obtains at present.

An important feature of the TN Nutrition Study was its operational component. Several interventions were studied in a pilot way. These included a Take Home Food Test which was effective in increasing the food of weaning infants although it was a family subsidy; a feeding test of extruded, continuously processed and "convenience" infant foods as a replacement for expensive central kitchen cooking and delivery of meals and an evaluation of the study itself as a planning intervention (the work is to be carried on). The marketing-oriented technique of testing ideas while surveys are in progress and feeding back information to correct and refine conclusions proved to be most effective.

The TN Nutrition Study succeeded in developing a system of analytical methodology especially suited to nutrition planning. It features not only efficient data handling but means for multidimensional displays which define the interdependence of the many factors which govern action. Planning must obviously be done along a broad front; isolated attention to single factors is fruitless. The beginning of a State data base has been achieved as well as the initiation of an input/output model of the system.

The incorporation of a cultural anthropology component in the study proved most useful since the statistical analysis could consistently be converted into human terms. The behavior of target groups must help to structure the educational approach used to correct it. Both general and nutrition education become critical components for delivery at Child Development Centers and elsewhere.

The continuation of the work begun in this study, which has been approved by both the Government of India at New Delhi and the Government of Tamil Nadu, should follow a carefully planned course. Suggestions for organization, intervention testing and data analysis are contained in the report.

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The composite report of the Tamil Nadu Nutrition Study is presented in six volumes: Vol. I and Vol. II, Sections A through E. A guide to the contents of these will be found in Chapter I of this volume.

Another section of the report which amplifies this Overview is Chapter X of this volume: The Planner and the Analyst: A Dialogue on the Tamil Nadu Food and Nutrition Situation.

* * * * *

The project organization and identification of project staff members is shown on pp. 6-8.

The dedication and hard work of each and every staff member, of sub-contractors and their staffs both in India and in the U. S. A. and of service personnel is hereby acknowledged with gratitude.

TAMIL NADU NUTRITION STUDY - STAFF ORGANIZATION

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Mr. Bruce Strassburger	Manager, Field Operations and Chief of Party, Madras
------------------------	---

The field work in Tamil Nadu was conducted jointly with the subcontractor, American Technical Assistance Corporation, as the CANTOR/ATAC project.

Home office members of ATAC assigned to the project were Mr. S. H. Chafkin and Mr. James Pines.*

* Mr. Chafkin left his company and the project in December 1971.
Mr. Pines left in December 1972.

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The field structure of CANTOR/ATAC was:

Mr. Bruce Strassburger	Director, Field Operations
Mr. Kalman E. Schaefer	Field Technical Director (Econometrician)

Tamil Nadu Field Team

Ms. Judy Apte	Cultural Anthropologist
Ms. Radha Bai Arumagar	Sociologist
Dr. T. P. Gopaldaswamy	Agricultural Economist
Mr. K. B. Kothari	Rural Marketing Specialist
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Mr. Michael Moffatt	Cultural Anthropologist
Mr. S. Rajagopalan	Senior Statistician
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(Dr. Rajamal Davidas, Principal)

Subcontractors, U. S. A.

American Technical Assistance Corporation (Mr. S. H. Chafkin;
Mr. James Pines)

Symbionics, Inc., Waltham, Mass. (Dr. James Storer, Mr. Robert South)

EDUCATION IS ACQUISITION OF THE ART OF THE
UTILIZATION OF KNOWLEDGE (AND THOUGHT, AND
FEELING AND VALUES).

ALFRED NORTH WHITEHEAD

CHAPTER I

INTRODUCTION AND GUIDE TO THE REPORT

Objectives

The Tamil Nadu Nutrition Study as originally planned had the following objectives:

- 1) Identify, describe and analyze a nutrition system - those conditions and forces in one Indian state which appear to be the principal determinants of the diets of preschool children in selected family income classes;
- 2) Identify possible points or elements in the system which appear to be susceptible to modification in order to achieve significant changes in these diets and therefore in the survival rates of the children, and describe the kinds of action programs needed for this purpose;
- 3) Identify the possible points or elements in the system which can sensibly relate nutrition, via increased survival rates, to socioeconomic areas such as (i) family planning, (ii) general economic development, and (iii) quality of life;
- 4) Limit the foregoing analysis to those parameters most relevant to proposed solutions to nutrition problems in the state of Tamil Nadu;
- 5) Propose, as they emerge during the course of the project, specific action programs related to solutions of nutrition problems in the state which could be undertaken by the State Government, the Central Government, and private Indian or other organizations.

General Status of Project

To a variable degree, all of these objectives have been reached although

the entire systems analysis and the construction of a complete systems model, both implied in the objectives, have not been entirely completed. A sufficient start has been made, however, to provide enough information to planners on the interrelationships of the Tamil Nadu food and nutrition system so that significant modifications in state nutrition planning have already resulted. Of greater importance, the State and Center Government have authorized continuation of the work of the project as a part of the national and state planning function. The continuing program is expected to continue organization of the data bank, operational testing of interventions and sharpening of the analytical methodology. It will also include training of staff for carrying on comparable work in other Indian states.

While many unexpected delays relating to the Bangladesh situation occurred, problems encountered in data collection, ordering, programming and analysis were considerably greater than anticipated. The implied preconceptions in the objectives —those for example, relating to economic factors obtaining in developed countries— simply did not supply enough resolution of the complications of the system to allow cause and effect relationships to emerge clearly. Thus, a different analytical methodology had to be developed and it required the availability of entirely unpre-aggregated data. In addition, cultural variables were formidable and, in some instances, entirely controlling; thus their quantification was a major challenge.

Despite these problems, as well as expected interdisciplinary communication difficulties, the firm data base which has been established (the substance and implications of which are described in detail in this report) is believed to represent the first truly systematic examination of a food and nutrition system in all of its economic, social, and cultural ramifications. As the work is continued a more and more accurate model of the system will develop. This, we are confident, will contribute both to continuing evaluation and intervention design. These designs, in turn, upon passing appropriate tests, should increase the effectiveness of scarce food subsidies in terms of achieving the objectives of survival of children and improvement of the quality of life described in the objectives.

Orientation of the Project Direction

The orientation of the direction of the project can be classified under

"marketing systems." In brief, the process starts at the market, - in this case, the consumer subsystem. This subsystem is analyzed in great detail to establish the nutritional status as well as the variety of economic, social and behavioral factors which affect the consumer's actions; from these data the nutritional status of the population and its needs are determined and organized in forms which can link to other subsystems. Two of these were investigated: the agricultural subsystem (in terms of secondary data) and the food processing and distribution subsystem - from a primary assessment of these activities in Tamil Nadu. Together, these three subsystems represent more than 70 percent of the economy of Tamil Nadu. In terms of process dynamics, the investigation feeds back from the consumer, through processing and distribution to the production function and attempts to rationalize the forces which satisfy or deny the needs of the consumer. The purpose obviously is to examine the relationships in sufficient detail to intervene in an effective manner, thus making the consequent modified forward flow acceptable to the major controlling influences and not impeding the process. At the same time, the intervention must improve the nutritional status of the consumer or it has no meaning.

Operational Orientation

The project, in its direction, was also operationally oriented - again, in the marketing or intervention test sense. It was assumed and correctly that insights would develop quickly from early experiences in the field and these would suggest sensible intervention trials.

First, it must be noted that the project itself was an intervention. It was a test of installing an interdisciplinary working group as an adjunct to nutrition planning. Its success is attested to by approval of its continuity.

Second, two food product related interventions were studied. One was a test of a distribution system - the Take Home Food test. This test examined the effectiveness of using take home delivery to reach the weaning infant. This turned out to be remarkably revealing in an unexpected way. The second food test related to evaluating two products from a continuous cereal processing (extruder) installation. Both were "convenience" foods, in nursery school feeding programs. The continuous process itself was being examined as a mass production device to replace expensive

central kitchen replication planned for subsidized food preparation.

Finally, another operational intervention had to do with evaluation of ongoing feeding programs. This not only evaluated the programs for comparison in the project but also the acceptance of evaluation.

In all of these cases, the validity of the combined data gathering, analysis and testing procedure (the integrated marketing process) was verified and is highly recommended as a productive technique for the ongoing work.

Interdisciplinary Orientation

The interdisciplinary orientation of the project staff is shown on the accompanying staff organization chart. It consisted of direct staff members and individuals, assigned as consultants or joint staff members, and supplied by both Indian and American subcontractors. The field work was somewhat tenuously connected at times due to the aforementioned problems but this only slowed and did not halt progress. The anthropological task force was most productive and its mixed Indian and American identity made it particularly effective.

As the behavioral nature of the problem was brought into sharper focus, the need for a behavioral technologist became apparent. The incorporation of such an expert in the continuing work is strongly recommended. Nutrition problems in every instance involve major components of behavioral change and the simplistic approaches of advertising and promotion are not the answer.

Two econometric views were represented on the staff: one conventional and the other oriented to developing a better methodology to meet the requirements of the emerging data. The dialogue which developed between the two views was productive in the early stages of the project, but was inhibiting as the need for more refined data analysis was widely recognized. The conclusion was reached that conventional systems approaches are useful for "roughing out" early relationships but more imaginative mathematical treatment is required for resolution of complex cultural and economic relationships. The preconceptions contained in standard

econometric analysis fall short for allowing the projection of the dynamics of such relationships as Professor Paul Samuelson's Nobel Prize testifies.

Three members of the project staff were trained in the physical and biological sciences. The value of such training in handling the relationships of dynamic systems is apparent. Food and nutrition systems show many relationships characteristic of both surface chemistry and resonating molecular structures. Recognizing this, allowed concepts to be drawn and established mathematical treatment to be used that otherwise might have been missed. Best of all, few difficulties were encountered in moving these concepts across interdisciplinary boundaries.

GUIDE TO THE REPORT

The report of the Tamil Nadu Study is organized in six volumes. These are identified as Volume I and Volumes II, Sections A through E.

Volume I, "An Operations Oriented Study of Nutrition as an Integrated System in the State of Tamil Nadu" is a composite report which features the findings of the study as completed to the end of the field work in India (Jan. 31, 1973) and the end of the data analysis in the Haverford, Pa. location of the contractor and at the USAID computer installation in Washington, D. C. (early June, 1973). The findings are examined in terms of their planning implications and are illustrated by maps, tables, figures and charts showing relationships drawn from the data. Special chapters are devoted to major findings and planning applications. Tamil Nadu planning documents are reproduced and a program of continuity is incorporated.

Volume IIA, "Data and Methods" is a detailed account of the technical and analytical phases of the project. It commences with sampling design and proceeds through questionnaire design, data collection, data handling technology

and the details of data analysis. Included in the latter is the development and illustration of multidimensional displays and models. Volume I and IIA together present the study results in the full application and technical context which can be perceived at this stage of data analysis.

Volume IIB, "Anthropology and Nutrition" provides a collection of papers the first of which deals with worldwide problems of child malnutrition and following, a collection of anthropological reports from the staff. The latter complement the consumer subsystem data analysis of Volume I and, read together, they succeed in putting the statistics of the project into human terms.

Volume IIC, "Take Home Food Test" presents (Part I) a complete and detailed account of the field testing of a nutrition intervention and (Part II) a compilation of pertinent Exhibits and Tables.

Volume IID, "Feeding Programs" presents three papers: (i) A proposal for an independent government commission to administer food and nutrition activities in Tamil Nadu; (ii) A paper recounting the results of evaluating ongoing feeding programs in Tamil Nadu; and (iii) An evaluation of the acceptability of extruded foods in balawadies and an economic study of the continuous processing (extrusion) scheme for replacing central kitchens in feeding programs.

Volume IIE, "Food Processing Industry" is an edited reproduction of the survey of the Food Processing and Distribution Sector of Tamil Nadu. This report, a valuable compilation by itself, was conducted by the Operations Research Group of Baroda, Gujarat.

SIDNEY M. CANTOR ASSOCIATES INCORPORATED

Each volume in the series contains critical and summary commentary by the project editorial staff. As much as possible, the volumes have been cross-referenced.

This presentation in six volumes, together with the data tapes (listed in Volume IIA), represent the complete report of the "Tamil Nadu Nutrition Study."

CHAPTER II

PLANNING IMPLICATIONS: THE TAMIL NADU NUTRITION PROJECT AND THE FIFTH PLAN

Introduction

"An Operations Oriented Study of Nutrition as an Integrated System in the State of Tamil Nadu" (The Tamil Nadu Nutrition Study) was accepted by the Government of Tamil Nadu because it offered the promise of assisting the State in its nutrition planning programming efforts. These were already being organized when the project was in its planning stage and a visit was made to Madras to locate a home for the project. The nutrition planning was part of a much larger state planning activity which has since been seen to have pioneered in India in state level planning. The TN project was approved by the Government of India because of the possibility that it might serve as a model for nutrition planning by other States. The TN Nutrition Study was, therefore, a timely and a cooperative project in many ways.

The project team, while independent in pursuing its work plan, was, in effect, a part of the TN Government's coordinating group on nutrition since it reported to the chairman of this group— the Secretary for Social Welfare. Other members of the coordinating group were the secretaries of Agriculture and Food, Health and Family Planning, Education, Rural Development and Finance and Planning. As the total planning effort took shape, members of the project team were invited to serve on individual task groups and participate as ex-officio observers in the planning activities related to nutrition. The project thus represented a bona fide operational activity and was logically expected "to facilitate the process of program planning to achieve stated broad nutrition objectives of the Government of Tamil Nadu."

While hard results from the study were not available in time to influence in more than a casual way the first plan issued, succeeding documents reflect the early emphasis on preschool and infant nutrition which emerged from the field work and preliminary analysis of secondary data. The main purpose of this report, therefore, is to examine the implications of the findings of the study which are available at this time in relation to the current plans of the Tamil Nadu Government for nutrition intervention and to determine the extent to which the study can indeed "facilitate the process of program planning."

Tamil Nadu Nutrition Plans

The official plans of the TN Government as regards nutrition are contained in two documents appended to this report. The first of these, "The Official Planning Document"* published in 1972, focused primarily on "Kulanthaigal Kappagams" or nursery schools (in the North, balwadies) which were to be increased substantially in number to provide "feeding programs to meet at least a third of the daily requirements for calories and nutriment of 2,000,000 children below six years of age, who constitute 50 percent of the target population ---- for nutrition." Also, ---- "the school feeding program will be continued and strengthened. Nutrition education will be imparted from the nursery through secondary schools to the university level with separate curricula for professional personnel and extension services"

- The document recognized the imperative to integrate "educational, medical, nutritional, public health (including family planning and maternity and child health) services ----.
- On a long-range basis it recognized the desirability of a program which would cater to the nutritional requirements of "(a) children below 30 months; (b) preschool children, 2-1/2 to 6 years of age; (c) pregnant mothers; (d) school children, (e) adolescent boys and girls; and (f) adults"(i. e. , target groups).
- The document pointed out that ---- "If massive measures were taken to secure the survival of the first two children through better nutrition, parents might feel ---- more receptive to the ---- aims and methods of family planning. "

In short, the document in recognizing that a "solution to the problem of malnutrition is so urgent that it cannot wait upon a satisfactory level of economic growth", ---- committed the State to a broad search for effective nutrition intervention at all levels of society, committed the State, without reservation, to increasing the rate of child survival and recognized that ----.

- "Nutrition is a multifaceted discipline intimately related to agriculture, animal husbandry, fisheries, health, education, rural development, and

* See Appendix A in this Volume. The "Document" is extracted from Plan Document No. 3 (August 1972), "Report of the Task Force on Health, Family Planning, Nutrition and Sanitation, 1972-1984, State Planning Commission, Ezhilagam, Madras - 5.

social welfare." To accomplish this socially advanced program in its further recorded detail, a substantial budget was planned, as noted in the document, through the Sixth Plan (1984).

Further consideration in the light of total state requirements has led to the "Minimum Need Based Nutrition Program" * of the Social Welfare Department" which has recognized certain implied priorities —the preschool child— but has in nowise changed the broad approach addressed to nutrition planning and the commitments thereby implied.

A major change is the reorientation of the "nursery school" identity of the original document (Appendix A) to what are now called Child Development Centers or CDCs. This change recognizes the need for a package of services addressed to the preschool child, the training of staff for the projected increase in CDCs, an organizational hierarchy —independent and interdepartmental— required to administer the program and the motivating force provided by both general education and nutrition education. It emphasizes effective evaluation methodology, public relations (publicity and propaganda) needs and sets sensible goals for attainment in the Fifth Plan.

Research and Development - The accompanying recognition by both the Government of India and the Government of Tamil Nadu that the planning function and its organizational hierarchy require a research and development arm** to extend and institutionalize the work started in the Tamil Nadu Nutrition Study is an important decision. It recognizes that the system is a dynamic one, that interventions must be carefully drawn from well established data, that evaluation systems must be built into plans and that an up-to-date data bank must be maintained. *** This is one of the most important teachings of the Tamil Nadu Nutrition Study.

* This Volume, Appendix B.

** It is a pleasure to note that Mr. S. Rajagopalan, Senior Statistician, who contributed so effectively to this project has been appointed director of the ongoing work.

*** This Volume, Chapter X, "Continuity"

General Planning Implications

While the "Minimum Needs ----" planning is admirable in its full understanding of the nutrition problem, there are opportunities which emerge clearly from the data— to be more precise, in organizing specific projects and drawing priorities within the plan. It is in this sense that the TN Nutrition Study, at its present level of completion, can make major contributions and save scarce rupees. It is in this sense also that the continuing research and development work can be expected to pay its way.

Three aspects of the point of view which has developed in the course of work on the Tamil Nadu Nutrition Study are felt to have an especially strong bearing on any use which is made of findings in support of the planning process.

First, the planning and execution of nutrition intervention programs cannot proceed in a vacuum, figuratively speaking. There must be integration and coordination with every aspect of development: economic, social, and cultural. This point is emphasized in a subsequent discussion of national development, nutrition and population.* It is reinforced by the observation that nowhere in preparing this report, as chapter titles testify, has it been found comfortable to address a single, isolated subject.

Second, nutrition and, therefore, planning programming should be approached as a process coordinated with the human biological processes in the life cycle of the population to which, traditionally, special attention is paid in the Indian culture. Program effort should be distributed according to accurate identification of target groups, specific needs of these target groups, and the broad interests of the community and its development generally.

A clearly defined segment of the life cycle involving four particular target groups is seen as the proper focus of nutrition programming. The period of the life cycle with which we are concerned is that ranging from late adolescence of the female population through first pregnancy, lactation, and successful weaning of the child to an adequate normal diet, followed by corresponding critical phases with each successive pregnancy. Placed in what is conceived as the correct order of priority on a practical as well as biological basis, the four target groups are (1) the weaning child (defined as a child between the period when breast feeding ceases to be enough for its

* This Volume, Chapter VII.

full nutrition and the time when it should be adequately nourished on normal post-weaning foods), (2) the pregnant woman, (3) the lactating mother, and (4) the adolescent female.

The third aspect of the underlying point of view, perhaps the most important of all, is a recognition of the primacy of the local culture in determining the applicability, probable acceptance, and ultimate success of any proposed intervention. This portion of the general point of view is supported strongly by observations made by project anthropologists and by numerous findings derived from the data and analysis. It is emphasized and reinforced by the following remarks made by Dr. John Wyon in discussing some aspects of the Khanna Study.*

"We were able to measure birth rates and birth intervals to show the influence of long lactation, which prolongs the birth intervals. We were able to show the differential death rate by sex— only about 800 females survived for every 1000 males in the population." -----

"When we compared these parameters on a village to village basis we found villages extraordinarily comparable, but when we broke them down into different caste groups, we found that these distinct social groups had their own ways of practicing birth control, of allowing more females to die than males, of migrating and, of course, of earning their living. Within the individual villages these groups have their own particular ways of responding to population problems and of making use of the nutrients available to them. All of them, however, know too little about the importance of feeding children and how much food children need in the crucial period from 6 months to 2 years." **

* J. Wyon in "Nutrition, National Development and Planning" Alan Berg, Nevin S. Scrimshaw and David L. Call (eds.), M. I. T. Press, 1973, p. 309.

** This Volume, Chapter V, "Intrafamily Food Distribution."

Implications: Specific Guidelines

Proteins or Calories?

A few years ago it became axiomatic among international nutrition experts that there was a worldwide protein shortage; more recently considerable doubt has been thrown upon this point of view. It has been possible to examine the situation in some detail in the Tamil Nadu study and abundant support has been produced for the point of view that protein shortage as such is not the basic problem, on a statewide average basis. The primary deficiency definitely is calories. However, examination of the data provides convincing evidence that there is both a calorie and a protein shortage. The problem is maldistribution among families, resulting from the operation of many factors, geographic, social, economic, occupational, and others. There is also an extremely severe intrafamily distribution problem.

Average data - On a statewide basis, calculated from 24 hour recall of individual food intakes, and confirmed by thirty-day inventories of family food availabilities, about 80 percent of calorie needs and 95 percent of protein needs are met for the average individual. There is a disparity in dietary quality between the rural and urban areas. Average percentages of calorie needs met are 81 and 79, respectively, but in the rural zones only 75 percent of the protein needs are being met, in a range of 82 to 102 percent, by Districts, while in the urban areas 96 percent of protein needs are met for the average individual, the range, 90 to 115 percent. Looking at the diet qualitatively, intake of both protein and calories for average older adults of both sexes, ages 40 and above, is at a level of adequacy; the protein/calorie ratio is approximately 1.0. For all other sex and age groups, however, the protein/calorie ratio is substantially above 1.0. But, unfortunately, the average percentage of calorie need fulfillment is extremely low, ranging from about 60 percent for pregnant and lactating women in the 15 to 19 year old group, 65 percent for weaning children in the 7 to 18 month group, up to 80 to 85 percent for adults. Average intake of protein is approximately at the level of adequacy for all groups except pregnant and lactating women, where it ranges from 75 to 90 percent, and for weaning children, where it is about 85 percent. But in view of the extreme calorie shortage in many instances, much of the protein has to be utilized for its caloric content and is not available protein.

Average data do not equal security - To the unthinking, average figures can give a false sense of security. Figures at or near a level of adequacy for the "average" individual intakes of calories and protein are not an indication that the state diet is adequate. Rather, it confirms that there is a deficiency of serious proportions in both of these primary nutrition factors. If the protein and calories in the food supply were distributed equitably according to need amongst all families and individuals in the state, the malnutrition problem would be minimal. However, by the very nature of things the distribution is far from equitable and always will be. Per capita food supplies have to be considerably higher than per capita needs if there is not to be an ever-present malnutrition problem. In the United States, for instance, supplies and average intakes of available protein are nearly double actual need and calorie availability in foods entering the distribution chain is one quarter to one-third greater than need. Yet there are millions of persons in this affluent country not receiving enough calories and protein, as well as other essential nutrients, due to the inevitable inequities in distribution. It would seem that even with abundant per capita wealth in a reasonably well-ordered society, 5 to 10 percent of the population will always be suffering some degree of undernutrition. However, this is a far cry from having half of the population suffering from serious malnutrition. The general shortage of food imposes an infinitely greater task (of planning and controlling internal distribution) upon a state such as Tamil Nadu than it does upon an affluent country.

Planning responsibility - Government planners have a grave responsibility, not simply to strive for the most equitable distribution of available food, in the community interest, but to insure that the disparity is not made to persist or even become heightened as economic growth takes place during the process of economic development. This has happened in some developing regions as, for example, when increasing affluence at the top of the economic scale resulted in diversion of grain from direct feeding of humans to animal feeding. Result: the already well fed people tended to become better fed, while the disadvantaged became hungrier, in spite of a general rise in per capita income. Planners in developing countries should be obliged, therefore, to make an extremely critical analysis and evaluation of proposals to increase livestock production using a part of the grain supply or other food which customarily had been used directly for meeting human nutrition needs. The same thoughtful consideration should be given to proposals for new agricultural inputs, whether they be land, fertilizer, water or other, that would be devoted to livestock feeding and thereby diminish the potential of additional inputs to crop production for direct human feeding in a situation of scarcity.

Protein rich products no panacea - In the light of current knowledge about the food situation in Tamil Nadu, the tendency in some quarters to regard the provision of protein rich commodity mixtures as a panacea for all nutrition problems should be viewed as fallacious in the extreme. Every indicator — cultural, agricultural, social and economic— points to the pathway of simply striving to provide more food of the accustomed kind and striving to distribute additional food production more nearly according to individual needs as the way to make significant progress on the problems of malnutrition and undernutrition. What we choose to think of as the "protein-rich food fallacy" has now been recognized by international nutrition authority, as illustrated in the following quotation from a recently issued bulletin of the World Health Organization:

"When intakes of both energy and protein are grossly inadequate, the provision of protein concentrates or protein-rich food of animal origin may be a costly and inefficient way of improving the diets, since energy can generally be provided more cheaply than protein of good quality. This is an important point in planning programs for meeting the needs of vulnerable groups in developing countries. Clearly, energy and protein needs should be considered together in planning for the nutritional improvement of populations whose diets are deficient in either."*

Early in the course of the Tamil Nadu study project, it was suggested that a critical look be taken at the ways in which the corn-soy-milk blend** was being used in feeding programs. The recommendation still holds. Are the timing and admixture with other foods carried out in such a way that effective use is being made of the protein, or is much of it being utilized simply for its calorie content? There is evidence that an undernourished person, with minimal reserves or labile stores of body protein, should receive balanced proportions of protein and total calories at each meal. Such an individual apparently is unable to carry a surplus of protein (relative to calories) from one meal to the next occasion of eating, several hours later.

* WHO Technical Report Series, No. 522. "Energy and Protein Requirements", Geneva, 1973.

** CSM-20% of calories from utilizable protein; 10% is adequate for even the rapidly developing preschool child, when his calorie needs are also being met.

Program planners should investigate and evaluate the overall food intake and eating patterns of target groups, then adjust composition of programmed rations to maximize utilization of both calories and protein. Appropriate dilution of protein-rich, imported commodities (such as C. S. M. and wheat-soy blend) with locally available, protein-poor commodities can make a substantial contribution toward most effective use of the limited food supply.

Shift in Program Emphasis Needed

To some extent, the large concentration of effort in the Midday Meals program may be looked upon as an accident of the availability of donation commodities and voluntary agencies to carry out the distribution. It is obvious that resources and effort thus applied are not contributing significantly to solution of the basic problem. This has been clearly recognized by State planners, as indicated by their espousal of the Child Development Center concept as the basis of pilot programs at the present and, hopefully, the major thrust of public nutrition programs in the future. The Child Development Center, as outlined in the plan proposal of the Social Welfare Department (see Appendix B) represents an ideal facility for development of programs to treat nutrition problems of the entire reproductive phase of the life cycle as a unit. In the light of the findings of the Tamil Nadu Nutrition Study, establishment of a Child Development Center would appear to represent an excellent start on planning a stepwise expansion of the program to accommodate as quickly as possible the necessary services, mostly educational but perhaps with some additional food distribution involved, to deal with the other target groups that were identified in the previous section as weak links in the life cycle chain: the pregnant woman, the lactating mother, and the adolescent girl. Services to these groups should be so coordinated and integrated that it will be clearly evident that each person is part of a growth, reproduction, and development process that is truly a continuum, with preceding events seen to have an important bearing on everything that follows. A necessary added feature, if such an integrated program were to become a successful reality, would be to include the older women, the grandmothers and decision makers, in positions of deference and honor as students partaking of the educational and demonstration program being offered.

* This does not imply a recommended cessation of the Midday Meal program which has other values, notably decreasing the school dropout rate. It does imply modifying the ration to reflect the calorie needs of the children involved and shifting the savings to the CDC.

If such coordinated development should take place, one can readily see that in the course of a short time the activity would require qualified leadership and direction that would in all probability be beyond the capabilities or position enjoyed by a balsevika typical of the ones who have been responsible for operation of balwadies. Slightly longer range planning should in fact consider whether the Child Development Center should not be the nucleus around which all of the nutrition and health programs of the community are centered. "All" includes not only the medical and nutrition package, but nutrition education of the decision makers, the family planning clinic, the propaganda center, the hub for the take home food distribution program and perhaps even a food shop as part of a joint sector food products development program.*

Plans, Programs and the Life Cycle

Balancing the nutrition intervention - Based upon material falling generally under the heading "Problems of Maternal and Infant Nutrition", a very strong case can be made for structuring plans and programs as a functional unit coordinated with the critical period of the life cycle running from female adolescence through the weaning period in a child's life. In total effect, intervention programs should constitute a balanced effort toward improving and strengthening the weak parts of the process (improving the lot of nutritionally deprived target groups) and maximizing the quality of product (weaned children) within the limitations of available raw material (the food supply) and facilities.

The potential and later, actual, childbearing female might be thought of as the production facility and a healthy, vigorous, intelligent child the desired product. In human terms, this means that plans and programs should strive for healthy, happy young women and mothers, giving birth to and nurturing children who reflect their own good qualities. It means also that absolutely the most effective possible use will be made of local food resources, that school children and older males will be put in the most advantageous nutrition situation attainable after the primary need — strengthening the reproductive phase of the life cycle— has been met.

Weak links in the chain - In dealing with the nutritional problem of Tamil Nadu as an elemental concern of the Government and society, one perceives it as a classic example of the chain being only as strong as its

* This Volume, Chapter IX, "Food Products, etc."

weakest link. There can be no doubt that the weakest link is the feeding of weaning children is the 7 to 18 months old group of the population.

Next weakest link in the chain is the nutrition of pregnant women. Nutritional state of the mother, right up to the time of delivery, is the single most important factor affecting the postpartum health and growth of the infant, and as a matter of considerable concern, the efficiency with which an infant utilizes the food he receives. It is true that if one is to be successful in discouraging the practice of restricting the food intake of pregnant women in order to produce smaller babies, he must provide reassurance that childbirth difficulty will not be the result. The existence of competent medical obstetrical care, along with adequate health care for the mother both before and after the child's birth, is essential to back up such reassurance. This is a place in which planning and program coordination between health services and nutritional improvement must be highly effective. The fact that most Indian mothers live a rather vigorous, physically active life is a most favorable circumstance for changing the practice of deliberate underfeeding in the last trimester of pregnancy, without creating a major obstetrical problem for the childbearing population.

The next weakest link to be strengthened in the chain is the feeding of lactating mothers. This is important not only to insure adequate nutrition of the infant until proper weaning can take place, but to insure the health and vigor of the mother herself, both for the present and for subsequent childbearing.

The remaining weak link in this segment of the life cycle chain is the adolescent girl. In a very real sense, it is with the health and proper nutrition of this part of the population that the quality of future children and adults begins to be fixed. A weakened, undergrown, ill-nourished young woman at marriage is already at a disadvantage for producing the kind of children that are desired. Conversely, a strong, well nourished person will be much better able to withstand the effects of subsequent nutritional deprivation she may encounter.

Emphasis on the cultural context - Every aspect of the study findings supports the determination of the Planning Commission that weaning children, pregnant and lactating mothers shall be the primary targets

for nutrition improvement. The one point that the planners have not dwelt upon, but which is crucial, is the need to understand the constraints and limitations that local culture and tradition impose upon any efforts to bring about desired change. Idealized program goals, insofar as they relate to the amount of benefits to be delivered to the target individuals, will frequently need to be compromised. Realistic goals will seek balance and stability among the different phases of the life cycle; neither the family structure, because of its cultural roots, nor the community at large is likely to accept an overbalancing that puts the reproductive phase in a state of optimum nutrition and health while at the same time the adolescent and adult male population — the wage earners, providers, and protectors — is noticeably weakened. The limited food supply of the present and near future will in large measure determine the balance that is struck between family integrity and the biological quality of the individuals making up the family.

The Crucial Role of Education in Nutrition

General education and nutrition education - The importance of general education to the overall process of development, nutritional improvement of the population included, is crucial.* Its emphasis in planning is accepted. The only point that need be made here is that education be oriented toward understanding, problem solving, and analytical as well as creative and abstract thinking; moreover, that rote learning and uncritical absorption of information and dogma be downgraded and guarded against with all the vigor that the educational establishment can muster. Rote learning applied to nutrition is useless. It disappears in far less than a generation. National development and improvement in quality of life demand the highest priorities for thinking ability and relating as opposed to mere capacity for remembering. This orientation is of paramount importance for nutrition education at all levels. Nutrition education must be biologically related, and be presented in the setting of the life cycle with all of its changing characteristics and requirements. Above all, it must be harmonized with the national and local culture, otherwise it will not be applied.

Education of the consuming public in nutrition has not, up to this point, been even reasonably successful in the developed countries, certainly not in view of the weight of human and capital resources that have gone into the effort. In truth, the average American consumer is little, if any, more knowledgeable on the subject of nutrition than the average Indian villager. For such reasons, proposals for nutrition education programs (directed to consumers, that is) based upon the subject matter and communications media used in industrialized nations should be subjected to

* This Volume, Chapters VI and VIII.

the most critical scrutiny and evaluation. A case in point is the recent mass media educational trial sponsored by the Protein Foods Association of India. Remarkable success was achieved in penetration and recall of such words as protein, vitamin A, and other specific nutritional terms. But they were mere words: the participants did not know the significance of the words in relation to their own growth and sustenance, nor did they have any idea of the relationship of the nutritional terms to the foods they actually consume.

Relationship to available foods and natural functions - The core of any public education program in nutrition must be built around information and demonstrations concerning the foods that are currently eaten or would be available, in relation to the quantitative and qualitative need at each stage in the life cycle; that is, the needs for growth, development, and reproduction. The relationship of foods to energy output, resistance to disease, and wound healing and recovery should also be made part of the teaching material. Emphasis should be placed upon familiar foods and their properties, not upon nutrients as such. The need for this kind of approach to nutrition education has been made unmistakably clear in the course of work on the Tamil Nadu Nutrition Project. The evidence for faulty perception of nutritional needs at critical stages in the life cycle, as illustrated in Figures 14, 15, and discussed^{*} is unequivocal. Furthermore, independent observations of the cultural anthropologists employed on the project reinforce this point of view strongly.^{**}

Another aspect of the problem is the need to teach people, with supporting demonstrations, how to appreciate and make best use of local food resources, such as green leafy materials for the alleviation of vitamin A deficiency, for example, which could benefit them greatly, but are not being used.^{***} This area of educational effort should deal strictly with things that are familiar and understandable to the villager. There seems to be no point whatsoever to invoke classroom teaching materials about specific nutrients and popularized presentations of the science of nutrition. Nutrition education appropriate to the village setting and perceptions is of extreme importance in fostering the ideal of self reliance and helping the community make the best use of its local resources.

* This Volume, Chapter V.

** Vol. II Sec. B.

*** This Volume, Chapter VIII.

Education of local decision makers - The most critical factor of all, beyond any doubt, is that the educational effort in nutrition must not only be compatible with the cultural milieu in the locality but it must work through and with the compliance of the established, domestic decision-making authorities. * Sources of information were reported by survey respondents when asked questions in two categories: the first concerning knowledge of specific nutrients; the other related to questions on actual food practices and behavior. It was clear that specific nutrition knowledge came overwhelmingly from formal schooling and from the communications media. On the other hand, the information which actually guided food behavior, in terms of the responses as to sources of information and knowledge, was almost entirely culturally oriented. The ruling factor was unquestionably the voice of authority, i. e., the elders in the household, as the source of guidance and decision-making related to food behavior. The lesson is perfectly clear: not only must the subject matter and presentation in nutrition education be carefully and studiously oriented toward cultural patterns and traditions, but if it is to be effective, it must be transmitted through the elders, the traditional authorities within the family. In short, to have any hope of improving or changing food behavior one must work through the agency that controls that behavior. Needed improvements in the nutrition of pregnant and lactating women, weaning children, and adolescent girls will be effected widely only through the education of grandmothers.

Cultural revolution - The alternative is a cultural revolution involving a separation of generations, the nuclear family displacing the joint family as the dominant social and economic unit of the community. Authority and decision-making on food matters, as in almost everything else affecting health and well-being of children and their mothers, would then rest with the head of the nuclear family, or be externally (other) directed. This change is bound to take place, paced by the rate of change from an agrarian to an industrial society, but it is a slow, evolutionary process, not revolution; it is taking place in India now. Since abrupt cultural revolutions generate their own new problems, the wise course for education program planners is to work as harmoniously and effectively as possible within the present cultural setting, and to adapt to cultural change at a rate just enough greater than the change itself so as to provide leadership.

* See Table 23 , Chapter VI .

Geographical Implications

Geography is important in problems of hunger and malnutrition as illustrated in calorie and protein maps according to District, food production and consumption maps related to calorie needs met by District and Taluk and calorie sufficiency by Taluk related to geographical features such as rivers, dams, roads and coastal and altitude variations.*

To the degree that subsystem linkages and data analysis have been completed, the planner will profit from a more detailed knowledge of the flow of nutrients from rural to urban areas. If a more equitable distribution is the goal, greater control must be exercised.

The observation that food production is related to water resources comes as no surprise, the variable nutritional status by Taluk, however, emphasizes the multidimensional considerations necessary to resolve the relationships and understand the controlling forces. Some of these have been achieved, others' require more data derived from experimental interventions and further analysis.

A major planning use of the Taluk - nutritional status relationship is in ordering the priorities for installation of Child Care Centers. Opportunities for comparing extreme differences between areas in terms of nutrition status should not be ignored.

Food Production

The major implication emerging from an examination of production - consumption balances; District by District, and calorie and protein need met status, is the overriding requirements of just more food. This, in simplest terms, should be more of the kind of food that the population is accustomed to.*** District variations as they affect local protein/calorie balance are important and subject to fine structure variation. Striking opportunities also exist for vitamin and mineral improvement by encouraging home production and consumption of the common green leafy vegetables of the region.*** Intervention opportunities will be obvious to the planner intimately familiar with the findings of the study.

* This Volume, Chapters III and IV.

** This Volume, Chapter X.

*** This Volume, Chapter VII.

Food Processing and Delivery

It is quite clear that usually achieved production increases will not reach target populations without organized and controlled means which appreciate the intricacies of the system. In the final analysis, if no other practice blocks the delivery of food to target groups, the intrafamily food distribution behavior will. To overcome this culturally persistent practice, advantage needs to be taken of the finding that a combination of increased family food and food (especially supplementary infant foods), delivered to targets through a "take home" distribution channel, can improve the status of weaning infants. *

The source of the "take home" food is the critical problem. One possible solution is a joint sector institutional food production and delivery system supported by government subsidy at the Child Care Center, and also sold under uniform identification and promotion in the free market. **

For allowing low income families who can afford to buy commodities in small volume an opportunity to participate in increased food production, buying cooperatives are briefly discussed. ***

Organization Implications

The need for an organizational structure dealing with food and nutrition problems which succeeds in crossing departmental boundaries has been recognized in various planning documents. **** However, admonitions for representatives to cooperate and attend meetings will not work unless the structure allows for control and enforcement of plans. Much thought has been given to this problem by the study staff and from these efforts, the proposal for an independent "Tamil Nadu Children's Commission" has emerged. While this plan has several faults, including insufficient recognition of nutrition and family planning linkages, it is a useful model.

* This Volume, Chapter VII and Vol. IIC

** This Volume, Chapter IX.

*** This Volume, Chapter X.

**** This Volume, Appendices A and B.

In summary, leadership, autonomy, goal generation and credible evaluation of programs emerge as the main purposes of the Commission described here. The subject is critical to effective continuity and the plan described is a good one. It deserves careful consideration, clarification and adaptation to Tamil Nadu acceptability criteria. Clearly, however, there is no substitute for strong, well-motivated and well-educated leadership which recognizes and believes in its purposes.

Population Implications: Success or Disaster?

The Government of Tamil Nadu is committed to a program of increasing child survival through nutrition planning coordinated with other components of a package of critical services. All are to be delivered at Child Development Centers. This program has great potential for succeeding* and, if successful, could lead to problems of greater magnitude than the present because of the implications of increased population. The calculated child mortality rate per thousand live births in Tamil Nadu is shown by age group and cumulatively in Table ★ .

Table ★ : Child Mortality Rate in Tamil Nadu:
Birth to Five Years of Age
(calculated data based on TN Nutrition Study sample)**

Age Group (months)	Number of Children in Sample					Mortality Rate Per 1000 Births	
	Living by Grp.	Cum.	Dec'd. by Grp.	Cum.	Total by Grp.	No. by Grp.	Cum.
0- 6	380	380	118	118	498	165	165
7-18	620	1000	82	200	1200	166	331
19-30	392	1392	66	266	1658	32	363
31-71	905	2297	62	328	2625	27	390

* This Volume, Chapter VII

** Mortality data on 999 families distributed to 2589 families.

The mortality rate per 1000 births provides a conservative estimate of the mortality rate. Overall, it appears that one child is deceased for every seven children surviving to the age of five years.

The brutal impact of these data is revealed in Table ★★. . The differential death rates by age group have a cumulative effect which demonstrates that for every 1000 live births only 555 are survivors at the end of the fifth year. The meaning is clear by comparison with a composite of similar data from Europe and North America in which 960 survivors are the experience.

Table ★★ : Number of Children Surviving at Selected Ages:
Birth to Five Years
(calculated data based on TN Nutrition Study sample)

AGE	Number of Survivors Per 1000 Original Live Births	
	TAMIL NADU	Composite Europe and No. America
BIRTH	1000	1000
6 mos.	816	980
18 mos.	631	970
30 mos.	582	965
5 yrs.	555	960

The implications of reversal of this trend are startling. If reversal is complete, the first level primary school population of Tamil Nadu would increase by approximately 90 percent in six years and continue to rise year by year at the same rate thereafter. In just 18 years, employment seekers would increase by approximately 90 percent and continue each year thereafter at the same rate. If survival is not quickly apparent to families and does not result in population curtailment, it can easily become a source of disaster instead of security.

The relationship of an effective nutrition program to national development and the special responsibility of planners to link family planning strategies should be apparent. The entire economy must be planned for rapid enough expansion to absorb the impact of new people. Therefore, a proper investigation of family planning strategies linked with nutrition interventions is imperative. It is estimated that at minimum a growth rate of 4 percent per year of the entire economy is required to absorb the initial impact of a successful nutrition intervention. Further, long-range aspects need careful estimation and planning* because as has been noted -

"There are cogent but not publicly articulated arguments against devoting scarce resources to infant and child nutrition. In oversimplified terms, death of preschool children due to malnutrition is de facto the most widely used method of population control---**

The existence of an indigenous mechanism for population control which has been suggested by Dr. John Wyon*** would appear to be in agreement with the calculations shown in the Tables ★ and ★★. Putting together information from this project, i. e., mortality calculations, intrafamily food distribution and the observations of anthropologist members of the project staff, it is difficult to deny that probably ages-old behavioral patterns, deeply rooted in the Tamil Nadu culture and reinforced by a variety of legitimized practices, combine to achieve some significant measure of reduction in population growth rate.

In the face of these realistic assessments, one critical factor must be noted: The absence of formalized mortality statistics in Tamil Nadu emphasizes the need for a top priority project which can furnish these essential statistics based on totally random sampling. Reliable mortality (and morbidity) data are crucial to measuring the impact on survival of any nutrition intervention.

* This Volume, Chapter X.

** R. E. Klein, J. P. Habicht and C. Yarborough, "Effects of Protein-Calorie Malnutrition on Mental Development", *Adv. Pediatrics* 18, 75-91, (1971).

*** John Wyon in "Nutrition, National Development and Planning", Alan Berg, Nevin S. Scrimshaw and David L. Call (eds), MIT Press, 1973, p. 309.

CHAPTER III

THE FOOD SYSTEM OF TAMIL NADU

On the basis of the approach discussed in the previous chapter and the guiding principle expressed (namely, an integrated, stepwise investigation of the food and nutrition system initiated by as complete an understanding as possible of the consumer subsystem in all of its social, cultural, and economic complexities), it should be clear that for purposes of discussion and development of a useful model, the food system of Tamil Nadu can be entered at any point. It is immaterial whether one enters via the production or consumption subsystem. Only in an equilibrated system can an exploration proceed in a forward direction until its cyclic character is revealed. The Tamil Nadu food system, on the contrary, is a non-steady state system in which nature, economics, politics, cultural roots, infrastructure, the technological state of art to craft development, and hunger vie for dominance. For each concerned TN department or planner, a different need recognized in a different context, generating a different option, may dominate at any given time.

For these reasons, input/output analysis is the basis of methodology, with the reservation that each generality drawn must be qualified by "more or less." Moreover, each indicated or implied cause and effect relationship includes insights drawn from the conventional wisdom and the local conditions prevailing at the time of the survey.

The verbal narrative of the nutrition status of the population provides many opportunities for spot disagreements and challenges leveled at the findings. Yet as the narrative unfolds, it can be anticipated that information will be encountered which may, to a degree, depart from previous generalities to confirm or deny the view of the challenger. In short, the attempt is made as the story unfolds to damp the oscillations which can be expected to be high at the start and, hopefully, low at the finish because sequentially more information of a specific nature is brought to bear point by point until a full view of the current status of the system is achieved.

Patterns

Because the system is referred to as a non-steady system which can be entered at any point, the descriptive pattern and order of the presentation is circular. As previously noted, we have arbitrarily defined three subsystems as major parts of the Tamil Nadu food system. These are the Agricultural Production Subsystem, the Food Processing and Distribution Subsystem (the marketing mechanism) and the Consumer Subsystem (purchasing and consumption mechanism). These are oriented as in Figure 1.

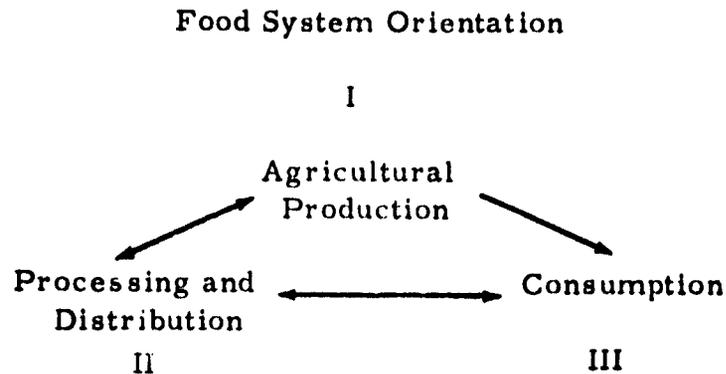
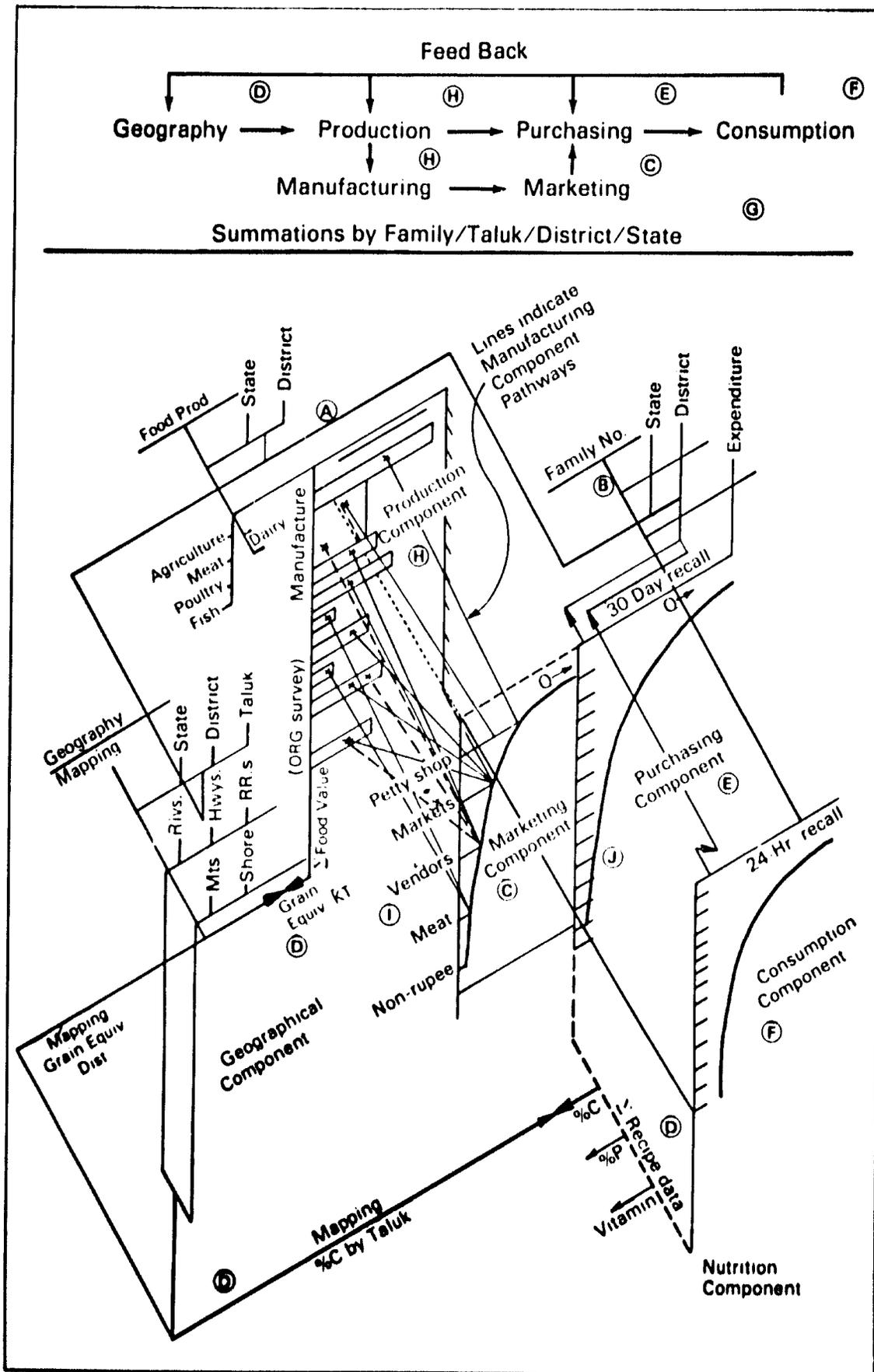


Figure 1

This is the system in skeleton form with all internal details and exogenous factors temporarily excluded. Tools, farm machinery, cooking utensils, storage facilities and the like are ignored for the present.

Within the subsystems, there are many component sub-subsystems, each manifesting one or another degree of importance at various junctures or nodes where interactions take place. In the diagram of the Tamil Nadu food system, Figure 2, the interface between subsystems II and III is indicated where family (B), purchases foodstuff (D) from market place (C). The foods purchased (E) may be redistributed daily (F) and consumed. From this, the nutrition status of families and/or individuals may be summed at (D). These data, for example, may be compared and mapped (D) by geographical features or by political subdivisions.

**FIGURE 2 Food System Integration:
Tamil Nadu Component Interrelations.**



This is a duplicate of Figure 1 in Chapter V, Volume II-A

For practical purposes, it has been concluded that the degree of calorie need fulfillment by family or by individual is the most representative universal indicator of nutrition status for humans. Also, that a general production indicator for district to taluk is food production or purchase or distribution as grain equivalents where 1 kg grain equivalent is the calorie value of one kilogram of commercial dried rice (about 3400 calories). Conventionally, when the average person is discussed, the median person is meant. Average availability of a commodity is usually stated as the mean value. Consequently, the average (median) individual receives about 77 percent of the average (mean) available calories in Tamil Nadu.

A. Subsystem I - Agricultural Production

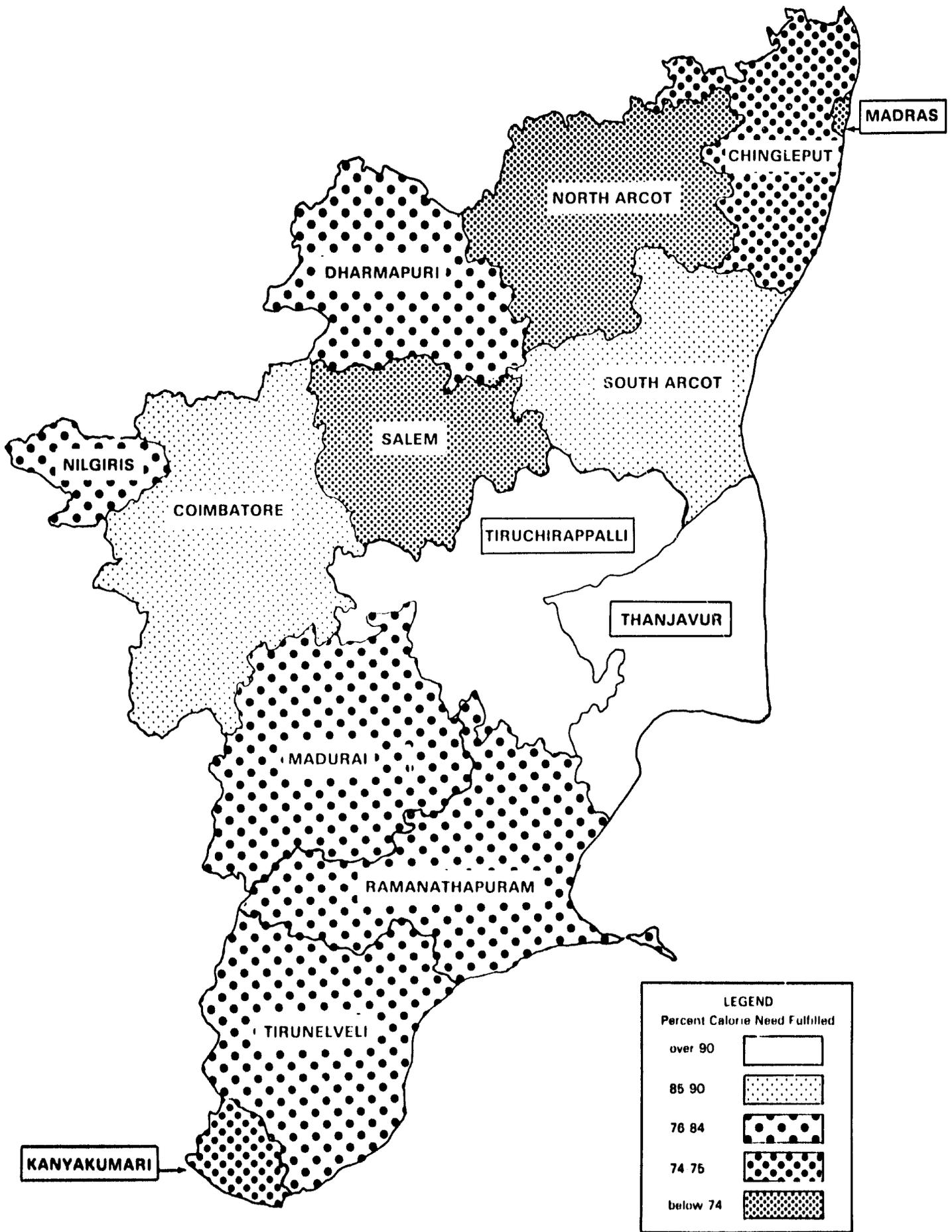
The Agricultural Production Subsystem is described in two ways. First, from food availability data in the consumer survey, i. e. , primary data. Second, from secondary data, the food production statistics are reduced to a per capita basis for comparison.

The Basic Maps - Map 1 is the basic map used to characterize the Tamil Nadu food system. Each district is ranked by the degree to which the median person is nourished based upon percent fulfillment to calorie need (%C). It is upon this map that other data are reflected.

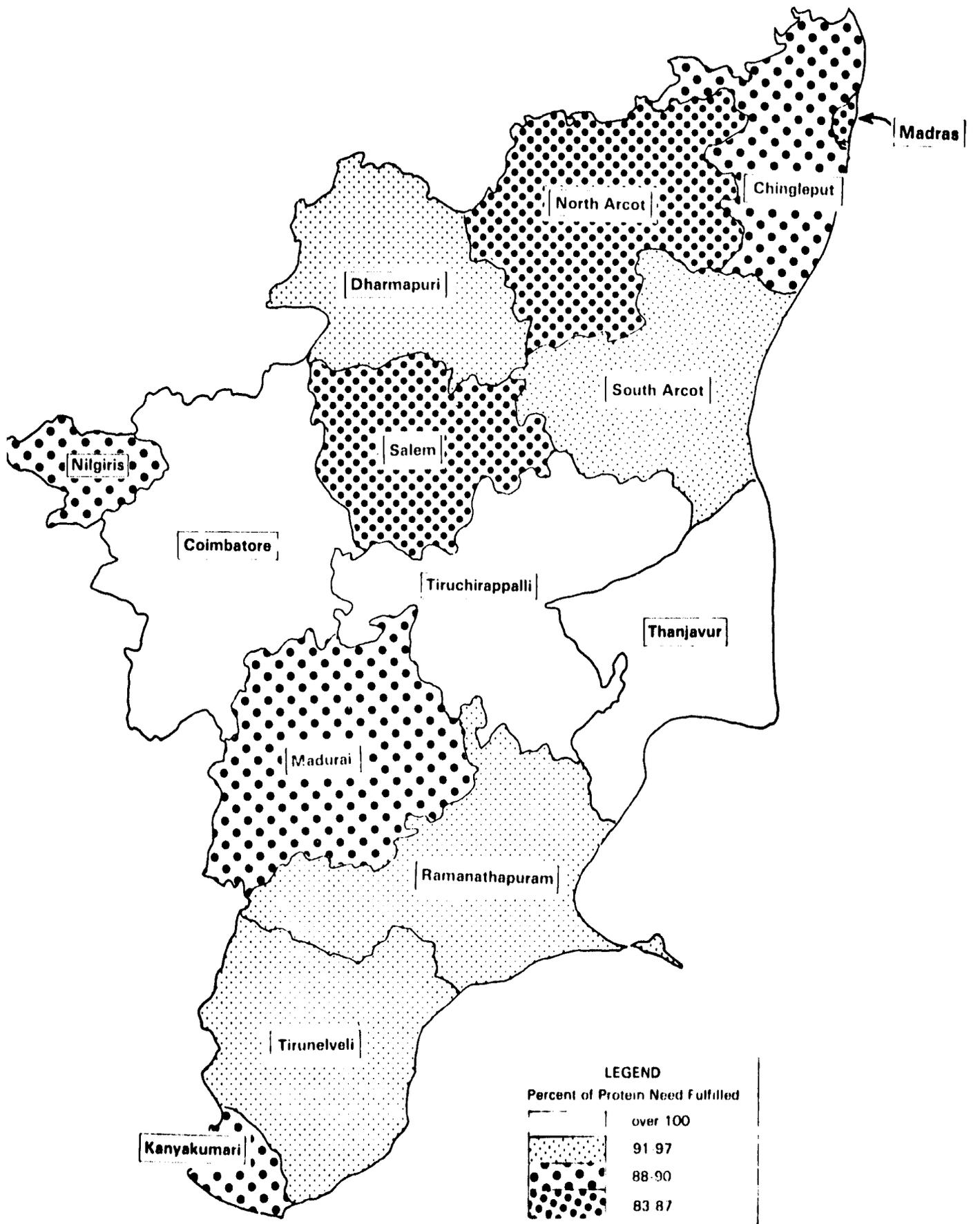
For comparison, Map 2 presents the median fulfillment of protein, requirement (%P) by district. Maps 1 and 2 are generally similar but protein need is clearly shown to be more nearly met— a relative, not absolute, conclusion. There is obvious need for more protein but it must be accompanied by a relatively greater supply of calories.

Grain Equivalent Mapping - In Map 3, the per capita production, consumption and food balance by district is shown superimposed on Map 1. The data indicate that only in a gross way is production a determining factor in consumption.

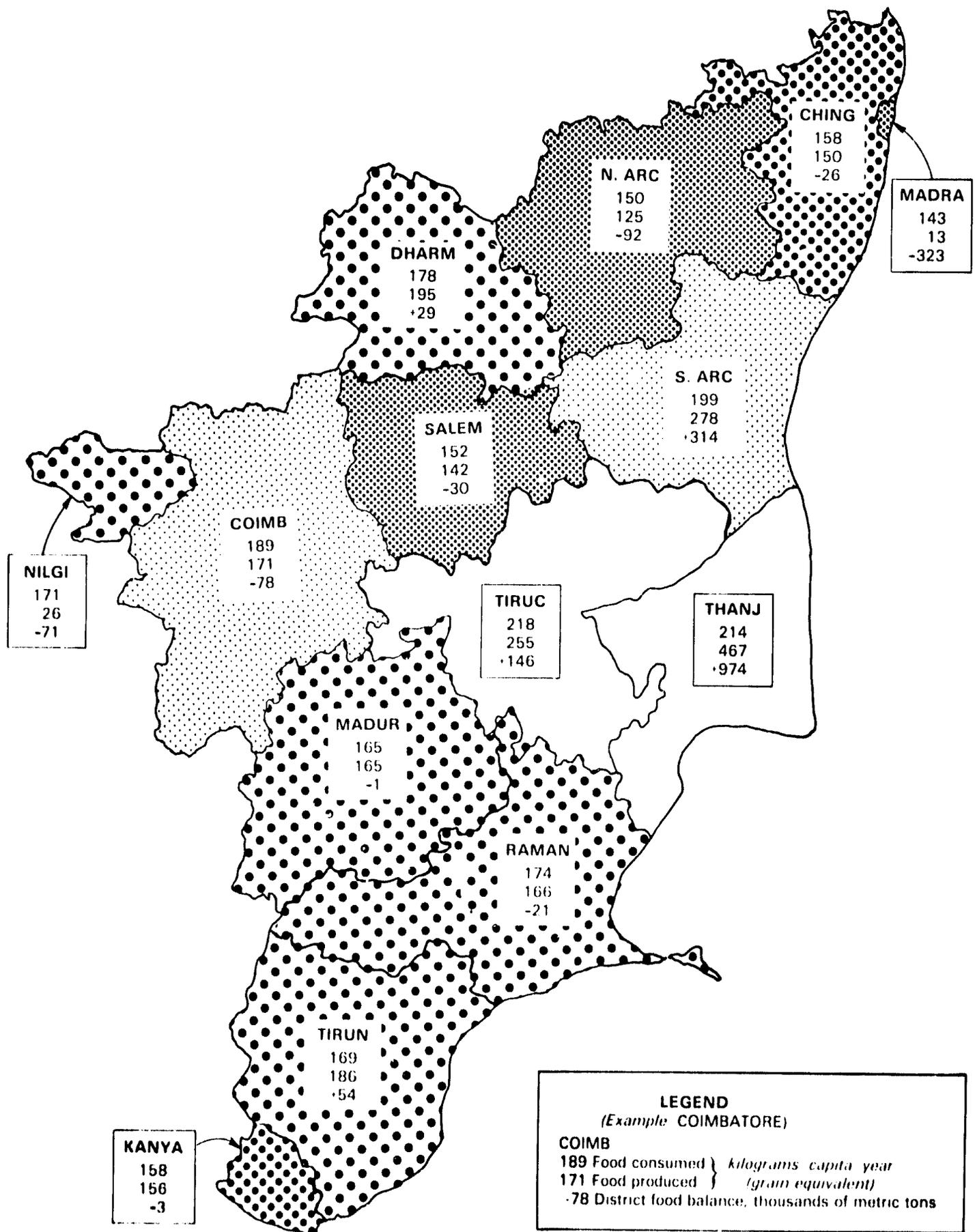
In Map 4, the grain production pattern is reflected upon consumption. This serves to indicate that the high ragi production in Dharmapuri and Nilgiris is a major reason for the low nutritional status of these districts. The large pulse production in Dharmapuri, although mostly for commercial market, did provide a better than average protein ration for the district (Map 2).



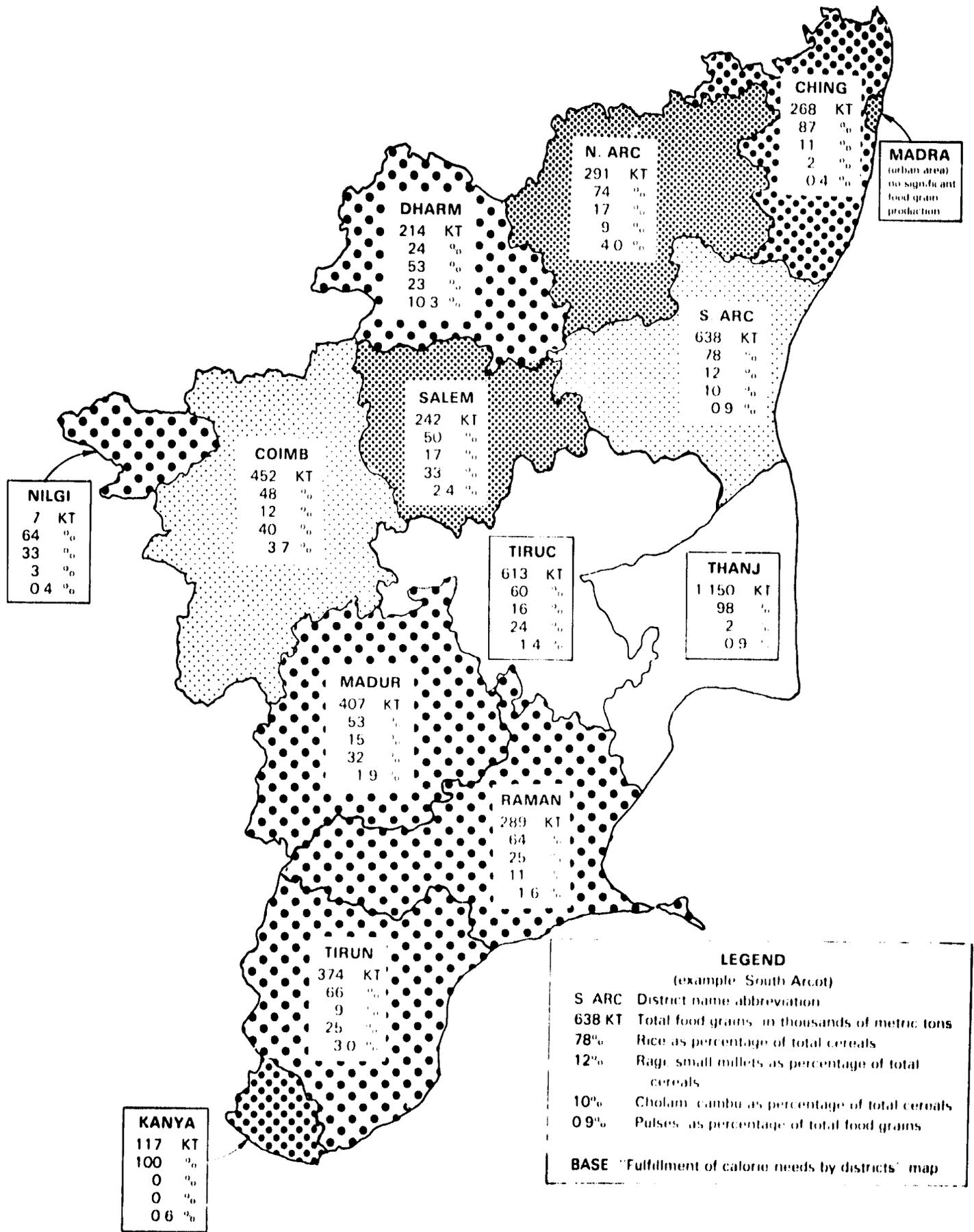
MAP NO. 1. Fulfillment of Calorie Needs by Districts.



MAP NO. 2 Fulfillment of Protein Needs by Districts.



MAP NO. 3. Per Capita Production, Consumption, and Local Food Balance, by Districts.



MAP No. 4. Proportions of Different Food Grains in the Total Food Production by Districts
(based on 1968-69 data)

Further Subdivision - The survey sample was sufficiently large to provide data for a reasonable distribution of %C (percentage of calorie need met) data by taluk in the third round. Map 5 shows the distribution. A pattern similar to Map 1 emerges, but in considerably greater detail. The conclusion is that in each district production is probably concentrated in those taluks where a higher percentage of calorie need is met.

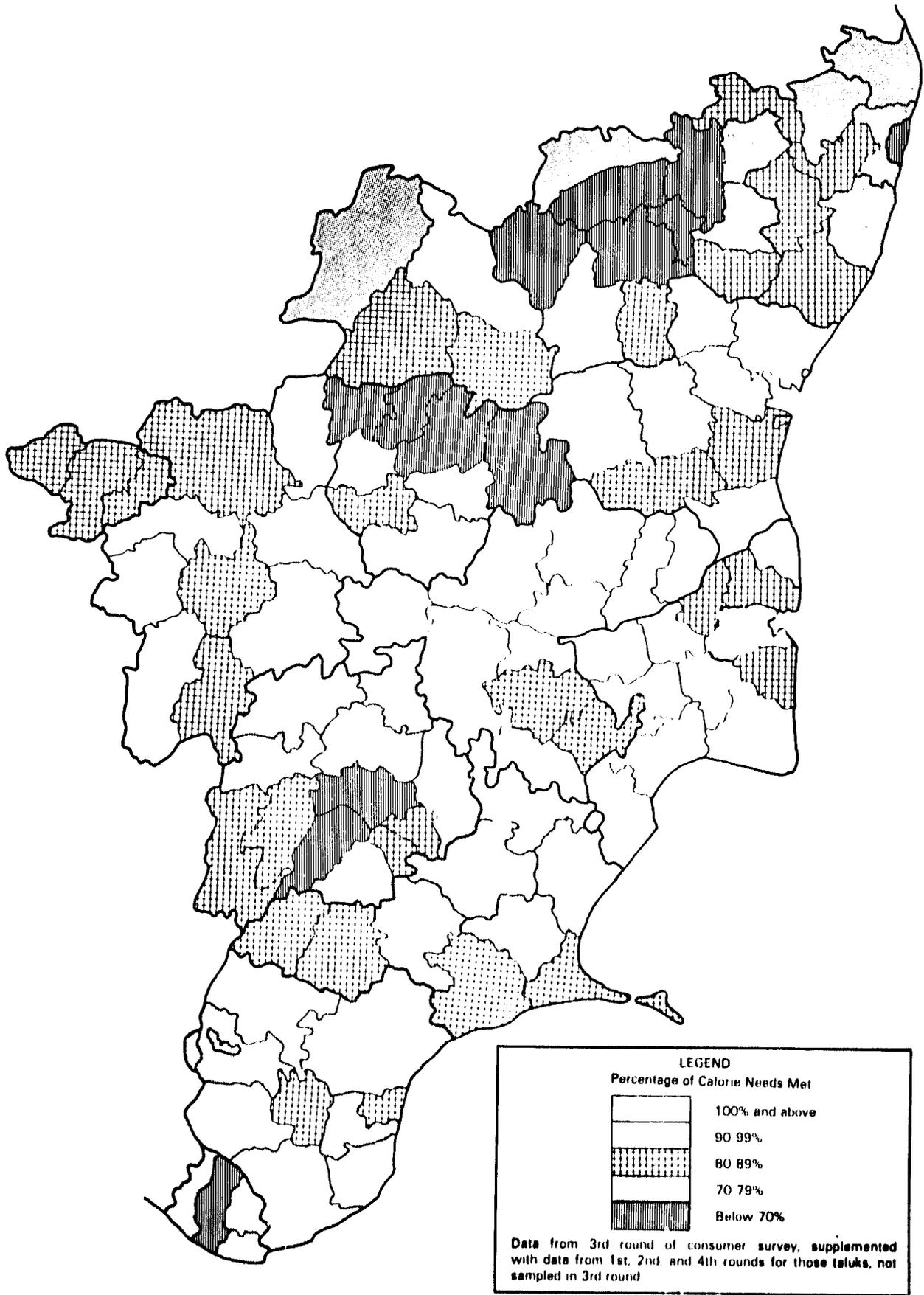
The taluk-based data made possible a better look at the "geography of nutrition" in the State. Results of this somewhat refined view (in comparison with the cruder district subdivision) are presented in Map 6. The data of Map 5, percentage of calorie needs met, are shown by numbers* placed at the approximate geographic centers of the taluks. Important geographic features shown on Map 6 include elevations, principal rivers, and the National Highway network in the State, which is for the most part paralleled by rail lines. The relationship between topography and water availability on the one hand, and taluk nutritional status on the other, is demonstrated. It is emphasized, as would be expected, by taluks in the basin of the Cauvery/ Coleroon River basin, and as an incidentally interesting example, by a "No. 5" taluk in the south of Coimbatore District, on the state border and in the upper part of a river basin receiving rainfall from the west and draining into Kerala. The data and map are not sufficiently refined to show a postulated nutritional advantage of living along a major transport route.

Implications - The most favored district in Tamil Nadu is Thanjavur, the least favored, North Arcot. The implications of this are shown in Figure 3, a plot of selected district populations against percentage of calorie needs met by individuals. In North Arcot only one-third as many persons as in Thanjavur had fully adequate diets, and more than three times as many had seriously deficient diets.**

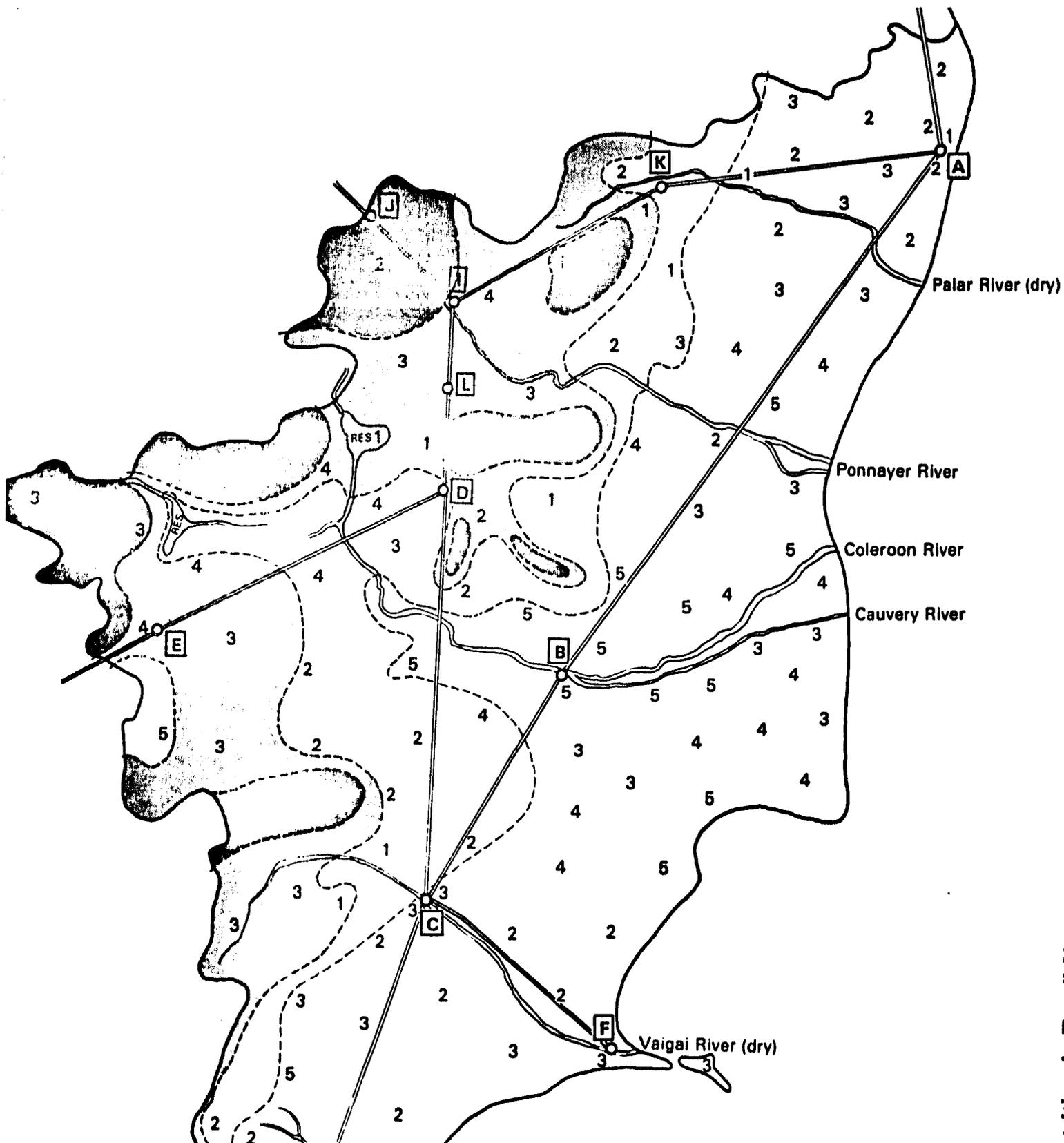
If it is assumed that the objective of the agricultural production system should be to raise all of Tamil Nadu to the level of nutritional well-being of Thanjavur, the state mean level, presently at 101%C, must be increased to a mean available calorie level of 128%C. This step would also provide a strictly proportional increase in animal sources of protein calories. A more accurate goal would be an actual increase to a mean

* No. 1 is low, 5 high, corresponding the shading in Map 5.

** Estimates for other districts of interest may be plotted from data in Table 4A, in this chapter.



MAP NO. 5. Fulfillment of Calorie Needs, by Taluks.



Notes and Legends — All interior political boundaries have been omitted. Roads shown schematically are the National Road network in T.N. The numbers, 1 through 5, correspond to the shading on Map No. 00. They are placed at the approximate centers of the tables.

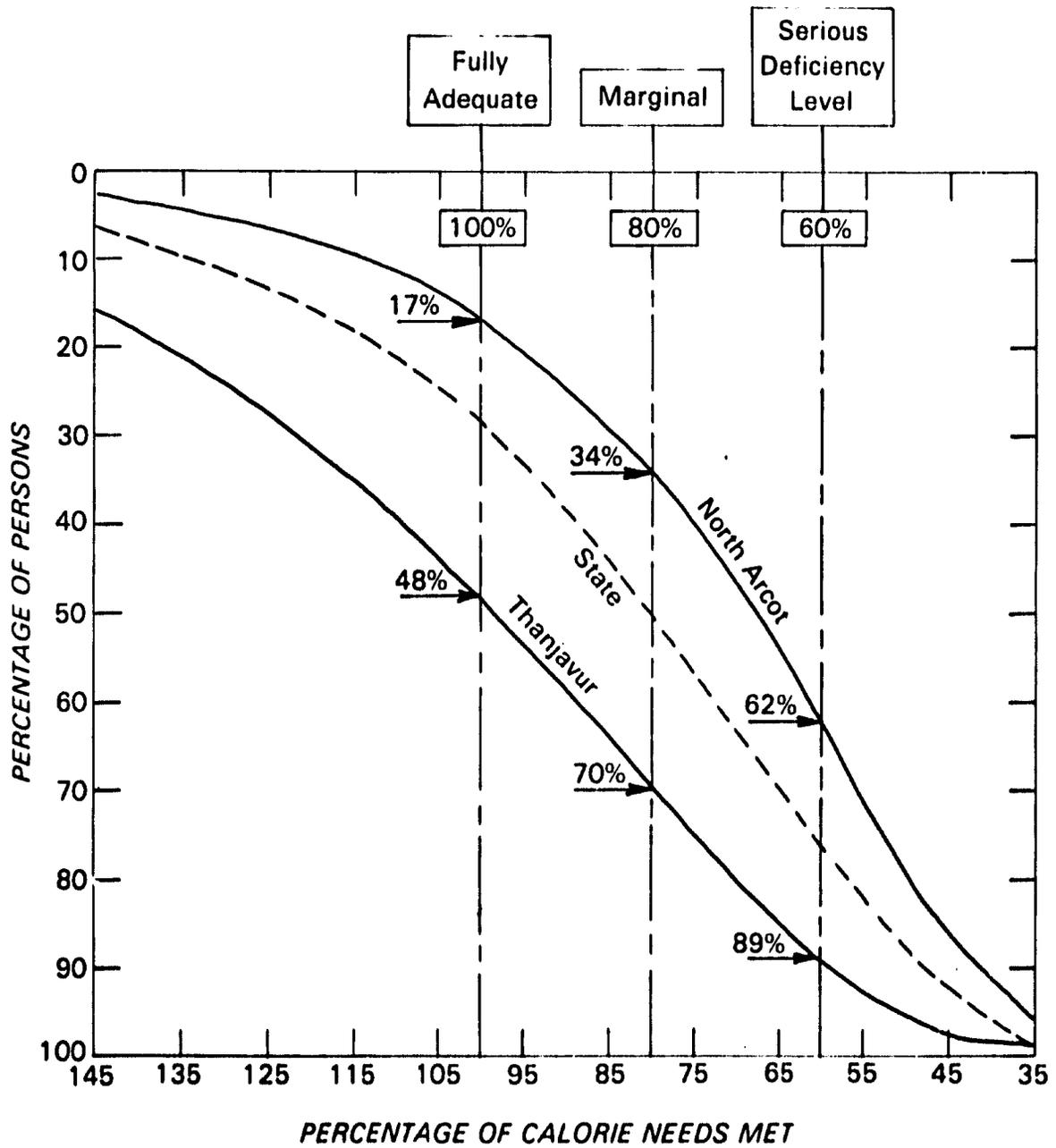
<u>Percentage of Calorie Needs Met</u>		<u>Cities Shown on National Highway Network</u>
5	100% and above	A — Madras
4	90-99%	B — Truchirappalli
3	80-89%	C — Madurai
2	70-79%	D — Salem
1	Below 70%	E — Coimbatore
		F — Ramanathapuram
		G — Tirunelveli
		H — Nagercoil/Kanyakumari
		I — Krishnagiri
		J — Hosur
		K — Vellore
		L — Dharmapuri

Elevations in Meters

0-150	[Shaded Box]
150-300	[Shaded Box]
300-600	[Shaded Box]
Above 600	[Shaded Box]

MAP No. 6. Geography of Nutrition in Tamil Nadu.

FIGURE 3. Relative Adequacy of Caloric Intake of Individuals, for the State and for North Arcot and Thanjavur Districts.



calorie availability of 145%C as grain calories, of which 25% would be used as animal feed to produce meat, milk, and eggs in proportions normal to Tamil Nadu. The result would be an increase in mean available calories to 128%C. Such an increase would reduce the deficient fraction of the population from 50% to 25%, using 80%C as marginal calorie deficiency (see Figure 3). But even this improvement would have little impact on the most deprived targets —the weaning child and the mother. This example emphasizes the need of a more direct access to target groups and all of the complexities which such an intervention entails. In other words, simple supply pressures which anticipate extension of more food to the deprived cannot be expected to work.

B. Subsystem II - Food Processing and Distribution

The survey of the food processing industry in Tamil Nadu was carried out by the Operations Research Group of Baroda. Its objective was to describe the nature and size of the Tamil Nadu food processing industry, what commodities were handled, what processing techniques were used, how its products are distributed, and what economic groups participate. This subsystem represents the interface between agricultural production and the consumer. The food processing component in Tamil Nadu is seen to be small; household processing in a subsistence society still dominates. On the other hand, the marketing system and its infrastructure is extensive.

The data compiled by ORG are voluminous. Some key points should be borne in mind when considering these data, whether superficially or in depth. These include:

- 1) Most of the food processing units within the State belong to what is called the unregistered sector. These are units not registered under the Factories Act of 1948 and are those which either employ less than 10 persons and use electric power or less than 20 persons with no electric power.
- 2) The largest number of units, irrespective of sector, represent the rice, oil and baking industries (flour mills) category.
- 3) The total rupee value of products is greatest in the oil, rice and sugar industries; oil and rice account for 50 percent of the total value of goods produced by the food industry in Tamil Nadu.

Full Processing versus Servicing

- 4) When considering inputs and outputs of processing plants, a strong distinction is made between (a) those units for which materials are procured, processed and from which finished products are sold (processed goods), and (b) those units to which persons other than the mill owners bring raw materials for processing and take away finished products (serviced goods).
- 5) Major sources of raw materials are local although raw material for dhal mills is brought in from other states and cashews are, in part, imported. Major markets are mostly local. Major problems cited by processors are price fluctuations (a normal occurrence, it would seem), poor quality, inadequate credit and seasonal supply.
- 6) Processing technology is mostly traditional. Exceptions are modern sugar mills, dairy plants and tea curing units. A very noteworthy rice processing modernization program has been in force. *

Nutrition Sources

According to the ORG survey, approximately 80 percent of the calorie and protein sources in Tamil Nadu are raw materials fed to the rice mills and oil mills. In view of this observation it is to be noted that the oil milling industry is not cited for being modern in technology. Rice mills in the State are being modernized actively. There are 12 modern rice mills in the State, three of which were covered by the survey.

Nutrition Through the Food System

It is important to trace raw material calories and proteins from origin through processing and distribution to the consumer. Actual production of rice, the principal source of both calories and proteins, for the year 1970-71 was 5.3 million tonnes. This is equivalent to about 18.3 million

* See particularly the Report of the ECAFE Expert Team on Rice-Processing Machinery, 9 March, 1970.

million Kcals. The ORG survey, which covered 1971-1972, identified the source of 2.1 million tonnes of rice or about 6.0 million million calories. The shortfall was traced in large measure to the low estimate of smaller processor units (operated by fewer than 5 persons), existing throughout the State. Reestimation by ORG resulted in a value of 4.3 million tonnes of rice or about 15 million million Kcals for the State as a whole (still short of the production figure). Such an error is indicative of the problems involved in finding these units and in intervening in the food process chain via this route.

From the Consumer Food Habits Survey, the amount of rice consumed during 1971-1972 was estimated at 18.7 million million Kcals, which corresponds with production approximations and still leaves the food processing survey somewhat short. This may reflect again the emphasis placed on the relative size of operation dealt with by the survey.*

Protein Accountability

Rice accounts for almost half of the protein in processed foods, and data from the Consumer Food Habits Survey showed that about half the protein consumed is from rice. Secondary sources for available protein from the food processing industry are flour and dhal mills. However, as in accounting for calorie availability, the amount of food processed accounts for only about two-thirds of the 670 million kgs. of protein reaching the consumer.

Processed - Serviced Accounting

A brief description of the amounts of calories and proteins arising from the food processing industries both as processed and serviced products is given in Table 1. The Table also includes results taken from the Consumer Food Habits Survey for comparison. The indicated percentage of foods, as measured by calorie and protein intake, reaches the public through channels of complete processing (20-25%), servicing (40-50%) and other means (35%). The other means are those accounting for the differences noted between the ORG survey results and those obtained through the Consumer Food Habits Survey, Figure 2 (II) (C)

* It should be noted that a limited examination of the raw data on family purchasing patterns demonstrates that many families located along major food transfer arteries appear to purchase food as much as 20 to 30% in excess of their rate of consumption. It is possible that local vendors have not differentiated between their own purchase to resell and purchase to consume (wholesale-retail) and this reflects again both on size of the survey unit and the complexity of the distribution system, i. e., these vendors may be a reflection of the shandy.

TABLE 1

Sources of Consumer Food Products
Food Processing Survey vs. Consumer Food Habits Survey^a

	Kcals x 10 ⁶			Protein, Kg x 10 ⁶		
	ORG Survey ^b		C. F. H. S. ^b	ORG Survey ^b		C. F. H. S. ^b
	Processed	Serviced	Consumed	Processed	Serviced	Consumed
Rice Mills	4,000	12,600	18,700	76.0	302.0	313.0
Oil Mills	1,200	800	1,400 ^c	---	---	---
Flour Mills	800	350	2,700 ^c	26.0	9.0	46.0
Dhal Mills	110	170	1,960 ^c	8.0	11.0	10.9
Sugar Mills	890	---	840	---	---	---
Total for TN ^d	7,600	13,200	31,800	116.0	321.0	670.0

- a. Measured as calories and proteins.
- b. ORG = Food Processing Survey; CFHS = Consumer Food Habits Survey
- c. These figures do not correspond to the processed quantities because the food consumption categories used contain many more items than the limited number which are processed in the oil, flour, and dhal mills.
- d. Totals include other processing categories in addition to the five tabulated here.

Data from the ORG and Food Habits Surveys were also combined to assist in locating major food purchase points. These data are shown in Table 2. Five variables are combined in this table. These include the cross referencing of 5 major commodities by processing source and retail outlets. Then each is subdivided into rural and urban components as well as the nutrition furnish in terms of calories and protein.

Petty shop and shandy distribution - At the retail purchase level of distribution, the petty shops and shandy are the only intervention points apparent in the established distribution system. The petty shops account for 70 percent of total retail food sales, including almost all of the grain. The shandy, with about 10 percent of all sales, offers a wide variety of items for weekly purchase. The most significant intervention perceivable at this time, making use of this part of the distribution subsystem, would be a scheme to use the petty shops as sales points for commercial distribution of household quantities of the new and nutritionally improved foods produced for public feeding programs.

TABLE 2

SOURCES OF SUPPLY OF MAJOR COMMODITIES ON A RURAL AND URBAN BASIS

Reported as Percentages of Calories and Protein

Point of Purchase / Food Source	Calories, % of Total					Protein, % of Total		
	Rice Mills	Oil Mills	Flour Mills	Dhal Mills	Sugar Mills	Rice Mills	Flour Mills	Dhal Mills
<u>RURAL</u>								
Petty shops	99.5%	2.8%	71.5%	30.0%	---	100.0%	75.0%	30.0%
Provision stores, coops, ration shops	---	79.5	2.6	41.0	89.0%	---	---	42.0
Vendors, vegetable markets, shandy	0.5	7.7	21.0	14.5	11.0	---	25.0	14.0
Not paid for (homegrown)	---	10.0	4.9	14.5	---	---	---	14.0
<u>URBAN</u>								
Petty shops	99.8%	2.0%	87.0%	31.0%	---	100.0%	100.0%	37.5%
Provision stores, coops, ration shops	---	95.0	6.0	55.7	98.5%	---	---	62.5
Vendors, vegetable markets, shandy	0.2	3.0	1.0	11.4	1.5	---	---	---
Not paid for (homegrown)	---	---	5.0	1.9	---	---	---	---
<u>STATEWIDE</u>								
Petty shops	99.8%	3.0%	74.5%	30.5%	---	100.0%	67.0%	25.0%
Provision stores, coops, ration shops	---	87.0	3.8	48.0	94.5%	---	---	50.0
Vendors, vegetable markets, shandy	0.2	5.0	16.7	13.0	5.5	---	33.0	12.5
Not paid for (homegrown)	---	5.0	5.0	8.5	---	---	---	12.5

C. Subsystem III - The Consumer

The nutritional status of the consumer, described as realistically as can be done, presents the challenges that workings of the production (I) and processing (II) subsystems must meet. In the last analysis, it is the consumer who will determine the acceptability and, therefore, the cost/effectiveness of nutrition operations.

For the nutrition planner to work effectively, with reasonable chance that his proposals can be implemented successfully, he must have knowledge of the specific nature and extent of the nutrition problem, the location, identity, and characteristics —economic, social, and cultural— of the people experiencing malnutrition, their food habits and food behavior, and the specific conditions and situations governing acceptance or rejection of the proffered food or program by the proposed beneficiaries. Rarely, if ever, heretofore, has this kind of information been available on a state-wide scale. The conventional modes of data gathering, processing, and analysis do not provide it. Information from food balance sheets, from the normal kind of economic and econometric studies, and in fact, most nutritional status and food habits surveys -- because of the way data are handled -- does not penetrate to the level where acceptance or rejection, thus success or failure, takes place. The critical level is the individual household and its individual members.

Unaggregated data - The usual method of handling survey data has always been to disperse the information from the household units, lump categories together into what are often broad and undefined classes, aggregate data by individual items, average, and attempt to provide the required inputs to the planner's work by an analysis of the averaged data. Unfortunately for the utility of this kind of work, no real person is an average one. To give the planner the kind of inputs he needs, it is necessary to preserve and bank all data in its raw, completely unaggregated form, to withdraw and integrate appropriate data items into analytical operations as needed, and to aggregate data only in the course of the analytical process. Data are aggregated only to attain a desired level of statistical significance, accepting some loss of definition of the problem in so doing, or to scale the information to a level at which comparisons are to be made (such as by District, for example), but never merely for the convenience of the data processor. The modern computer has made it possible to produce this kind of information for the planner. The present work has taken the opportunity to fulfill this important objective. The technology of data preparation and processing has been fully detailed in Chapter IV, Volume II-A, of this report.

Analytical methodology - As noted in the introduction to this chapter, input/output analysis is the basis of the methodology used. To facilitate the handling of large masses of unaggregated data and the innovative analytical methods used, rank ordering and partile analysis were employed extensively. Mean and median partile positions, and in some cases, boundary values, become numbers that can be handled by appropriate statistical procedures to give measures of precision and dispersion, and along with summations of numbers in individual or aggregates of cells in data matrices, the basis for computing correlations and regressions, and vector analysis. A variety of multidimensional data displays was developed to facilitate the analysis of systems of up to five variables handled simultaneously. These procedures and methods have been described in detail in the technical section of this report. *

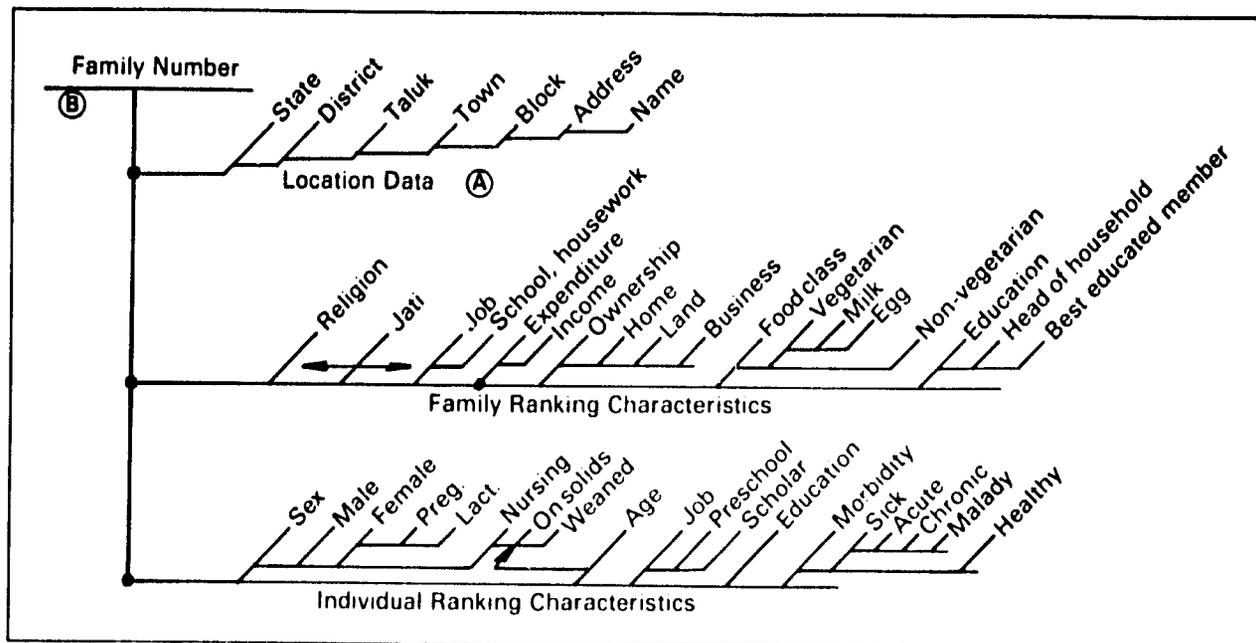
Dynamics of the consumer subsystem— This subsystem is designated by ⑤ in Figure 2 and is delineated by Figures 4 through 6 shown in the following pages. In its interrelationships with Figure 2, the subsystem integrates the marketplace, ③, with foodstuffs, ①, and output, ④, describing the many steps from raw food purchase through meal preparation and final distribution of food to the individuals in the family. These diagrams describe how data were ordered. A useful process for recording and measuring differences is incorporated in the data analysis section.

Data characteristics - Data sets are here presented by families and individuals, and aggregated by taluk, district, caste, occupation of head of household, or other factors, depending upon the relationships under examination.

Data on protein and calorie need fulfillment by individuals and families, expenditures, the socioeconomic (S/E) index, and educational level are presented in Table 3, which covers the third round survey and summaries of the first, second, and fourth. The data sets included in the table are identified in the accompanying key. For both protein and calorie need fulfillment, 100 percent of need met is the goal, but 80 percent is accepted as a critical point below which problems of malnutrition demand some form of intervention. As a device for calculating and comparing the nutritional status of families, family size has been computed as the number of adult

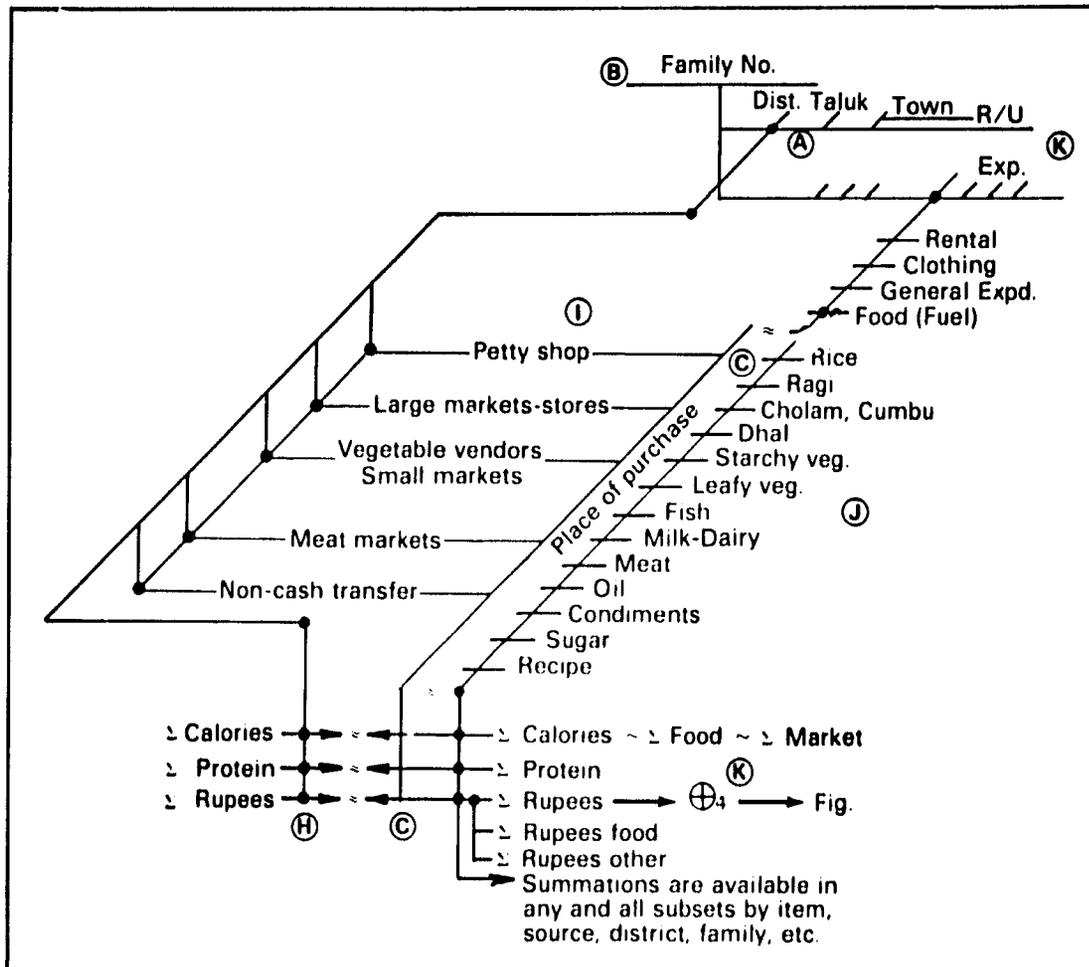
* See Vol. II Sec. A "Technical Data and Methods" Chapter V.

FIGURE 4 Identify Data Tree: Family and Individual.



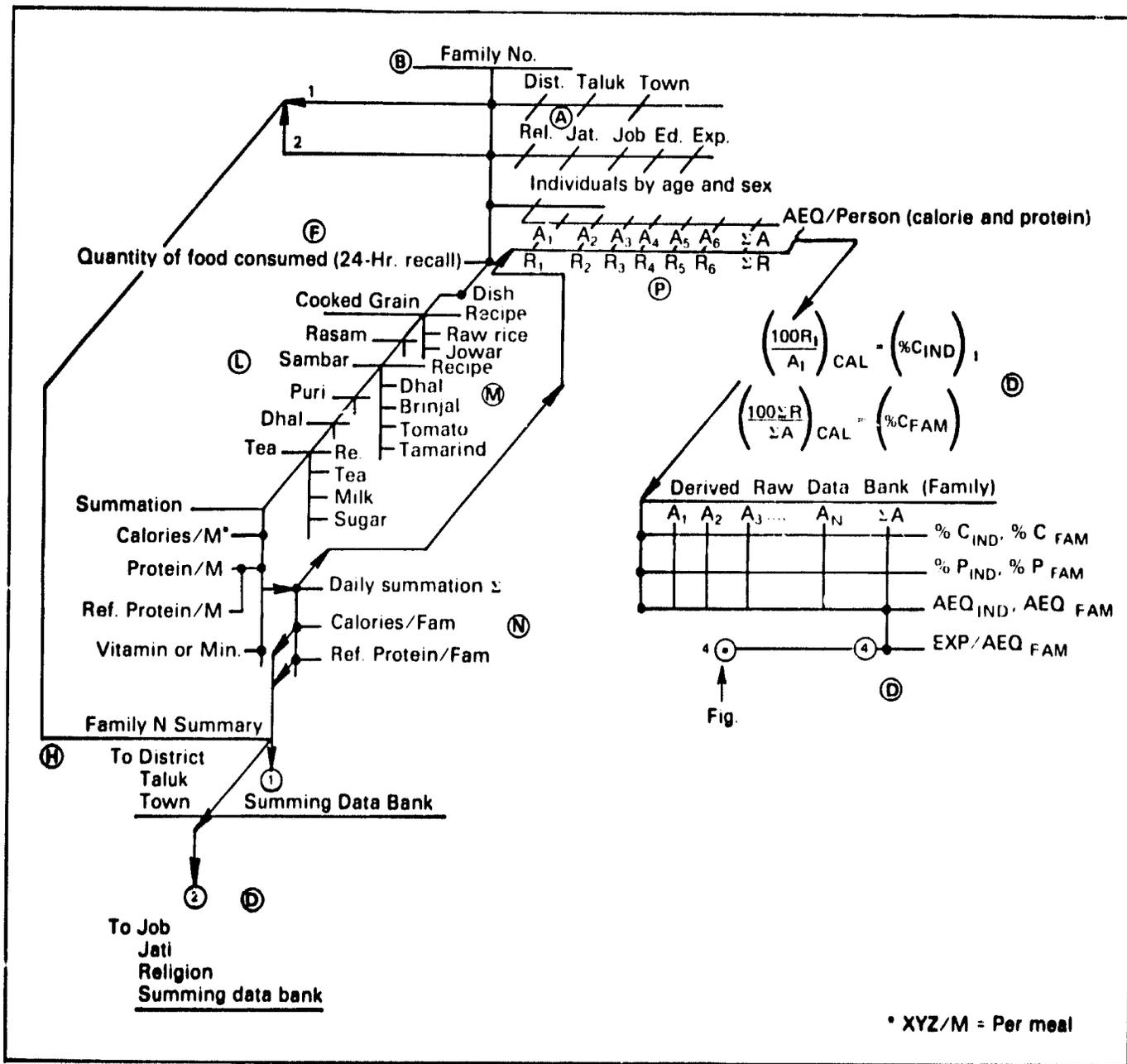
This is a duplicate of Figure 2 in Chapter V, Volume II-A

FIGURE 5 Food Purchase Patterns (30 Day Recall) by Family.



This is a duplicate of Figure 3 in Chapter V, Volume II-A

FIGURE 6 Food Consumption Patterns (24 Hr. Recall) by Individual and Family.



This is a duplicate of Figure 4 in Chapter V, Volume II-A

KEY TO COLUMN HEADS OF TABLE 3

<u>Column</u>	<u>Definition</u>
A	% Protein need fulfilled by household based on 24 hour food recall for 3rd rd. of FHS.
B	% Protein need fulfilled by household based on 24 hour food recall for 1st, 2nd, and 4th rds. of FHS.
C	% Protein need fulfilled by household based on 30 day food inventory for 3rd rd. of FHS.
D	% Protein need fulfilled by individual, based on 24 hour food recall for 3rd rd. of FHS.
E	% Protein need fulfilled by individual, based on 24 hour food recall for 1st, 2nd, and 4th rds. of FHS.
F	Number of Calorie Adult Equivalents (AFQs) per household in the 3rd rd. of FHS.
G	Number of Calorie Adult Equivalents (AEQs) per household in the 1st, 2nd, and 4th rds. of FHS.
H	% Calorie need fulfilled by household based on 24 hour food recall for 3rd rd. of FHS.
I	% Calorie need fulfilled by household based on 24 hour food recall for 1st, 2nd, and 4th rds. of FHS.
J	% Calorie need fulfilled by household based on 30 day food inventory for 3rd rd. of FHS.
K	% Calorie need fulfilled by individual, based on 24 hour food recall for 3rd rd. of FHS.
L	% Calorie need fulfilled by individual, based on 24 hour food recall for 1st, 2nd, and 4th rds. of FHS.
M	Protein-Calorie Ratio for household based on 24 hour food recall for 3rd rd. of FHS.
N	Protein-Calorie Ratio for household based on 24 hour food recall for 1st, 2nd, and 4th rds. of FHS.
O	Protein-Calorie Ratio for household based on 30 day food inventory for 3rd rd. of FHS.
P	Protein-Calorie Ratio for individual, based on 24 hour food recall for 3rd rd. of FHS.
Q	Protein-Calorie Ratio for individual, based on 24 hour food recall for 1st, 2nd, and 4th rds. of FHS.
R	Total household expenditure per month (rupees) for 3rd rd. of FHS.
S	Total household expenditure per month (rupees) for 1st, 2nd, and 4th rds. of FHS.
T	Total household expenditure per calorie AFQ per month (rupees) for 3rd rd. of FHS.
U	Total household expenditure per calorie AEQ per month (rupees) for 1st, 2nd, and 4th rds. of FHS.
V	Total household expenditure per capita per month (rupees) for 3rd rd. of FHS.
W	Total household expenditure per capita per month (rupees) for 1st, 2nd, and 4th rds. of FHS.
X	Socio-Economic Index by household for 3rd rd. of FHS.
Y	Socio-Economic Index by household for 1st, 2nd, and 4th rds. of FHS.
Z	Highest education in household for 3rd rd. of FHS (number of years of formal education completed, "ILL" - illiterate, F.I. - Functional Illiterate, no formal education but can read and write).
1	Percent position in sample. The first line is read as "5 percent of the sample population of each column is equal to or below the value listed in each column".

TABLE 3 VALUES OF CALCULATED INDEXES AT TWENTIETH PERCENTILE POINTS*

% tile	Protein Data					AEQC's		Calorie Data					Protein/Calorie Ratios					Expenditure Data						S/E Index		Educ.
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
5	48	47	53	46	42	1.70	1.69	41	43	41	37	33	95	93	92	88	87	65	73	20	22	16	18	3.1	3.1	III
10	56	58	66	56	54	2.05	2.07	51	51	52	46	44	100	98	100	93	91	90	95	24	27	19	22	3.7	3.7	III
15	65	64	75	63	61	2.58	2.53	56	57	60	52	51	103	101	104	97	95	101	112	27	31	21	25	4.1	4.2	III
20	70	69	82	69	67	2.80	2.76	61	61	66	57	56	105	103	108	100	98	113	124	30	34	24	28	4.4	4.6	F.L.
25	74	73	89	73	72	3.01	2.96	64	65	72	61	61	107	105	111	103	101	124	136	32	37	26	30	4.8	4.8	1
30	78	78	96	78	77	3.21	3.20	68	68	77	65	65	109	107	114	107	105	135	148	35	40	28	32	5.1	5.2	2
35	82	82	102	82	81	3.52	3.44	71	72	81	69	69	110	108	118	110	108	146	162	37	42	30	35	5.6	5.7	3
40	86	86	109	86	86	3.70	3.62	74	75	85	72	73	112	110	121	113	112	159	176	39	45	32	37	6.1	6.2	4
45	89	89	116	90	90	3.84	3.77	77	78	91	76	76	113	111	124	117	116	172	192	42	49	34	39	6.6	6.7	4
50	92	93	122	95	94	4.04	3.96	80	81	96	80	80	115	11	127	121	119	183	209	45	52	37	43	7.0	7.3	5
55	96	96	130	100	99	4.25	4.19	84	85	101	84	84	117	115	130	125	124	196	225	48	56	39	46	7.6	7.7	5
60	101	100	137	105	104	4.50	4.42	87	88	106	88	88	119	117	134	129	127	210	245	51	59	42	50	8.1	8.3	6
65	105	104	147	110	109	4.76	4.69	90	92	114	92	93	121	119	137	133	132	226	265	56	64	45	53	8.8	9.0	7
70	110	109	156	116	115	5.05	4.95	94	95	121	97	97	123	121	142	137	136	249	290	60	70	49	58	9.5	9.8	8
75	115	114	120	123	122	5.34	5.25	98	99	130	102	103	125	123	146	141	140	277	320	65	76	54	64	10.3	10.6	9
80	121	120	183	132	131	5.72	5.58	104	105	142	108	109	127	126	152	146	145	309	368	71	85	60	71	11.2	11.5	10
85	128	127	201	142	141	6.19	5.93	111	111	157	115	117	130	129	160	151	151	355	419	81	95	68	79	12.1	12.3	11
90	139	138	230	157	157	6.83	6.60	119	121	183	124	128	133	133	170	159	159	419	507	97	115	81	95	12.9	13.4	12
95	156	160	293	181	184	7.71	7.39	132	137	236	142	147	139	139	193	170	171	560	686	128	152	106	130	14.3	15.0	H.E.
Total No. In Sample	2484	2799	2484	12953	13886	2484	2799	2484	2799	2484	12953	13886	2484	2799	2484	12953	13886	2484	2792	2484	2792	2484	2792	2475	2770	2484

* Statewide figures. See facing page for definition of column heads.

equivalents on a calorie need basis (AEQC).^{*} Average family size for the state is 4.0 AEQC, which equals 5.3 persons. Protein and calorie need fulfillment based upon 30-day recall of food purchased (columns C and J) tends to be quite high relative to data based on 24-hour recall of food consumed. Checks of raw data revealed that in many instances rupee expenditure was in line but quantity of food purchased was abnormally high. In computation of nutritional status such errors were compensated by using a test for significance with a limiting value of 5000 calories purchased per rupee, and applying this as a default value where necessary.

Protein/calorie ratio is a measure of the nutritional quality of the food eaten, but is not an indicator of quantitative sufficiency of the diet. A P/C ratio of 1.0 defines a balanced diet; if calorie needs are met by such a diet, the person will be adequately nourished, insofar as these two basic nutritional factors are concerned. If the person is chronically underfed, in terms of calories, a portion of the protein will be metabolized to supply needed energy and the effective P/C ratio will be less than 1.0. This latter situation holds, at present, for perhaps half or more of the people in the state.

Expenditure per adult equivalent (EXP/AEQ) is a measure of family economic well-being. It is calculated from the 30-day family expenditure balance sheet, with a 10 percent upward adjustment for those who own their own dwelling places. The 30-day total rupee expenditure is then divided by the number of consumption units (AEQ) in the family. Less than 40 rupees per capita per month, roughly 52 rupees per month per AEQ, is considered the poverty level.

Education rank, in column "Z" of Table 3, is the highest level reached by any individual in the family.

Aggregation of data by District - Table 4 shows the distribution of the sample for the third round survey, along with the actual population distribution by District, including the rural/urban division. For comparison, a population density map (Map 7) taken from a report of the 1971 Tamil Nadu census is shown. Table 5 shows, for households, the various median data values of five variables for each District. Districts are listed in rank

^{*} AEQC corresponds roughly to the consumption unit used in the National Sample Survey and many other nutrition and expenditure surveys.

TABLE 4
DISTRIBUTION OF 3RD ROUND FOOD HABITS SURVEY SAMPLE BY DISTRICT

District	RURAL						URBAN						TOTAL					
	No. of sample families	Percentage of column total	No. of sample individuals	Percentage of column total	Actual population (1000's of individuals)	Percentage of column total	No. of sample families	Percentage of column total	No. of sample individuals	Percentage of column total	Actual population (1000's of individuals)	Percentage of column total	No. of sample families	Percentage of column total	No. of sample individuals	Percentage of column total	Actual population (1000's of individuals)	Percentage of column total
Tiruchirappalli	130	9	654	9	2,990	10	46	5	215	4	855	7	176	7	869	7	3,845	9
Thanjavur	134	9	657	9	3,045	11	78	8	425	8	788	6	212	9	1,082	8	3,833	9
South Arcot	181	12	887	12	3,094	11	141	14	713	13	513	4	322	13	1,600	12	3,607	9
Coimbatore	117	8	604	8	2,804	10	21	2	109	2	1,553	12	138	6	713	6	4,357	11
Dharmapuri	100	7	510	7	1,530	5	6	1	29	1	144	1	106	4	539	4	1,674	4
Ramanathapuram	97	7	470	6	2,112	5	45	5	236	4	746	6	142	6	706	5	2,857	7
Nilgiris	66	4	374	5	249	1	7	1	42	1	243	2	73	3	416	3	491	1
Tirunelveli	95	6	472	6	2,116	7	93	9	521	9	1,028	8	188	8	993	8	3,194	8
Madurai	139	9	661	9	2,609	9	71	7	391	7	1,322	11	210	8	1,054	8	3,931	10
Kanyakumari	66	4	333	4	1,024	4	12	1	183	3	204	2	78	3	516	4	1,228	3
Chingleput	99	7	509	7	1,885	7	111	11	599	11	1,006	8	210	8	1,108	9	2,889	7
Salem	103	7	455	6	2,192	8	58	6	333	6	795	6	161	6	788	6	2,987	7
North Arcot	159	11	830	11	2,957	10	47	5	248	5	781	6	206	8	1,078	8	3,738	9
Madras City	--	--	--	--	--	--	241	24	1,450	26	2,470	20	241	10	1,450	11	2,470	6
State Total	1,484	100	7,416	100	28,656	100	1,000	100	5,496	100	12,447	100	2,484	100	12,912	100	41,103	100

TABLE 4A

PERCENTAGE OF HOUSEHOLD CALORIE AND PROTEIN NEEDS FULFILLED
BY DISTRICT*

DISTRICT	Calories						Protein **					
	Rural		Urban		Total		Rural		Urban		Total	
	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank	%	Rank
Tiruchirappalli	92	1	95	2	93	1	106	1	115	2	107	2
Thanjavur	89	2	98	1	92	2	106	2	120	1	111	1
South Arcot	87	3	94	3	88	3	99	4	114	3	101	4
Coimbatore	85	4	89	6	85	4	101	3	109	5	105	3
Dharmapuri	81	6	92	4	81	5	94	7	112	4	95	7
Ramanathapuram	83	5	77	12	81	6	99	5	94	10	97	5
Nilgiris	77	8	92	5	80	7	91	8	107	6	93	8
Tirunelveli	81	7	78	9	79	8	96	6	96	8	96	6
Madurai	77	9	79	8	78	9	90	9	95	9	92	9
Kanyakumari	71	12	84	7	76	10	86	11	102	7	90	10
Chingleput	77	10	78	10	76	11	89	10	89	12	89	11
Salem	72	11	73	13	72	12	84	12	87	13	86	12
North Arcot	71	13	78	11	72	13	82	13	91	11	84	14
Madras City	--	--	69	14	69	14	--	--	86	14	86	13
State Total	81	--	79	--	80	--	94	--	96	--	95	--

* Data from 3rd round of Food Habits Survey.

** Protein is Modified FAO Reference Protein.

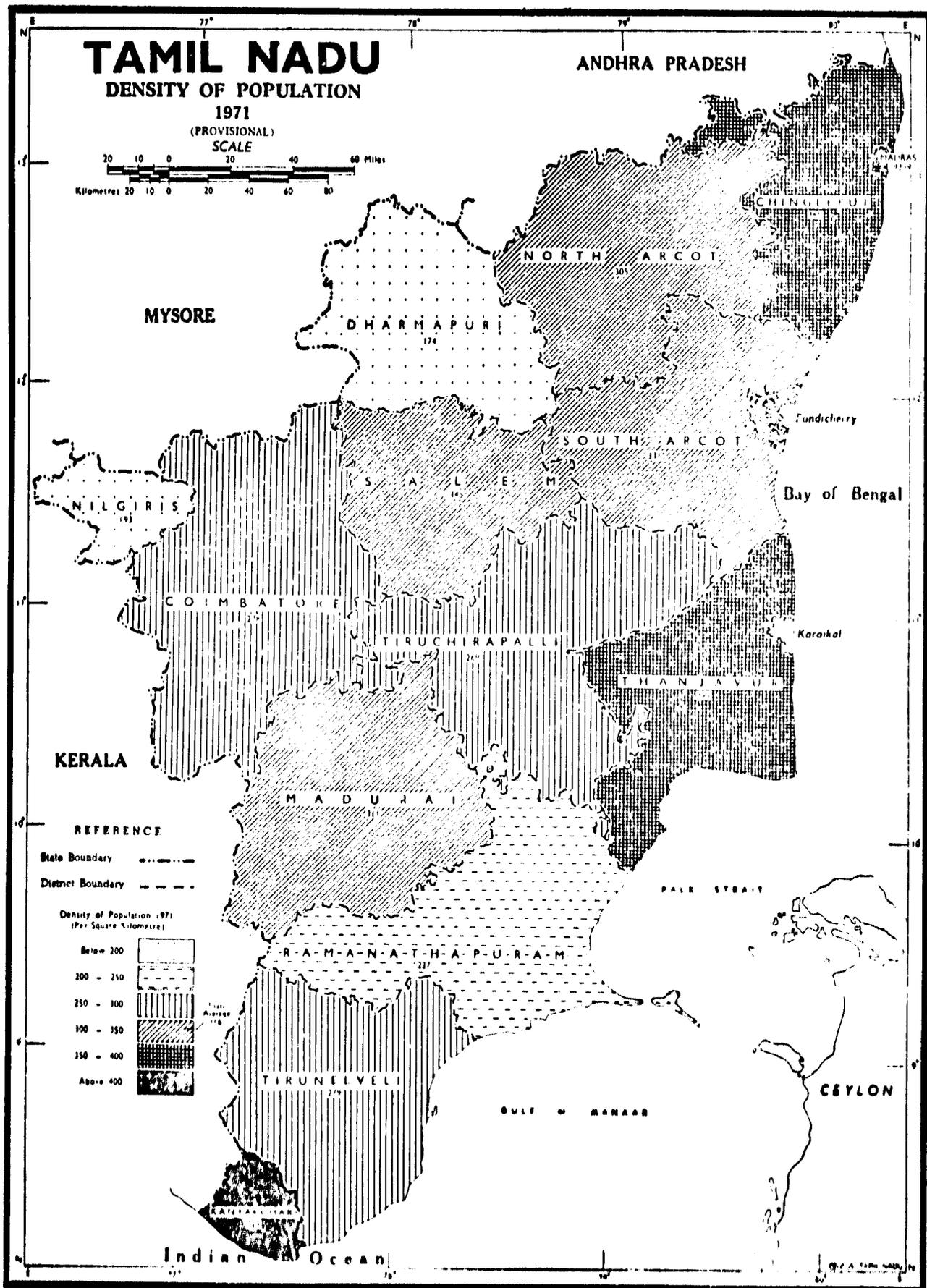


TABLE 5 - HOUSEHOLD DATA BY DISTRICT*

DISTRICT	A	Rank	B	Rank	C	Rank	D	Rank	E	Rank
Tiruchirappali	153	12	2.1	12	5.0	14	2.0	1	95	3
Thanjavur	160	11	3.2	7	5.2	7	1.1	9	94	5
South Arcot	142	14	2.3	8	5.3	6	1.8	4	92	8
Coimbatore	233	2	4.0	3	5.1	12	1.3	5	90	10
Dharmapuri	188	4	1.9	14	5.2	8	2.0	2	92	9
Ramanathapuram	152	13	2.4	10	5.2	9	2.0	3	96	1
Nilgiris	231	3	3.3	6	5.8	2	1.3	6	90	11
Tirunelveli	188	6	4.1	2	5.4	5	1.0	11	82	14
Madurai	186	7	2.3	9	5.2	10	1.3	7	94	6
Kanyakumari	197	4	3.4	5	5.6	3	0.7	13	96	2
Chingleput	181	8	3.8	4	5.5	4	1.0	12	89	12
Salem	172	9	2.2	11	5.1	13	1.1	10	95	4
North Arcot	161	10	2.0	13	5.2	11	1.3	8	94	7
Madras City	288	1	6.9	1	6.3	1	0.1	14	83	13
State Average	190	--	3.4	--	5.3	--	1.2	11	91	--

* Data from 3rd round of Food Habits Survey. Districts are ordered by degree of household calorie fulfillment.

Column heads:

A - Approximate monthly income (rupees).

B - Years of education of head of household.

C - Number of persons per household.

D - Acres of land owned.

E - Percentage of non-vegetarian households.

order by the median calorie fulfillment values (%C), the highest at top of the list, lowest at bottom. In addition, District rank is assigned for each of the factors, A through E, on a 1 highest, 14 lowest, basis. Table 6 further expands the data on expenditure per AEQ and family size to include the rural/urban distribution. Whereas Table 6 presents expenditure data versus need, Table 7 presents expenditure data versus consumption as the basis.

Aggregation of data by attribute - Data on family characteristics, land ownership, calorie and protein status, and expenditure, including fractions spent on different food groups, are aggregated by caste or jati in Table 8, by occupation of head of household in Table 9. The data in these tables also bridge the distribution and purchasing components of Subsystems I and II. Total expenditure for food, column "N" in both tables, and the percentage distribution of that sum among the major commodities, columns "O" through "V", provide an invaluable tool for examining how an intervention may influence diet.

Some general findings about the subsystem - The few individuals whose diets had protein/calorie ratios below 100 ($P/C = 1.0$) were older adults for the most part. This is shown with great clarity in the patterns in Figures 17 A through D in Chapter VI (on intrafamily food distribution). These same figures also show clearly that the quality of children's diets is invariably well above 100, but that the quantity received is often far too small, particularly in the groups of weaning children. (The upper left to lower right diagonal in the figures is the line of average quantity of food received. Those groups lying to the lower left of the diagonal received less than average, those to the upper right, more). The state average value of 120 ($P/C = 1.2$) indicates the real overall need for more food of the same quality that is presently being consumed.

Socioeconomic index is a useful attribute for analysis and interpretation. Although the simple two-way tables in this chapter do not permit the relationships to be observed, further analysis using multidimensional displays indicated that, in general, those in the midrange fared best in meeting nutritional needs. At the extreme ranges, firmly established social and cultural customs result in deterioration of nutritional status.

The education index, the highest level reached by any individual in the family, has more spread than the educational level of the head of household. This difference is a strong indication of an upward movement of families. A comparison of column "B" in Table 5 with the education

TABLE 6
AVERAGE HOUSEHOLD EXPENDITURE AND SIZE BY DISTRICT*

DISTRICT	Median Expenditure Per Month Per Calorie AEQ						No. of Household Calories AEQ**					
	Rural		Urban		Total		Rural		Urban		Total	
	Rs.	Rank	Rs.	Rank	Rs.	Rank	Calorie AEQs	Rank	Calorie AEQs	Rank	Calorie AEQs	Rank
Tiruchirappalli	39	11	41	13	39	13	3.99	5	3.76	14	3.90	13
Thanjavur	43	6	45	9	44	6	3.94	6	4.06	9	3.98	9
South Arcot	48	1	50	4	49	2	3.85	11	4.01	12	3.91	12
Coimbatore	41	9	50	5	42	11	4.12	2	4.04	11	4.10	5
Dharmapuri	44	3	49	6	44	7	3.91	7	4.33	4	3.94	11
Ramanathapuram	44	4	44	11	44	9	3.91	8	4.06	10	3.95	10
Nilgiris	48	2	60	1	49	3	4.29	1	4.44	3	4.30	2
Tirunelveli	43	7	47	8	45	5	3.90	9	4.15	8	4.02	6
Madurai	42	8	45	10	43	10	3.86	10	4.27	6	4.00	8
Kanyakumari	39	12	54	3	44	8	4.12	3	4.53	1	4.23	3
Chingleput	44	5	48	7	46	4	3.83	12	4.26	7	4.15	4
Salem	41	10	42	12	42	12	3.71	13	4.28	5	3.88	14
North Arcot	35	13	29	14	34	14	4.07	4	3.82	13	4.02	7
Madras	--	--	59	2	59	1	--	--	4.50	2	4.50	1
State Average	42	--	49	--	45	--	3.94	--	4.19	--	4.04	--

* Data from 3rd round of Food Habits Survey. Districts are ordered by degree of household calorie fulfillment.

** 1 calorie AEQ = 2500 calories.

TABLE 7

**MEDIAN HOUSEHOLD EXPENDITURE PER MONTH PER AEQ OF CALORIES
AND PROTEIN CONSUMED, BY DISTRICT***

DISTRICT	Calories						Protein					
	Rural		Urban		Total		Rural		Urban		Total	
	Rs.	Rank	Rs.	Rank	Rs.	Rank	Rs.	Rank	Rs.	Rank	Rs.	Rank
Tiruchirappalli	42	13	43	13	42	14	37	13	36	13	36	14
Thanjavur	48	11	46	12	48	12	41	11	38	12	40	12
South Arcot	55	4	53	10	54	8	48	4	44	10	46	8
Coimbatore	48	12	56	9	49	11	41	12	46	9	40	11
Dharmapuri	54	7	53	11	54	9	47	5	44	11	46	9
Ramanathapuram	53	8	57	7	54	10	44	9	47	7	45	10
Nilgiris	62	1	65	2	61	2	53	1	56	2	53	2
Tirunelveli	53	9	60	5	57	6	45	7	49	5	47	6
Madurai	55	5	57	8	55	7	47	6	47	8	47	7
Kanyakumari	55	6	64	3	58	4	45	8	53	4	49	4
Chingleput	57	2	62	4	61	3	49	2	54	3	52	3
Salem	57	3	58	6	58	5	49	3	48	6	49	5
North Arcot	51	10	37	14	47	13	44	10	32	14	40	13
Madras City	--	--	86	1	86	1	--	--	69	1	69	1
State Average	52	--	62	--	56	--	45	--	51	--	47	--

* Data from 3rd round of Food Habits Survey
 1 calorie AEQ = 2500 calories
 1 protein AEQ = 45 grams of reference protein.

KEY TO COLUMN HEADS OF TABLES 8 & 9

<u>Column</u>	<u>Definition</u>
A	Number sampled.
B	Social rank (1 is high status, 5 is low status; see Vol. II, Sections A and B of this report).
C	Percentage of sample that is non-vegetarian.
D	Years of education of head of household.
E	Acres of land owned.
F	Percentage of sample in rural areas.
G	Number of persons per household.
H	Number of calorie AEQs (adult equivalents) per family, 1 calorie AEQ = 2500 calories.
I	Total monthly expenditure per calorie AEQ (rupees).
J	Total monthly expenditure (rupees).
K	Approximate monthly income (rupees).
L	Degree of household protein needs fulfilled.
M	Degree of household calorie needs fulfilled.
N	Food expenditure per month (rupees).
O	Percentage of monthly food expenditure spent on rice.
P	Percentage of monthly food expenditure spent on ragi and small millets.
Q	Percentage of monthly food expenditure spent on jowar, cholam, cambu.
R	Percentage of monthly food expenditure spent on dhals.
S	Percentage of monthly food expenditure spent on meat and fish.
T	Percentage of monthly food expenditure spent on milk and dairy products.
U	Percentage of monthly food expenditure spent on edible oils.
V	Percentage of monthly food expenditure spent on sugar.

TABLE 8

HOUSEHOLD DATA BY HOUSEHOLD CASTE*

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Naicker	121	3	99	2.9	1.5	41	5.6	4.55	59	268	179	86	74	157	42	8	3	7	8	11	6	3
Mudaliar	144	1	90	5.0	0.6	27	5.5	4.52	63	285	217	87	76	159	41	4	3	7	9	14	6	3
Nadar	122	1	98	4.1	0.9	52	5.4	4.52	66	298	233	91	76	165	46	2	2	9	11	9	6	3
Badaga	36	1	97	3.6	2.5	100	6.6	5.39	53	286	229	88	78	193	36	13	3	9	5	10	5	4
Reddi	34	3	97	2.8	3.9	89	5.0	4.15	55	228	200	90	79	140	44	11	4	8	5	9	6	3
Brahmin	94	1	1	10.7	1.4	30	5.8	4.75	94	447	401	92	79	227	34	0	2	9	0	21	9	5
Asari	80	3	94	3.4	0.4	54	5.5	4.44	48	213	171	95	80	139	48	6	5	8	9	6	6	3
Harijan	285	5	100	1.4	0.6	80	5.0	4.06	42	171	120	91	81	110	55	13	4	5	6	1	4	1
Labbar	27	§	100	2.9	1.3	63	6.2	5.02	55	276	227	100	81	173	47	1	1	8	15	8	4	3
Edayar	62	3	97	2.6	2.0	69	5.1	4.28	52	223	146	96	83	149	46	7	11	7	7	6	6	3
Naidu	69	2	96	4.9	1.8	56	5.6	4.53	64	290	228	99	83	168	41	6	3	8	8	10	9	4
Gownder	210	2	99	1.2	2.1	85	4.9	4.03	55	222	162	95	84	142	40	12	7	7	4	5	6	2
Uyudayar	42	3	91	1.7	3.8	91	4.7	3.88	50	194	154	95	85	117	44	10	12	6	4	7	8	1
Pillai	83	3	75	4.8	0.9	66	5.3	5.12	55	288	208	100	85	147	44	3	3	10	7	8	8	4
Chettiar	119	3	89	4.4	0.9	34	5.5	4.49	65	292	222	102	85	164	42	6	4	9	8	10	7	4
Catholic	31	*	100	3.6	0.3	59	5.5	4.34	81	352	175	103	85	227	37	0	30	6	8	5	4	3
Palayatchi	94	3	99	2.0	1.7	80	5.6	4.60	45	207	171	100	88	137	46	12	3	7	9	4	6	2
Thevar	102	3	99	2.0	1.5	76	5.2	4.15	52	216	154	105	91	129	50	5	5	8	10	4	6	2
Rawthur	27	4	100	3.2	0.7	65	5.6	4.86	50	243	180	109	92	151	48	1	2	8	15	7	6	3
Vellalar	68	2	78	4.8	2.4	58	5.0	3.97	62	246	231	111	93	164	43	8	3	9	5	12	7	3
Ambalam	25	4	100	1.8	1.1	68	4.6	3.73	50	187	142	125	108	129	62	2	1	6	7	7	7	1
Muthuraja	25	4	100	2.4	1.1	81	4.6	3.66	37	135	123	120	110	81	56	5	4	6	6	8	5	3

* Data from 3rd round of Food Habits Survey. Castes are ordered by degree of household calorie fulfillment (column M).
See facing page for explanation of other column heads.

§ A Muslim sect, not a caste, included for comparison.

* A Christian sect, not a caste, included for comparison.

index (column "Z") in Table 3 shows the trend clearly. The state average years of schooling of head of household was found to be 3.4 while at the fiftieth percentile of the sample population, the education index is 5 years. Many families with illiterate or semiliterate (less than three years in school) parents have children with 7 to 10 years of schooling. This process is one of the best indications that real social and economic progress is being made in the state.

Data in Table 6 show an effect of urbanization on nutritional status. On a state average basis, the larger urban families (4.19 AEQ versus 3.94 AEQ) spend more per AEQ per month (49 versus 42 rupees) and are not necessarily as well fed. In nine of the 13 districts (Madras excluded, having no rural population) this relationship was expressed; in two more, having larger urban than rural families, on average, in the sample, the urban expenditure was also higher. One district, North Arcot, had both a larger average family and larger expenditure in the rural than the urban zone. In the cities, much more is spent on clothing and transportation, which automatically raises expenses. How much of the additional expenditure is necessary and how much discretionary is not yet known, but should be determined.

A comparison of Districts of the "Calories" "Total" rankings from Tables 6 and 7 provides an insight to the relative cost of living in each District. If the District rank from Table 6 column 3 (a measure of relative wealth) is subtracted from the District rank from Table 7 column 3 (a measure of relative cost of living) and the difference is positive, then residents in that District are relatively better off. This type of ranking indicates that other variables are responsible for the differences provided that all rank differences are not zero. In this case, Thanjavur, Dharmapuri, South Arcot, Tiruchirappalli, and Tiruvelveli, the food exporting districts (see Map 3) plus Ramanathapuram, one of the higher ranking food importing districts, show a positive difference indicating that in each the population is doing better than their economic status alone would indicate. A corollary is that people in food exporting districts are better off.

Table 8 presents an apparent anomaly that is most interesting and important. Listing of caste names is by nutritional status rank, from poor at top to good at bottom, while in column "B" high social rank (1 is high status, 5 low status) tends toward the top of the list with the poorly nourished. The implication is that caste or social standing is not a good tool for identifying nutritional status, at least not in the conventional view of a general positive association of high social standing with well-being. On the other hand, the data of Table 9 indicate that occupational status is an important identifier of nutrition status, in keeping with conventional wisdom.

TABLE 9

HOUSEHOLD DATA BY OCCUPATION OF HEAD OF HOUSEHOLD *

OCCUPATION	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V
Carpenter	27	4	100%	3.6	0.3	58%	5.8	3.11	40	124	151	83%	68%	118	42%	11%	2%	7%	11%	6%	7%	3%
Driver	30	4	85%	6.5	0.3	15%	5.9	3.33	65	216	230	83%	70%	172	43%	2%	3%	8%	12%	9%	6%	4%
Technician	22	3	83%	6.4	0.3	11%	5.9	3.36	73	245	212	89%	74%	159	39%	0%	2%	12%	7%	9%	9%	7%
Manual Laborer	70	5	99%	1.3	0.0	63%	4.9	2.54	53	155	128	85%	75%	116	37%	28%	4%	6%	7%	4%	5%	2%
Weaver	92	4	98%	2.3	0.2	28%	5.5	2.96	45	133	153	91%	77%	119	52%	7%	5%	7%	8%	5%	6%	3%
Washerman	23	5	96%	1.0	2.6	42%	6.1	3.08	37	114	161	95%	81%	100	53%	4%	0%	8%	10%	5%	6%	3%
Peon	21	5	96%	5.7	0.0	18%	5.5	3.23	48	155	177	95%	82%	120	47%	4%	2%	7%	12%	7%	5%	4%
Clerk	69	3	59%	10.5	0.5	19%	5.3	2.98	78	232	308	97%	82%	174	38%	1%	3%	10%	7%	12%	8%	5%
Coolie	285	5	99%	0.0	0.2	78%	4.6	2.42	37	90	107	92%	83%	80	51%	13%	4%	6%	8%	2%	5%	1%
Millworker	29	4	97%	4.1	0.2	32%	5.4	4.24	60	254	228	101%	83%	181	43%	3%	2%	7%	7%	22%	5%	3%
Ag. Laborer	224	5	99%	0.0	1.0	90%	4.8	2.56	40	102	118	94%	84%	97	46%	14%	10%	6%	6%	3%	5%	2%
Merchant	23	2	91%	3.1	0.2	33%	5.0	2.95	58	171	201	102%	88%	165	44%	4%	3%	9%	8%	10%	7%	5%
Cultivator	517	2	94%	2.3	3.5	95%	5.6	3.17	56	178	192	106%	88%	162	45%	13%	5%	8%	6%	5%	6%	2%
Teacher	44	3	76%	11.1	1.2	58%	5.8	3.15	65	205	311	107%	88%	175	40%	7%	3%	9%	7%	12%	6%	4%
Businessman	146	2	87%	5.0	0.9	34%	6.0	3.45	66	228	277	108%	88%	198	38%	3%	2%	9%	11%	13%	7%	4%

* Data from 3rd round of Food Habits Survey. Occupations are ordered by degree of household calorie fulfillment (column M).
See facing page for explanation of other column heads.

In the more detailed discussion of findings, * some of these data are collected and correlated in different ways to provide more elaborated descriptions of the consumer subsystems, descriptions which have more implications for planning.

While the analysis of the consumer subsystem is in no sense complete, the relationships which have been drawn are examples of the degree of resolution that is possible by this analytical system. Future work, by testing planning implications in the field, should pose further questions which by additional analysis can refine and reveal the priorities for cost/effective interventions.

D. Systems Integration and Models

In preparing the work plan of the Tamil Nadu Nutrition Study it was anticipated that a model of the food system of the state would be a product of the study. It was also anticipated that the model would provide a means by which proposed interventions in the system could be tested.** The degree to which a reasonably descriptive model of the system achieved has been described in three sections of this chapter (A, B and C). It is clear that a functional model of the entire food system of the state is far from complete. Such a model must await the proper ordering of enough linkable data i.e., data relating to the same basic groups from the production and distribution subsystems to amplify the relations established in the consumer subsystem. This is a task for the continuing program.

However, the model which describes the relationships established up to this point (Figure 2) is most productive of support and assistance to planners. This has been demonstrated in presenting the planning implications of an understanding of the complexities of the consumer subsystem. This subsystem, in the subsistence society represented by TN, dominates the entire food system insofar as effective decision-making is concerned. This subsystem determines the needs that other subsystems must satisfy.

* Chapter IV "Study Findings: Nutritional Status of the Population and Identification of Target Groups."

** A brief description of a conventional modeling process is presented in Vol. II, Sec. A, Chapter VII.

A Brief Discussion of Models

A few words about models is pertinent at this juncture. Repeatedly during the course of the TN Study and in previous work^{**} the point has been made that the use of conventional economic relationships in modeling succeeds only in superimposing expected behavior on a system and thus is of limited use in projecting the real life effects of interventions. The preferred approach is to allow the model to emerge from an examination of the system in all of its complexities. As support for a new approach, it is noted that virtually no interventions into developing country food systems based on conceptions from developed country economics, nutrition or food technology has succeeded in raising the general nutritional level aside from the agricultural production improvements represented by high yielding cereal grains. Food donations to malnourished millions do not result in self-sustaining food and nutrition programs. Mixtures such as corn-soy-milk (CSM) formulated to the specifications of the best nutrition information available, as successful as they are in terms of amounts used and acceptability, do not modify food systems in a favorable direction.

To make it possible to "let the model emerge from the data," the condition of no preaggregation of data was imposed. The additional condition that the data must be so stored that each questionnaire, in full detail, can be reproduced exactly leaves the situation open for investigation of any relationships in ways completely at the discretion of the analyst.

Complex Systems - A model is a tool and must constantly be regarded as one. A model is not reality, but it is frequently accepted as such or reified, whereupon the limits of the model become the limits of reality. This is a situation to be guarded against because it is the kind of situation which discourages the inventiveness required for problems relating to nutrition intervention.

** S. M. Cantor and G. E. Shaffer, Jr., "New Protein Foods From Plant Sources: A System for Economic Evaluation," Econ. Botany 22: 29, Jan. - March, 1968.

S. M. Cantor, G. E. Shaffer, Jr., and A. N. Meiss, "Comparison of Alternate Nutritional Strategies: A Study of the Possible Role of Fish Protein Concentrate in a Developing Country," in Amino Acid Fortification of Protein Foods, N. S. Scrimshaw and A. M. Altschul (eds) p. 549.

To create the model, every conceivable relationship which affects the state of the system must be examined. This is essentially simple, satisfying and therefore dangerous (from the standpoint of reification) since many tables of simple relationships can be constructed which isolate limiting conditions with apparently great certainty. For example, that 60 percent of the children in TN below six years of age are malnourished; and that the calorie deficit, on average, is less than 200 calories per day. The latter taken alone results in a need for 75 kilotonnes (Kt) of grain equivalent food per year if equitably distributed. In practice, the need is closer to 225 Kt when the realities of distribution are taken into account.

Thus, the need for considering more and more variables accumulates until enough have been considered to resolve a particular situation and define the system in a way which is sufficient or satisfactory for the purpose at hand.*

Most exhibits (charts, maps, or tables) in this report contain two or more variables. Thus, the maps are overlays on District % Calorie Neet Met or the latter on the geographical features of the state. This type of presentation serves to identify secondary forces which control the state of the system. That people eat better who live along active waterways may be obvious, but it is confirmed in Map 6. That people who live in Districts from which food is exported fare better than those who live in non-exporting districts is perhaps obvious but may be confirmed analytically from Figures 4, 5, and Map 3, which use multiple variable displays. Consensus shows that the weaning child and mother are the real target groups. But, analysis and the silhouette hypothesis (Chapter V) show the degree to which the process may be reversed by a take home food distribution system while the analysis of subsidies (Chapter VII) describes the degree to which any food intervention scheme will be a family subsidy.

Example represented by Take Home Food Test - It is important to emphasize that conventional econometric and market analysis performed on data from the Take Home Food Test** concluded that so far as it represented a new and separate delivery system directed at the infant, it failed to supply adequate food to the target. However, intrafamily

* The rules for determining when the number of variables is adequate are discussed in Vol. II, Sec. A, Chapter VIII.

** Vol. II, Sec. C.

food distribution analysis* demonstrated a consistent deficiency in the diet of the weaning child (silhouette hypothesis) which appears to be a behavioral characteristic of the culture and independent of family income. Oddly enough, the share of food supplied by take home distribution to the infant appears to just fill this deficiency and to do so consistently. So by this type of systems integration and analysis, Take Home Distribution is recommended as a potentially successful intervention even though the infant food is shared by the family. This is another example of the model in greater detail and complexity emerging from the analysis.

Need for sufficient variables - It is clear now that almost everything said about the nutrition status of individuals, based upon their relationship to family status is relatively true. However, only if the individual status is defined in terms of true intrafamily distribution will the real malnutrition targets be identified.

Defining a sufficient number of variables to describe the subsystem meaningfully is, therefore, a major responsibility. It is relatively easy to show that protein need met (%P) and calorie need met (%C) move through the food system together. It is only by defining a quality factor (%P/%C) that it is possible to show that people in cities tend to draw higher quality foods away from the rural areas.

The socioeconomic data appear to be a morass in which job, education, socio-ritual status and the rural/urban division each individually correlate poorly with nutrition status but all four together provide much greater insights to food behavior, and no one of the four can be ignored. The implication for a package of services or actions rather than single pressure changes in the system is clear.

Significance of field tests - It is noteworthy that the modeling technique employed thus far in the TN study is a combination of data analysis and testing. This is both testimony to the operational component of the project and the novel analytical approach. It confirms the view held from the beginning that constructive field testing, appropriate analysis and feedback can hasten the development of a realistic model which can be used to predict what will happen if a change is proposed. The testing and feedback

* This Volume, Chapter V.

is particularly appropriate where food products and their acceptability are involved. That is why such "market tests" are a fixed component of any product development scheme. Products which emerge from this type of testing meet needs but are produced in a context sympathetic to the cultural values of the consumer. They can be counted upon to survive in the food system. Products designed solely to meet nutrition requirements cannot.

Complex Systems: The Practical Utility of Concepts from the Physical Sciences - What emerges clearly from a consideration of subsystem data analysis of interrelationships, integrations of subsystems, field testing and model constraints is that the reality of the TN food and nutrition system allows of no simple solutions, i. e., solutions that are related to one or two variables. Rather, the system must be approached with a group of interacting changes - a combination of pressures, so to speak - the individual influences of which may be changed from time to time in order to optimize effects.

There is a moderately old concept in organic chemistry which provides a useful and highly visual analogy. It is known as resonance theory. By this theory, particular kinds of molecules are judged to be in several energy states at the same time as represented by a related succession of two dimensional models. None of these models describes the entire state but is symbolic of a part of it. The entire situation at any point in time is regarded as a "resonance hybrid" and it is possible to estimate the amount of each form in the equilibrium mixture or "hybrid." Moreover, the composition of the hybrid changes as physical conditions: time, temperature, pressure, etc., are varied and, therefore, the mixture of end products of any reaction, which differs from one form to another, will vary accordingly.

The food and nutrition system is such a resonating system and the "model" at any one time is a "resonance hybrid" and by varying the pressure, the products or mixture of effects is varied. Such concepts and the ways in which they are handled in other disciplines provide useful and practical means for treating such multivariate problems as a food and nutrition system.

CHAPTER IV

STUDY FINDINGS: NUTRITIONAL STATUS, IDENTIFICATION OF TARGET GROUPS AND FEEDBACK

Target Groups are People

The family which typifies rural Tamil Nadu and its food and nutrition problems has five members, and one on the way. There are two living children, two and a half and six years old, and one grandparent lives in the household, making it a joint family in a somewhat restricted sense. The husband and head of household, thirty-one years old, has had five years of elementary schooling; his twenty-four year old wife went to school for three years. The six year old son is presently attending the village school, and there is a high probability that he will complete eight years of school, perhaps even more. The family lives in a small house in a village; mud brick walls, tile roof, three small rooms and a small courtyard, alfresco sanitary facilities and water from the village well; they rent, but some day may own their house.

The family's jati, in which they take pride, allows them to look upon many people of lower social and economic standing, as well as many of higher status. The husband is a skilled agricultural worker, his wages and jajmani payment (mostly rice, some other grains) amount to Rs 190-200 per month, the entire family income. About 80 to 85 percent of this income, cash and kind, is spent for food, and almost half of the food expenditure is for rice. The rest goes for dhals, a little bit of milk, edible oil and jaggery; some coarse grains are bought when rice and money are scarce. Almost nothing is available to spend on fruits and vegetables, meats or fish; these, one generally does without. The family is able to consume only about 85 to 90 percent of the food that it should have; consequently, its individual members are always a bit hungry. But this, if one has no other experience, seems the natural thing, and the family goes about its business effectively in spite of the leanness of its existence.

There is an extension of this family description in the "Cultural Anthropology and Nutrition" portion of this report. Dealing as it does with the central characters in the life cycle drama of food and nutrition, it adds a different dimension. "The pregnant mother of Tamil Nadu, as she approaches the birth of her child, becomes increasingly restricted by custom and taboo. Her diet is severely limited not only by lack of food

* Vol. II Sec. B, Commentary

availability but by the choices she can exercise economically among the foods which she is allowed. In many ways, the child she carries is all important; the mother is essentially an instrument. There is particularly a lack of understanding of the relationship of quantity and quality of the mother's food to the viability and human quality of the newborn infant."

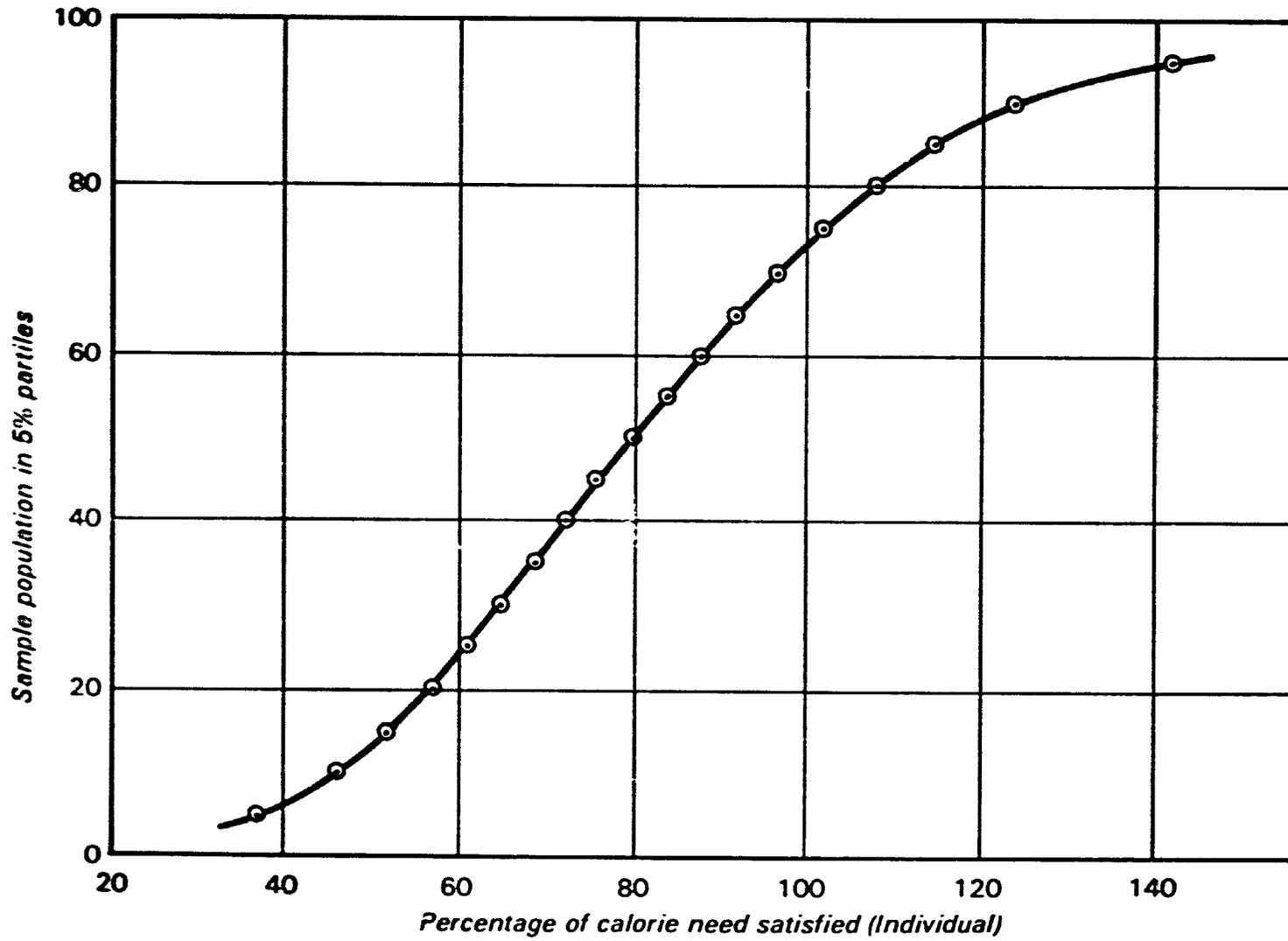
The Government of Tamil Nadu is interested in helping this family, along with some who are in better circumstances and many, many more who are in worse straits. It would like to insure that the two and a half year old, having survived the critical weaning period, continues to grow and develop normally; that the pregnant mother carries her new child to a normal birth, can nurse it adequately, and that both mother and child continue in good health and vigor. It wants to be sure that the new child is well fed throughout the weaning period and thereafter, and that the older child, father, and grandparent are adequately fed and healthy. Finally, it wants to teach this family many practical and important things about food and nutrition, so that the family can better take care of themselves and thereby contribute to their own success as well as the improvement of the community.

Our family is completely hypothetical, of course, and drawn with some imagination and a few liberties from data of the consumer survey. But it does typify the situation that is the central concern of this project, and the people who will, it is hoped, eventually gain some benefit from the on-going work and planning inputs derived from it.

Nutrition Status of Individuals

Chapter III presented many of the data which define nutrition status on the State and District levels, including a characterization of households by districts. This chapter focuses attention on nutrient status of individuals and target group identity, in terms of percentage fulfillment of caloric and protein needs, and according to sex, age, and reproductive status, all based on the 12,953 persons included in round three of the Consumer Food Habits Survey. Distribution of this mass of people, which includes the hypothetical, typical family just described, is shown in Figure 7, in which nutrition status is expressed as percentage of caloric need satisfied for the individual person.

FIGURE 7. Distribution by Partiles—12,953 Persons Surveyed in Round 3.



Basic information on individual nutrition status, differentiated according to age, sex, and reproductive status, is detailed in Tables 10, 11, and 12. Composition of the sample* is shown in Table 10; calorie and protein requirements and intakes for the differentiated sample are shown in Tables 11 & 12. Note that percentages of calorie requirements met are far below average among the younger pregnant women, lactating mothers of all ages, and children of both sexes between the ages of six months through four years and, most particularly, children in the 7 to 18 months age group. Protein deficiencies, as shown in Table 12, follow the same pattern, but at higher percentage levels of need satisfaction. It must be remembered, however, that under severe calorie deprivation the higher percentage of protein need met is more apparent than real because the protein is used as respiratory substrate (calories) rather than protein functions as such.

Calorie intakes in relation to needs are shown graphically in Figure 8. The lower graph, depicting needs, provides background for much of the discussion on inequities and complexities of intrafamily food distribution.** Note particularly, the sharp drop at the 7 to 18 month period, which identifies the primary target group. Recovery to near average level during the balance of the preschool years is then followed by a continuous decline in nutritional status during the adolescent years. Calorie need fulfillment then improves steadily with age, although overall dietary adequacy tends to level off from age fifty onward, due to a small relative decline in protein need satisfaction. The disparity between needs and need fulfillment is nowhere shown more strikingly than in a comparison of the forms of the upper and lower graphs in Figure 8.

Needs Computed on an Individual versus Family Basis

The capacity to distinguish between family nutrition status and that of individuals within the family, an outgrowth of the preservation completely unaggregated information in the data bank and processing system,

* The differentiated sample contains 41 fewer persons (0.45%) than the number shown in Figure 7. This small attribution results from rejection of specific bits of faulty data during analysis.

** This Volume, Chapter V.

TABLE 10
DISTRIBUTION OF SAMPLE BY AGE, SEX AND REPRODUCTIVE STATUS*

Age Group	Males		Females		Pregnant		Lactating		Total No. in Sample	Portion of Total Sample
	No. in Sample	Portion of Age Group	No. in Sample	Portion of Age Group	No. in Sample	Portion of Age Group	No. in Sample	Portion of Age Group		
<u>Months</u>										
0 - 6	195	51%	185	49%	---	---	---	---	380	3%
7 - 18	302	49%	318	51%	---	---	---	---	620	5%
19 - 30	193	49%	199	51%	---	---	---	---	392	3%
31 - 59	475	52%	430	48%	---	---	---	---	905	7%
<u>Years</u>										
5 - 9	915	50%	914	50%	---	---	---	---	1829	14%
10 - 14	668	50%	675	50%	---	---	---	---	1343	10%
15 - 19	462	47%	444	46%	12	1%	55	6%	973	8%
20 - 24	431	42%	4267	28%	58	6%	259	25%	1035	8%
25 - 29	488	43%	280	25%	48	4%	316	28%	1132	9%
30 - 39	961	54%	480	27%	32	2%	298	17%	1771	14%
40 - 49	661	58%	448	39%	1	0%	25	2%	1135	9%
50 - 64	543	50%	539	50%	---	---	---	---	1082	8%
65 -	165	52%	150	48%	---	---	---	---	315	2%
TOTAL	6459	50%	5349	42%	151	1%	953	7%	12912	100%

* Data from 3rd Round of the Food Habits Survey

TABLE 11
**CALORIE REQUIREMENT AND INTAKE PER DAY PER INDIVIDUAL
 BY AGE, SEX AND REPRODUCTIVE STATUS***

Age Group	Male			Female			Pregnant			Lactating		
	Calories		Need Met	Calories		Need Met	Calories		Need Met	Calories		Need Met
	Need	Intake		Need	Intake		Need	Intake		Need	Intake	
Months												
0 - 6	530	445	88%	530	445	88%	---	---	---	---	---	---
7 - 18	980	635	65%	980	635	65%	---	---	---	---	---	---
19 - 30	1100	790	72%	1100	790	72%	---	---	---	---	---	---
31 - 59	1230	945	77%	1230	945	77%	---	---	---	---	---	---
Years												
5 - 9	1530	1225	80%	1530	1225	80%	---	---	---	---	---	---
10 - 14	2150	1635	76%	2150	1615	75%	---	---	---	---	---	---
15 - 19	2875	1985	69%	2560	1895	74%	2850	1654	58%	3465	2070	60%
20 - 24	2830	2120	75%	2400	1920	80%	2680	1955	73%	3250	2080	64%
25 - 29	2660	2100	79%	2255	1985	88%	2520	2115	80%	3055	2110	69%
30 - 39	2500	2150	86%	2120	1885	89%	2365	1985	84%	2870	2040	71%
40 - 49	2370	2110	89%	2010	1910	95%	---	---	---	2725	2015	74%
50 - 64	2230	1965	88%	1890	1795	95%	---	---	---	---	---	---
65 +	2090	1925	92%	1770	1715	97%	---	---	---	---	---	---

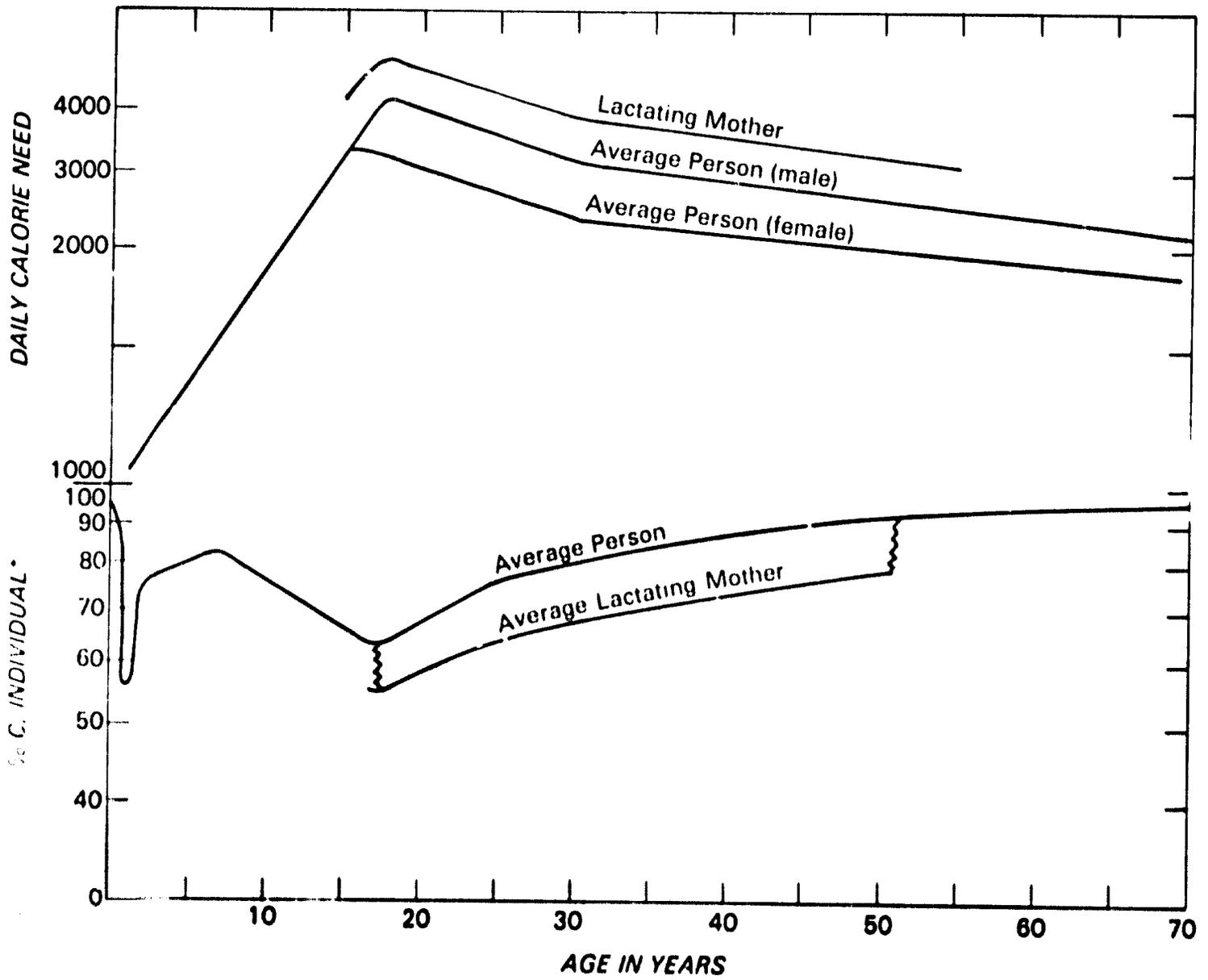
* Data calculated by individual from the 24-hour food recall question in the 3rd Round of the Food Habits Survey.

TABLE 12
PROTEIN REQUIREMENT AND INTAKE PER DAY PER INDIVIDUAL
BY AGE, SEX AND REPRODUCTIVE STATUS*

Age Group Months	Male			Female			Pregnant			Lactating		
	Protein		Need Met	Protein		Need Met	Protein		Need Met	Protein		Need Met
	Need	Intake		Need	Intake		Need	Intake		Need	Intake	
0 - 6	8.5	8.1	95%	8.5	8.1	95%	---	---	---	---	---	---
7 - 13	12.0	10.3	86%	12.0	10.3	86%	---	---	---	---	---	---
19 - 30	13.0	13.1	101%	13.0	13.1	101%	---	---	---	---	---	---
31 - 50	15.0	15.9	106%	15.0	15.9	106%	---	---	---	---	---	---
Years												
5 - 9	20.0	21.6	108%	20.0	21.8	109%	---	---	---	---	---	---
10 - 14	30.0	29.4	98%	30.0	29.1	97%	---	---	---	---	---	---
15 - 19	43.0	36.6	85%	38.0	35.0	92%	42.5	33.2	78%	51.5	39.1	76%
20 - 24	45.0	39.0	87%	38.0	36.9	97%	42.5	38.3	90%	51.5	39.1	76%
25 - 29	45.0	40.5	90%	38.0	38.0	100%	42.5	39.1	92%	51.5	41.2	80%
30 - 39	45.0	41.9	93%	38.0	37.2	98%	42.5	38.3	90%	51.5	40.2	78%
40 - 49	45.0	41.9	93%	38.0	38.0	100%	---	---	---	51.5	41.2	80%
50 - 64	45.0	39.6	88%	38.0	36.1	95%	---	---	---	---	---	---
65 +	45.0	41.4	92%	38.0	35.0	92%	---	---	---	---	---	---

* Data calculated by individual from the 24-hour food recall question in the 3rd Round of the Food Habits Survey, Protein is Modified FAO Reference Protein.

FIGURE 8. Comparison of Daily Calorie Need (upper graph) and Percentage Fulfillment of Calorie Need (lower graph).



*Percentage fulfillment of individual calorie needs

is one of the most important innovations of the present consumer survey and analysis. Never before has such differentiation been accomplished on such a large scale, which in this case is representative of a population of 41 million, the people of Tamil Nadu. Previous findings on intra-family food distribution and variation in nutritional status have been limited to intensive studies of two or three villages, or just a few families. The identification of target groups has rested largely on the expertise of trained professional observers, clinicians and nutritionists, looking at what to them was perfectly obvious. The weakness has been that, on a scale suitable for the guidance of planner, the groups have been defined too broadly —i. e., preschool children— and their needs have not been quantified. The Tamil Nadu study has accomplished a satisfactorily narrow definition of the groups and their quantitative needs.

Findings - The findings are illustrated in Tables 13 and 14.* Table data were obtained by applying the standard calorie allowances for age, sex, and reproductive status, for each individual in each family, to the percentage calorie need fulfillment of the specific family of the individual. Data handled in this manner are exactly analogous to that derived from a family consumption inventory (such as obtained in typical expenditure/consumption surveys, the sources of most broad-based findings on nutrition status of populations) and the demographic composition of the family. By contrast, data in Table 14 were computed directly on the basis of 24-hour food consumption recall for each individual. Attention is directed to the last (right hand) columns in each table (%C_F and %C_I, respectively). Both tables show the same overall average, 79 per-

* These tables are based on partile analysis, in which (1) the data were rank ordered (i. e., in a continuous series from lowest to highest percentage of calorie needs met, %C), (2) the rank ordered data divided into five sequential parts, each containing one-fifth of the 12, 943 individuals, and (3) each partile then distributed according to age groups as shown. The relationship is quantified by the "function values", bottom line of each table. These give the percentage of calorie needs met at the midpoints of the partiles and at the boundaries between partiles 1-2, 2-3, 3-4, 4-5, (there is no zero value and no defined upper limit in this distribution). In the investigation of specific relationships, this methodology permits concentration of all of the important characteristics and values of a large mass of data into a compact, simple format. For details and explanations, see Chapter V of Volume II, Sec. A, this report.

TABLE 13

**RELATIONSHIP OF AGE TO SATISFACTION OF CALORIE NEEDS,
ON FAMILY BASIS (%C_F)***

(data in pentile columns are numbers of persons)

Age Group	Percentage of calorie needs met: pentile distribution					Total	Average %C _F
	1	2	3	4	5		
65+	34	60	61	69	91	315	85
50-65	184	194	198	220	288	1084	81
40-50	216	207	188	250	276	1137	80
30-40	331	355	347	356	386	1775	80
25-30	222	218	235	231	229	1135	79
20-25	241	197	212	209	182	1041	78
15-20	224	193	180	203	175	975	78
10-15	266	288	269	258	263	1344	79
5-10	358	375	356	388	358	1835	79
30 mo.- 5 yr.	200	183	177	162	185	907	78
18-30 mo.	91	77	78	71	75	392	78
6-18 mo.	143	132	128	117	102	622	77
0- 6 mo.	79	82	80	74	66	381	78
Total	2589	2561	2509	2608	2676	12943	79
Function**							
Value	52 (59)	65 (72)	79 (82)	89 (97)	111		
c, (b)							

* Family %C applied to standard requirements for each individual according to sex, age, and reproductive status.

** Average %C_F values at partile center, c, and at partile boundaries, (b)

TABLE 14

RELATIONSHIP OF AGE TO SATISFACTION OF CALCRIE NEEDS
INDIVIDUAL BASIS (%CI)*

(data in pentile columns are numbers of persons)

Age Group	Percentage of calorie needs met: pentile distribution					Total	Average %CI
	1	2	3	4	5		
65+	15	34	50	91	125	315	96
50-65	86	129	215	253	401	1084	90
40-50	92	130	226	289	400	1137	90
30-40	239	303	415	389	429	1775	83
25-30	206	269	253	236	171	1135	78
20-25	268	268	228	182	95	1041	73
15-20	290	285	216	120	64	975	70
10-15	292	384	265	258	145	1344	75
5-10	347	355	364	409	360	1835	81
30 mo.- 5 yr.	262	167	133	150	195	907	77
18-30 mo.	141	75	63	48	65	392	73
6-18 mo.	321	129	69	50	53	622	65
0- 6 mo.	26	62	92	115	86	381	88
Total	2585	2590	2589	2590	2589	12943	79
Function**							
Value	47 (57)	64 (71)	79 (87)	97 (109)	131		
c, (b)							

* Individual %C calculated directly from 24-hour recall of food consumption.

** Average %CI values at pentile center, c, and at pentile boundaries, (b)

cent, but resemblance between the two columns of numbers ceases there. By computation of individual calorie need fulfillment on a family basis, the very real problems of intrafamily food distribution are made to vanish. Table 14, computed directly on an individual basis, depicts the true situation. The severe deprivation of the 6 to 18 months weaning child, relatively favorable situation of the child in this early school years, and his subsequent deprivation as an adolescent are clearly shown.

An Analytical Tool for Target Group Intervention

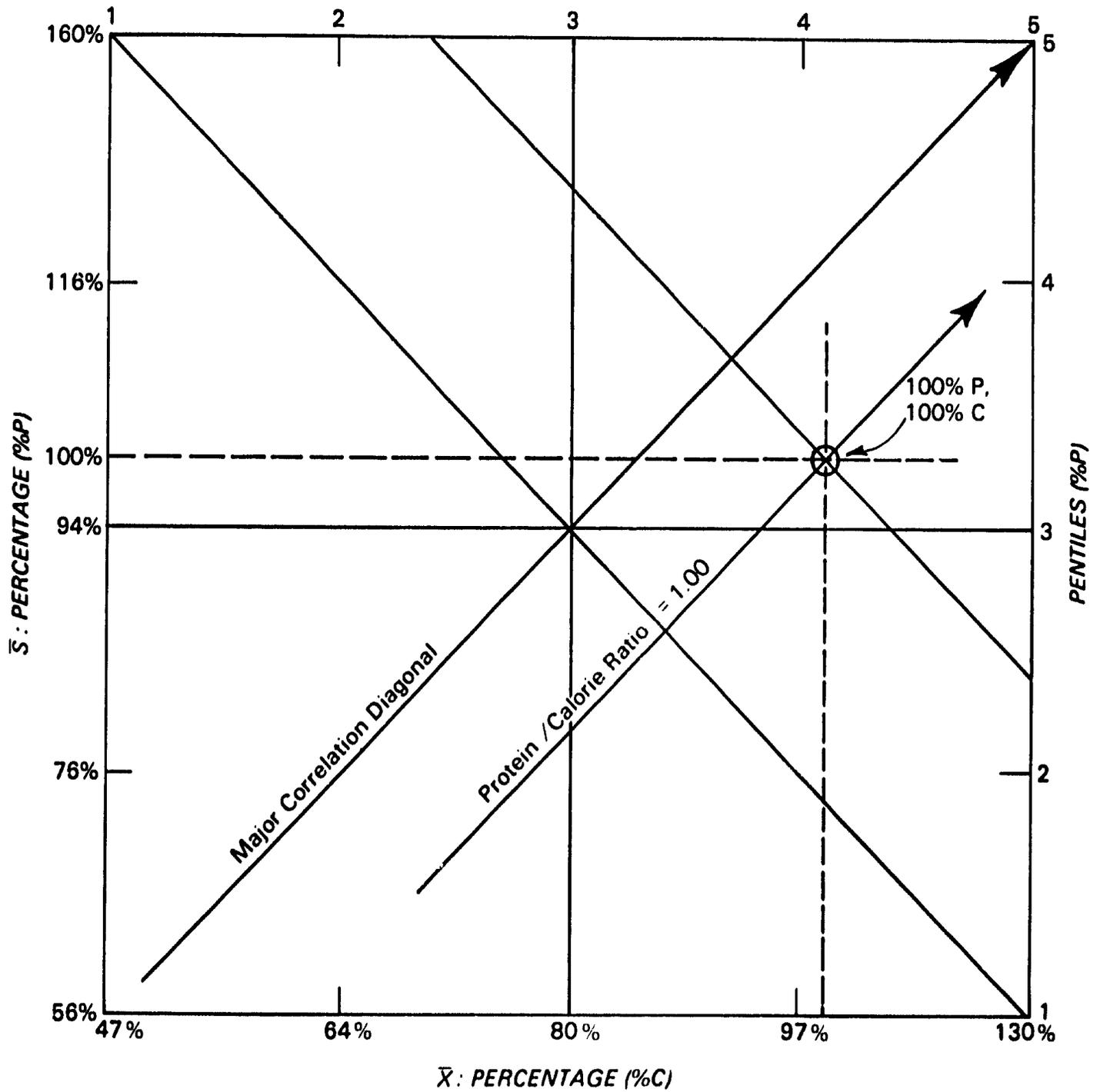
Figure 9 is a device that has proved to be extremely useful in establishing the position of a suspected target group in relation to other sex and age groups in a survey sample. Use of this chart is illustrated in the following chapter, dealing with problems of intrafamily food distribution as inputs to program planning. This chart is based on a two-factor pentile distribution grid; numbers 1 through 5 along the top and right sides represent the pentile midpoints for percentage of calorie need met (%C) at the top and percentage of protein need met (%P) at the right side. Opposite sides show the percentages of need met corresponding to the pentile distributions. The chart is divided into quadrants by horizontal and vertical median lines, through the midpoints of the two center pentiles (no. 3).

Nutrition status relationships among a set of defined groups of individuals sorted out of the total sample are defined by their relative positions on the chart: the upper right quadrant is high calories, high protein, lower left is low calories, low protein; lower right is high calories, low protein; upper left is low calories, high protein. Average for the total sample is at the center of the chart. The major correlation diagonal, lower left to upper right, is the locus of average quality of the diet; that is, it represents the protein/calorie ratio of the overall diet of the population (total sample). The diagonal from upper left to lower right is the locus of average quantity of food consumed by individuals in the population, with protein/calorie ratio varying continuously along the diagonal. This chart is scaled to pentile distribution of 12,912 individuals in the third round of the consumer food habits survey; the sample characteristics fix the location of 100%P/199%C for that population, and thereby defines the line, parallel to the main correlation diagonal, which represents a protein/calorie ratio of 1.00.

FIGURE 9. Graph of a Pentile Distribution: Protein Need Fulfillment Versus Calorie Need Fulfillment for individuals in Tamil Nadu.

(See text for explanation.)

Pentiles (%C)



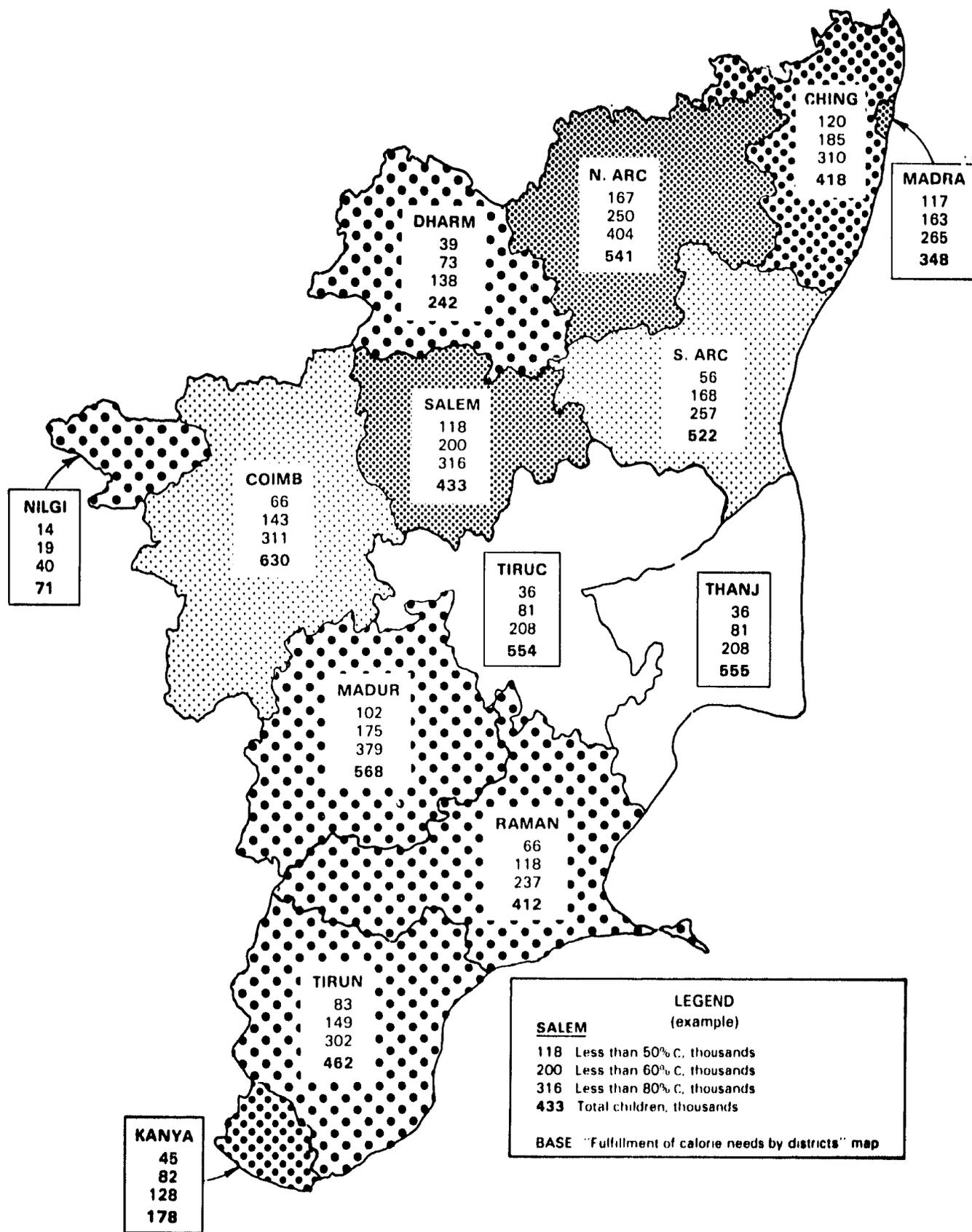
*Percentages are those that correspond to the pentile midpoints for %C and %P (Pentile median values.)

In the example discussed in Chapter V, a set of charts comprising one each of the Districts, Madras City, and the State was prepared, showing the relative locations of each of the 13 age groups listed in Tables 13 and 14. A characteristic pattern emerged which showed the 7 through 18 months age group always positioned down toward the lower left, and with a few exceptions, the group farthest down in that direction, low-low. The method has been applied to these age subsamples aggregated by Districts, but they can, of course, be analyzed with respect to any other factor for which there is reliable data and sufficiently large subsets in the sample.

A Closer Look at the Main Target Group

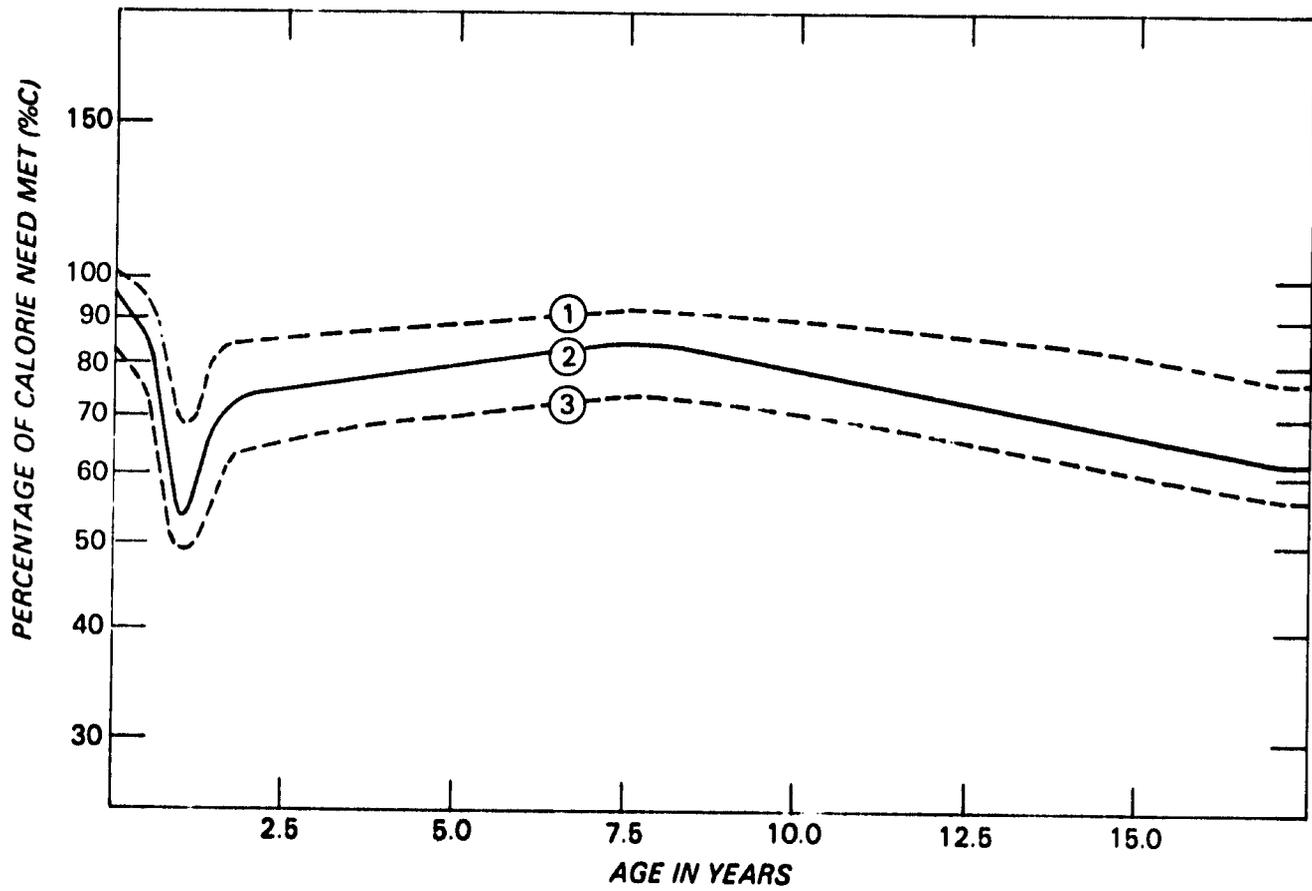
Magnitude of the childhood malnutrition problem in Tamil Nadu and variation in severity from District to District is shown on Map 8 which presents, for each District, the number of thousands of children (from birth through five years of age) who received less than 50, less than 60, and less than 80 percent of their calorie needs for the day on which the food consumption was recorded. The proportions below 50 percent, which can hardly be considered anything other than frank starvation if persistent at that level, range from over one-third of 348,000 children in Madras to a mere 6 to 7 percent of the 554,000 in Tiruchirappali and 555,000 in Thanjavur. The differences between the total number of children in a District and the number receiving less than 80 percent of calorie needs contain the group that is adequately fed. This group, some of whom actually are receiving not much more than 80 percent of their needs, still contains much hunger. It ranges from 24 percent of this child population in Madras to 63 percent in Thanjavur and Tiruchirappalli, the two best fed Districts.

Figure 10 shows a somewhat broader picture of childhood malnutrition, a graph of average percentage of calorie needs fulfilled for children from birth through the end of adolescence. This picture, with its spectacular valley between 0 and two and one half years, leaves little room for doubt about the severity of the problem in this age range, but it also points up the less severe, but nevertheless insidious problem of older children, from 7 to 8 years until adulthood is reached.



MAP NO. 8 . Nutritional Status of Children.
 Thousands of Children 0 through 5 Years Below 50 and 60 and 80 Percent of Calorie Need Fulfilled, by Districts

FIGURE 10. Percentage Fulfillment of Calorie Need by Children.
(Median Values)



LEGEND
1 Top three districts
2 Tamil Nadu State
3 Bottom three districts

The primary target has been identified beyond any doubt as the child in the age group from 7 to 18 months. Some important details concerning this subgroup in relation to the rest of the birth through five year group of children are displayed in Table 15, which focuses on the all-important problem of supplementary feeding in relation to breast feeding. The index of nutritional adequacy used here, as previously, is the percentage of calorie needs fulfilled. To aid in interpretation of the table, a corresponding distribution of the sample, which has a total of 2297 children, has been prepared (Table 16). Note that the fully weaned child in the 7 to 18 month group, at 65 percent of calorie needs fulfilled, is faring much better than his counterpart who is still receiving 75 percent or more of his calories from breast milk. This latter category of child is the most deprived of any subgroup shown; his condition surely reflects a popular misconception that the mere existence of breast feeding constitutes adequate nutrition for the child. By contrast, in the subgroup getting 26 to 74 percent of total calories from breast milk, many of the children are obviously receiving sufficient supplementary food to insure them reasonably adequate nutrition, as suggested by the figure of 83 percent of need met for the group.

Breast feeding is of negligible significance in affecting the nutritional status of the two older subgroups. Eighty-eight percent of the 19 to 30 month group and 99 percent of the 31 to 59 month group were fully weaned. These data do confirm the adequacy of customary breast feeding for the child up to the age of 6 months. Eighty-nine percent of that group received 75 percent or more of total calorie intake from breast milk, and for the group, 85 percent of calorie needs were met.

The need of a highly acceptable, economical weaning food, to be given in adequate amounts to all children from the age of 5 or 6 months onwards, is beyond argument at this time. Successful development of such a weaning food and virtually universal use of it by children in this critical age group constitute the main key to increased child survival in Tamil Nadu.

TABLE 15

REQUIREMENT AND INTAKE OF CALORIES, CHILDREN 0 - 59 MONTHS OLD,
BY PERCENTAGE OF TOTAL CALORIES RECEIVED FROM BREAST MILK *

Age group, months	Percentage of total calories received from breast milk												Age group total		
	None (weaned)			1 to 25			26 to 74			75 or more					
	Need	In- take	% of need met	Need	In- take	% of need met	Need	In- take	% of need met	Need	In- take	% of need met	Need	In- take	% of need met
0 - 6	---	---	---	---	---	---	530	594	112	530	450	85	530	445	88
7 - 18	980	637	65	980	1098	112	980	813	83	980	510	52	980	635	65
19 - 30	1100	792	72	1100	1166	106	1100	759	69	---	---	--	1100	790	72
31 - 59	1230	945	77	---	---	---	---	---	--	---	---	--	1230	945	77

* Males and females; data from 3rd round of the Food Habits Survey

TABLE 16

DISTRIBUTION OF SAMPLE CHILDREN 0 - 59 MONTHS OLD, BY PERCENTAGE
OF TOTAL CALORIES RECEIVED FROM BREAST MILK

Age group, months	Percentage of total calories received from breast milk								Age group total	
	None (weaned)		1 to 25		26 to 74		75 or more			
	no. in sample	% of age group	no. in sample	% of age group	no. in sample	% of age group	no. in sample	% of age group	Totals	% of total sample
0 - 6	8	2	2	1	30	8	340	89	380	17
7 - 18	115	19	16	3	195	31	294	47	620	27
19 - 30	346	88	18	5	18	5	10	2	392	17
31 - 59	895	99	7	1	3	1	---	---	905	39
Total	1364	59	43	2	246	11	644	28	2297	100

* Males and females; data from 3rd round of the Food Habits Survey

Interactions Affecting Nutrition Status of Families

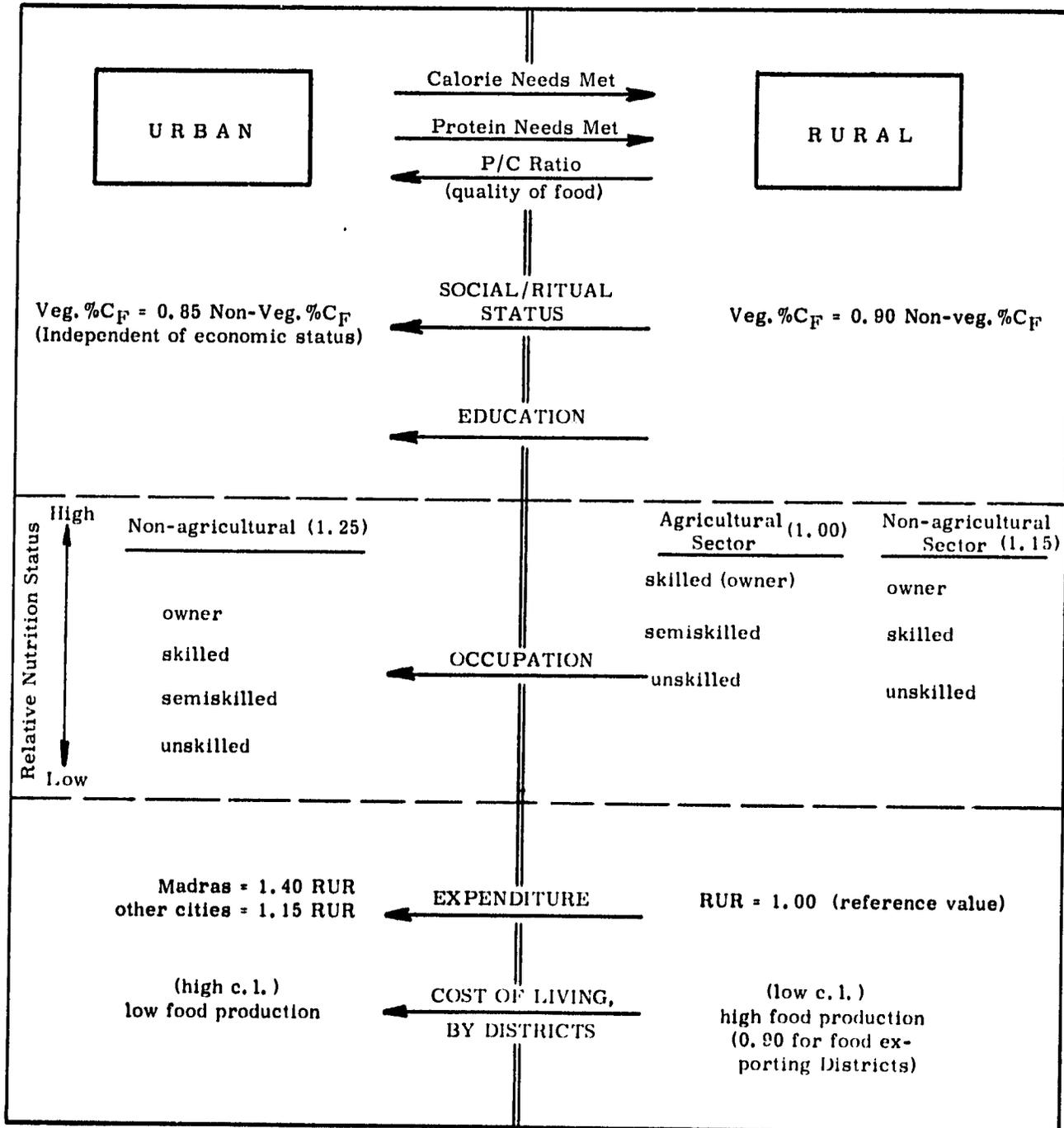
The interactions among multiple factors affecting a state or condition, such as nutrition status, can be presented and evaluated adequately only through the use of multidimensional displays and special methods based upon the displays. However, two and three dimensional diagrams can convey some insights into what is going on within a complex system provided that the tentative character of these relationships is carefully respected. Figure 11 shows some of the interrelationships —as they affect the nutrition status of families— among such variables as rural versus urban location, social/ritual status*, educational level, occupation, expenditure, and certain characteristics of Districts. These are essentially qualitative comparisons, although the several comparison factors used do have a quantitative basis derived from the data analysis. The right half of the diagram represents the rural zone, left, urban; upward movement is indicated by the direction of the arrows.

The fundamental nutrition status relationship between families in the rural versus urban zones is displayed at the top of the diagram: the percentage fulfillment of both calorie and protein needs is higher in the rural zone, while nutritional quality of the food available is higher in the cities; generally, the city dwellers are unable to purchase enough of their higher quality food to match either the calorie or protein need fulfillment attainment in the rural areas.

Vegetarian versus nonvegetarian food behavior is one of the most significant correlates of social/ritual status; the former generally enjoys higher standing in the community, other criteria being equal. But lower nutrition status usually goes with higher ritual status, regardless of economic position. As the diagram shows, the higher social/ritual status in the

* The term "social/ritual status" was coined to compensate, in part at least, for our inability to incorporate as modifiers all of the intricacies and subtleties of caste and jati as they influence social and economic standing in the community and any consequent influences on family well-being, including nutrition status. The word ritual was added because the word "social" alone cannot convey the all-pervasive effects of ritual status, purity, and pollution in a predominantly Hindu society.

FIGURE 11
CONSUMER SUBSYSTEM: SOCIAL, ECONOMIC, AND
GEOGRAPHIC INTERACTIONS AFFECTING NUTRITION STATUS
OF FAMILIES



Notes: (a) 1.40 RUR, etc., and the numbers with the main occupation category labels are comparison factors. 1.40 RUR, for example, indicates a need for a 40% greater expenditure in Madras City than in the rural zone to maintain a comparable nutrition status.
 (b) The arrows point in the direction of the higher status and to the higher levels of other factors.

city is accompanied by a greater disparity between vegetarian and non-vegetarian nutrition status. In the rural zone, the degree of calorie need fulfillment is about 10 percent lower for the vegetarian; in the city, about 15 percent lower.

Occupational status rises with a move from country to city, but the cost of maintaining equivalent nutrition status is about 25 percent higher than for a comparable occupation in the agricultural sector of the rural zone. Likewise, within the rural zone it costs the non-agricultural worker about 15 percent more to maintain the same nutrition status as his agricultural counterpart. The vertical dispersion of occupation types shown within the occupation display gives a rough indication of the differences in nutrition status with the shift of a given job category from agriculture to rural non-agricultural to urban. For example, the family of a semi-skilled agricultural worker would be expected to enjoy a nutrition status on a par with that of a skilled non-agricultural worker in the rural zone, and almost on a par with that of an owner of a typical small business in the cities.

The expenditure display, with the rural family set at 1.00 as reference value for a given nutrition status, shows that it would cost about 40 percent more in Madras and 15 percent more in other cities to maintain a comparable level.

Relationship of cost of living to agricultural production, by Districts, is shown in the last display on the diagram. In those districts in which food production is high, living cost tends to be low, and where food production is low, living cost tends high. In the high producing districts, there is roughly a further 10 percent differential toward lower living costs in those which export a substantial amount of food.

Feedback and Intervention

Target groups - There can be no doubt that the principal target groups for nutrition intervention in Tamil Nadu are the weaning child (age 6 to 30 months), pregnant and lactating women, and adolescent girls from the time of menarche onward. The adolescent female is proposed as an added target as a result of this study, but otherwise this work supports the international consensus on target group identification.

Value of the present work is that it defines the scope and magnitude of the problem far more accurately than more conventional approaches have done. In particular, it identifies and amplifies the cultural aspect of child malnutrition wherein the weaning child is inadvertently placed in jeopardy regardless of family income, education, occupation, caste and social status. In the overall view, it appears that this child is relatively and uniformly deprived by everyone.

An inevitable conclusion reached is that every effort must be made to improve the status of the entire population via well-directed interventions in the food system and accompanying infrastructure of Tamil Nadu. But unless a method of effectively intervening in intrafamily food distribution is found, broad economic efforts will have negligible effects on nutritional status of the target groups.

Feedback to agricultural production - Findings of the project should be interpreted and evaluated with this requirement of general nutrition improvement in mind. State aggregate food production statistics indicate that the average person * has 101 percent of his calorie requirement and more than 120 percent of his protein requirement available to him. The consumer survey data confirm this with a finding of 104 percent of calorie requirement purchased; the 24 hour food consumption recall indicates that 91 percent of calorie requirement is consumed. In this context, half of the people receive 80 percent or more of their calorie needs and 95 percent or more of their protein needs. An increase of food production, in excess of the proportionate population increase, of at least 25 percent would be required to insure availability to the average (median) person of 100 percent of the calories he needs. This quantity of calories is equivalent to about two million tons of grain per year.

Here we have the most obvious and crucial feedback from the consumer subsystem to the agricultural production subsystem. The present trend to encourage production high yielding varieties of rice is a step in the right direction, provided there is adequate and continued investment in water resources, fertilizer, and pesticides. The balance between conditions favorable to high yielding crops, with their high water requirements, and conditions under which drought resistant crops should be

* Representing the arithmetic mean; the "mean person" is represented by a considerably higher value than the "median person."

grown is dynamic; it poses a serious problem in allocation of investments in agriculture. The agricultural model should incorporate a variable relationship between drought resistant grains and the high yielding varieties. It should be supported by an accurate model of the weather cycles to assist in crop production planning for one or more years ahead so that the best balance between crop types can be achieved.

Land reclamation - The question of land reclamation as a production input should also be introduced into the agricultural subsystem model. Restoration of rough and eroded lands, followed by appropriate use and proper management to maintain their stability, might provide substantial additional area for certain pulses and drought resistant grains. If so, greater risks could be taken in planning apportionment of the presently productive land between high yielding and drought resistant varieties. It is obvious that extensive land reclamation can not be accomplished by individual small landholders without outside technical and financial assistance. Government assistance in the form of engineering, heavy equipment, and technical services would be needed. Forward planning for the agricultural sector should include an analysis of potential programs in this area, including any necessary subsidies to the cooperating landholders, to determine probable cost effectiveness.

Home gardens - The need for more leafy and green vegetables in the diet is discussed at length under vitamin deficiencies.* The agricultural and food processing and distribution systems are not adapted to supplying this need at present. Agriculture must of necessity concentrate on production of the maximum amount of calories in the form of commodities that can be stored for long periods of time, and the food processing and distribution industry is in no sense organized for the handling and distribution of large quantities of perishables. Although there is an existing and potentially larger food preservation (mostly drying) industry that could be adapted to processing and distributing many of these vegetable products having the desired nutritional properties, the final products would be priced much too high for the people who need them so desperately.

* This Volume, Chapter VIII.

There is an obvious need for nutrition intervention programs to increase production and consumption of these vegetables which are rich sources of vitamin A and other nutrients. The most promising program possibilities at the present time appear to be educational, in the form of home extension programs centered on home and village gardens and the use of locally available materials. The discussion of vitamin deficiencies also contains a generalized proposal* for the type of program that appears to be most suitable. A program to stimulate commercial production, on a small scale for highly localized distribution, should also be considered.

New food products - It is difficult to identify any major feedbacks from the consumer subsystem to the processing and distribution subsystem. The target populations for whom nutrition improvement is sought make relatively little use of products of the registered sector of the food processing industry, and the more extensive unregistered sector is so amorphous, diffuse, and difficult to characterize that it is hard to envision ways it may be utilized for nutrition intervention without further study. Such interventions as may be sought through the registered or public sectors must be limited, specific, and carefully designed. The one intervention that shows great promise and should be promoted vigorously at this time is the use of continuous processing, primarily that based on extrusion technology, to formulate and manufacture special foods such as an infant food for use in the various publicly financed feeding programs. This technology offers, moreover, an opportunity to move the same kinds of products into commercial distribution at prices that can be afforded by much of the low income population. A general scheme for production and distribution of an infant food in a joint sector venture appears to be a processing opportunity since Tamil Nadu has no institutional food industry.**

* This Volume, Chapter VIII.

** This Volume, Chapter IX.

CHAPTER V

BASIS OF IMPUTED INTRAFAMILY FOOD
DISTRIBUTION PRACTICES

Reference has been made elsewhere in this report to a set of food distribution practices that appear to be common among families in Tamil Nadu. These practices become manifest in the relative adequacy of diets of persons in the different sex, age, and reproductive status groups that have been studied. Characteristically, the breast fed infant, up to six months of age, is well nourished; the weaning infant, defined by age as from 6 to 18 months old, is most seriously deprived of nourishing food; the surviving older preschool child is the beneficiary of an improving trend in nutritional status which attains a peak in the early school years; the older school child suffers some diminution of nutritional status again, in a trend which persists until full adult growth is attained; from early adulthood into old age a continuing trend in improvement of nutritional status is apparent, except for women who are pregnant or lactating; nutritional deprivation of the lactating mother is second only to that of the weaning child, and the pregnant woman is at almost as great a nutritional disadvantage.

There can be no doubt that the pattern represented by these findings has deep and ancient cultural roots in South India. The strength of these cultural roots and the specific influences on nutritional status are amply attested in Chapters II through V of "Cultural Anthropology and Nutrition", Volume IIB of this report. Evidence of another sort may be seen in Figures 12 and 13. In both of these figures,* percentage of calorie needs met for individuals is plotted against age. The striking similarity in shape of these plots of five categories of family nutritional status and three levels of monthly expenditure show clearly the operation of a broad pattern of intrafamily food allocation as a fundamental aspect of the general culture. The pattern remains constant even though the level of family nutrition varies markedly. There can be little doubt, moreover, that this kind of variation in intensity,

* These figures were designed to display the nutrition status-age relationship effectively, and are not to be used for analytical purposes. The age axis was foreshortened by plotting on a logarithm scale.

FIGURE 12. Percentage of Individual Calorie Needs Fulfilled, by Age, for Five Levels of Family Calorie Adequacy.

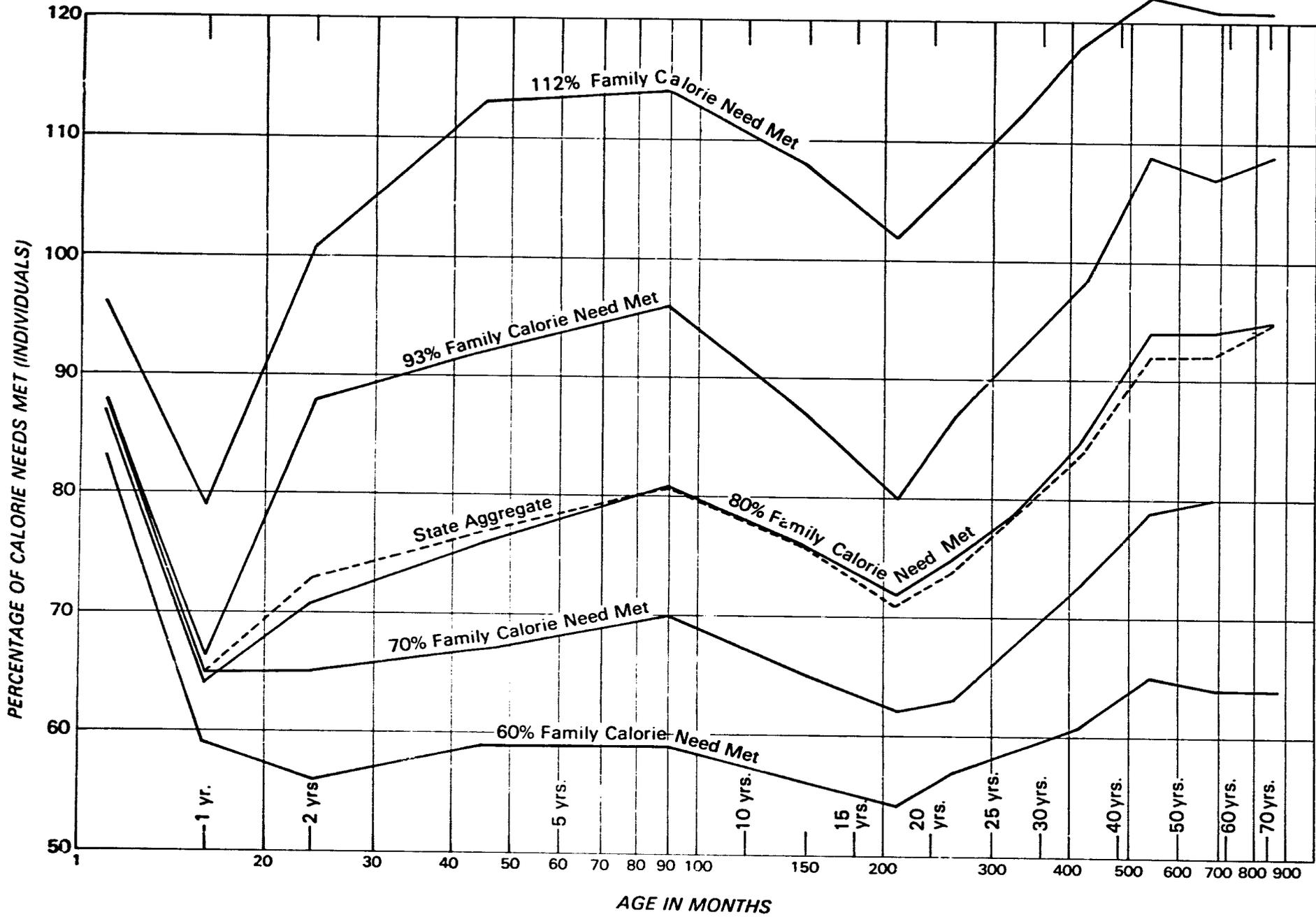
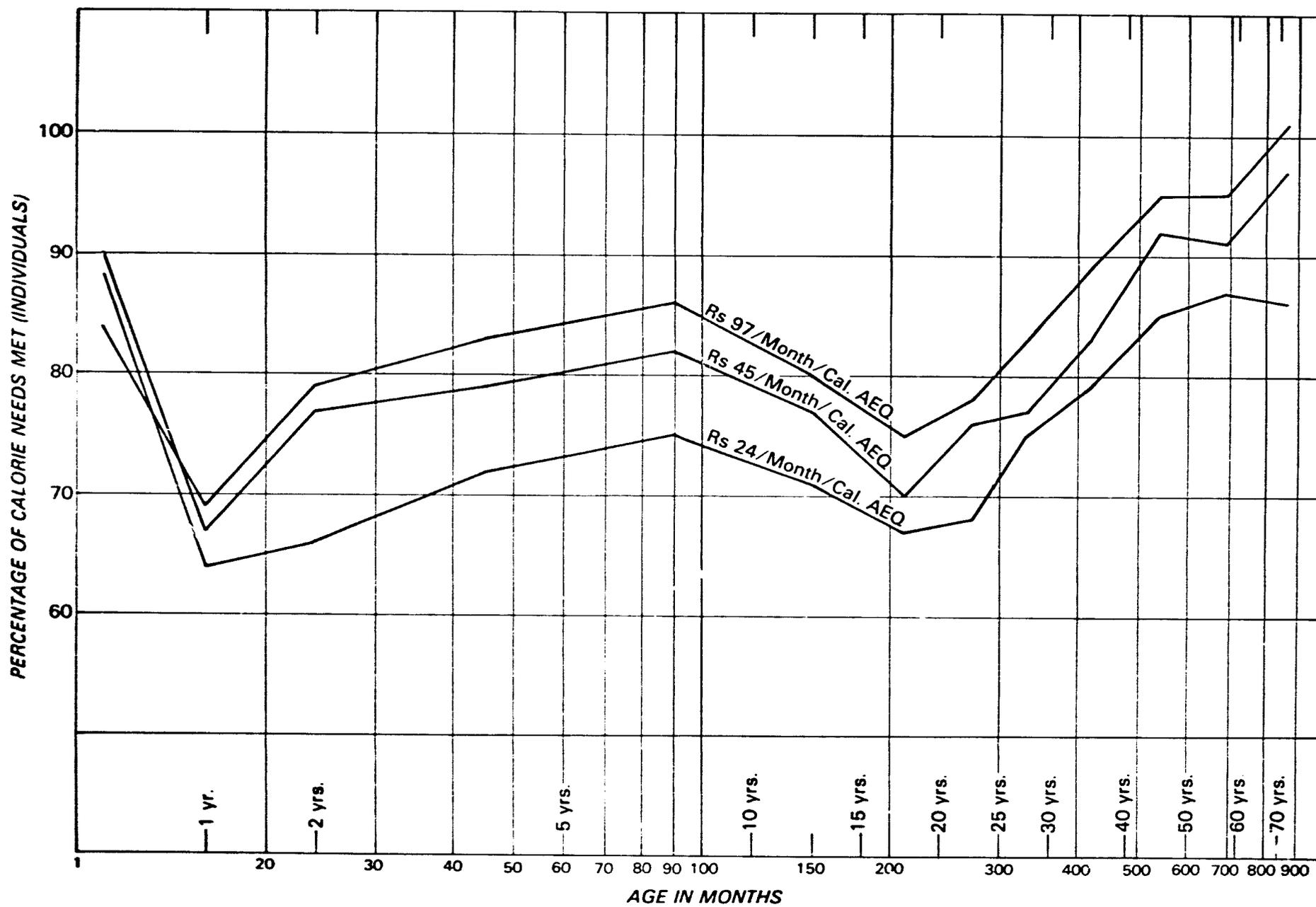


FIGURE 13. Percentage of Calorie Needs Fulfilled, by Age, for Three Levels of Family Total Expenditure.



but not of pattern, is associated with other attributes of economic, cultural, and social status in addition to family nutrition level and expenditure. As an input to nutrition planning, such culturally determined, persistent patterns of intrafamily food distribution are of great significance, and should be subjected to continuing, critical study. It seems obvious that invention of strategies to overcome the untoward effects of this aspect of India's food culture must be an important part of any general program of nutrition development.

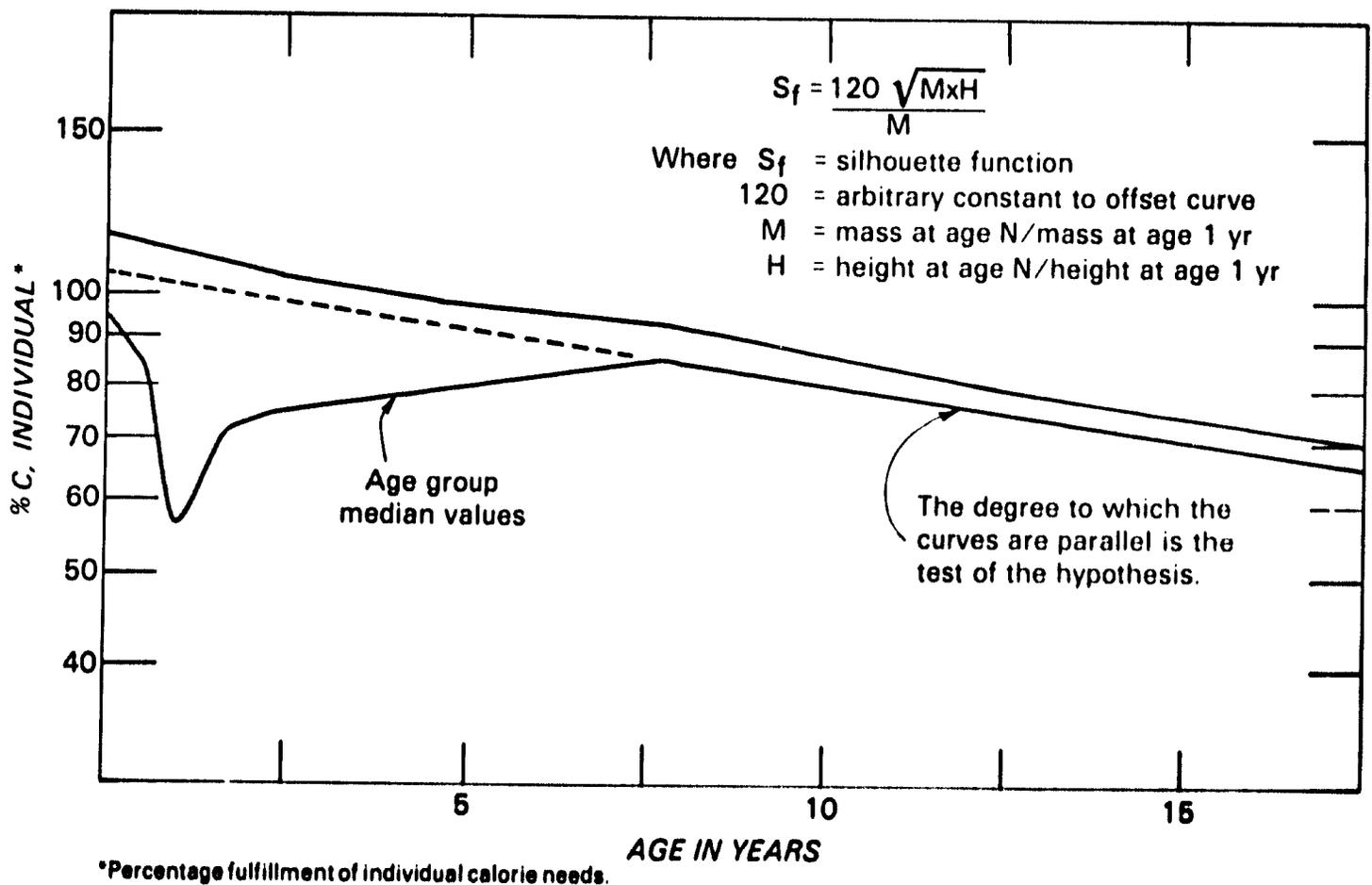
The silhouette hypothesis -

Notwithstanding the fact that nutritional status of target group individuals seems to rise and fall with that of their respective families, the obvious and widespread inequities (in terms of individual needs) within families in the distribution of food calls for an effort to understand the pattern and basis of food allocation practices. Quantitative aspect of the problem is shown clearly in Figures 12 and 13. If food were distributed exactly in proportion to individual needs, all of the plots in the two figures would be horizontal straight lines. Analysis of the consumer survey data has led to a hypothesis which provides a reasonable explanation of intrafamily food distribution and offers some guidance for planning nutrition intervention programs. It has been named the silhouette hypothesis.

It appears as if food were allocated according to the relative two dimensional size of the different family members: i. e., height or length by width, or the face-on body silhouette. Lack of perception of additional food needs for growth, for reproductive functions in the female, and variable needs according to body weight and activity provides an explanation consistent with the degree of malnourishment of different sex and age groups studied. Under this hypothesis, one would expect the elderly to be better fed than younger adults who are more active and have greater food requirements; the mere passage of time and progression through the life cycle would be expected to bring the older adults into a better state of nutrition. Basis of the silhouette hypothesis may be seen in Figures 14 and 15.

The hypothesis is represented in Figure 14, a plot of percentage fulfillment of individual calorie needs versus age of the individual. The upper curve, arbitrarily offset a fixed distance to display parallelism with the experimental curve below it, as expressed by

FIGURE 14. A Test of the Silhouette Hypothesis.



$$S_f = 120 \sqrt{M \times H} / M,$$

where S_f = silhouette function,

120 = arbitrary constant to offset curve,

M = mass (body weight) at age N divided by mass at age 1 year,
and

H = height at age N divided by height at age 1 year.

The lower, or experimental curve —experimental in the sense that it is based upon original data from the consumer survey— is actually a representation of a composite relationship. It is a composite of a food allocation relationship conforming to the silhouette hypothesis, modified by failure to perceive the additional food needs for growth and activity. Note particularly that the curves only cover the growth period of the life cycle, from birth to age 17 years, more or less. The experimental curve is divisible into two distinct parts, one extending from birth to 7 to 8 years, and the second from the latter point to the end of adolescence.

The second part of the experimental curve, extended back to birth date to bypass the chaotic disruption of proper response to food needs in early childhood, is the most plausible representation of intrafamily food allocation as it is practiced by the average family in the survey sample. Note that the extended curve is closely parallel to the theoretical silhouette function curve, to the degree that without the arbitrary offset the experimental and theoretical curves would virtually coincide. This is offered as presumptive evidence of the truth of the hypothesis.

The first section of the experimental curve, birth to 7 years, is the expression of a complex set of conditions affecting the fulfillment of calorie needs (and, therefore, food needs in general) during early childhood. During most of the first six months of life, breast feeding provides sufficient nourishment for the child, but thereafter, for the succeeding six months to one year, rapidly diminished breast milk supply coupled with none, or at best, insufficient supplementary feeding, throws the child into a condition of severe calorie deprivation. It is very likely that any amount of breast feeding after six months is mistakenly considered to be adequate in many households, with the result that supplementary feeding is delayed and the child's malnutrition increases. The gradual rise of the calorie fulfillment curve, commencing during the second year with

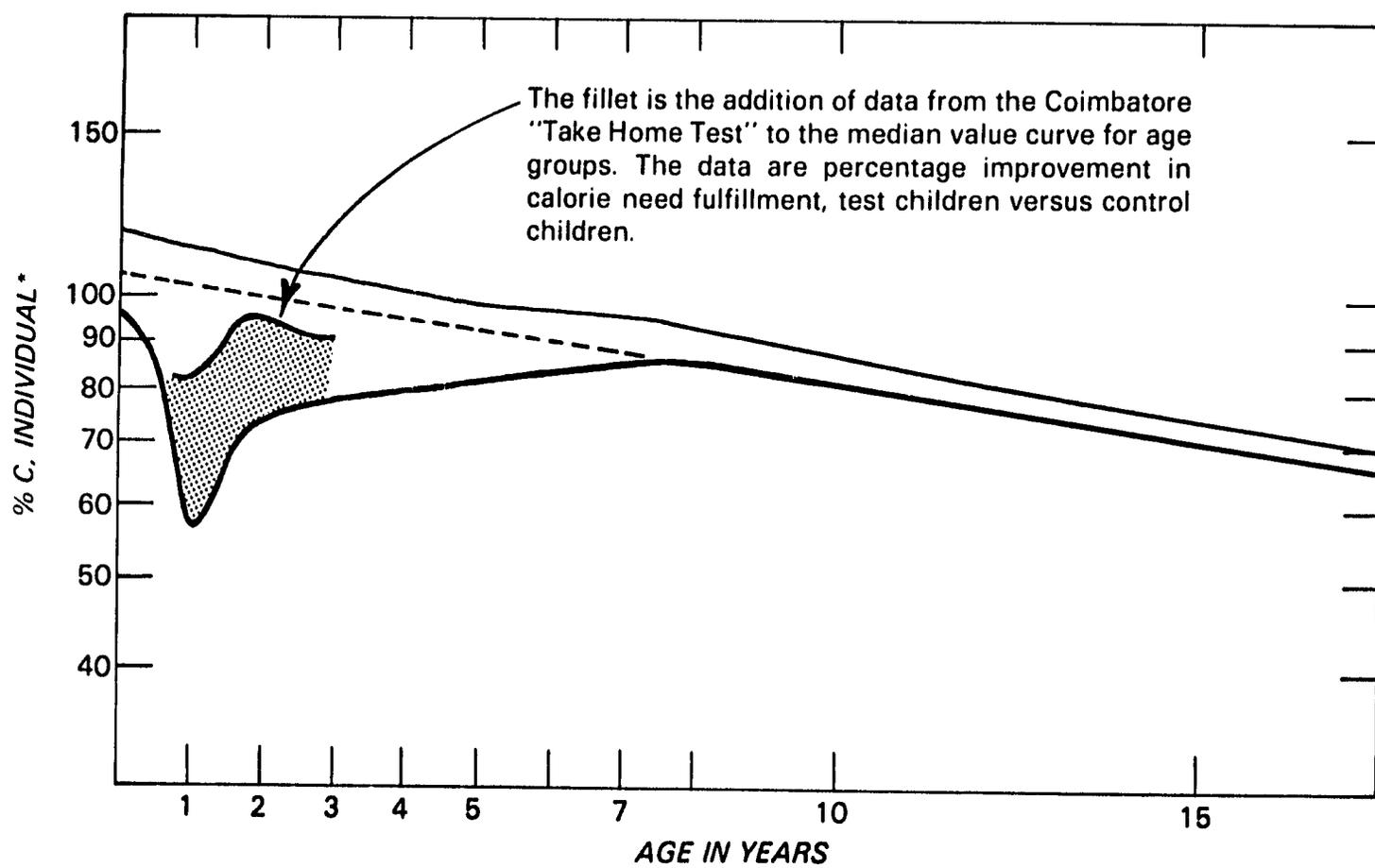
more general use of supplementary feeding, is abetted by the rapid diminution of calorie requirements per unit of body weight. At the end of adolescence, the number of calories required per kilogram of body weight is less than half that of the first two years. This is in keeping with the idea of the silhouette hypothesis. Increasing ability of the older preschool child to compete for its share of food is undoubtedly another factor in helping the child attain the level of the extended curve.

Data from the "Take Home Food Test" (see Volume II, Section C of this report) give further evidence of the reality of the silhouette hypothesis. The shaded area in Figure 15 represents the gains of test children over control children, on the assumption that the increments in weight gain were the direct expression of corresponding increases in fulfillment of calorie needs. One of the findings of the take home test was that the food given for the test child was shared with the rest of the family. As Figure 15 shows, the amount allocated to the child was enough to bring it up almost to the silhouette function curve, lending further credence to the idea that this in fact describes the manner in which food needs are perceived.

The overall fulfillment of calorie needs of individuals, from birth to 70 years, was shown in the lower graph of Figure 8. * On the basis of the arguments presented above, this represents intrafamily food allocation in proportion to two dimensional body size —the silhouette hypothesis— modified by failure to perceive the special needs for growth and development, including pregnancy and lactation, the decreasing requirements with advancing age in adulthood, and failure to understand or attempt to cope with the special problem affecting the weaning child. Figure 16 shows, again with exception of the weaning child problem, what the calorie fulfillment curve for older children and normal adults would look like if the way in which the responsible members of the sample population perceived food needs were correct. The graph is a straight line at the 100 percent level. The problem of the weaning child, making the transition from the breast to external food, is a unique case from the points of view of the family's understanding of the problem and of being able to solve it with the food resources at hand. An effective program following the general design of the Take Home Food Test could solve the problem, so that on average, even with the take home food allocated by the parents to the target child according to the silhouette hypothesis, the gap would be filled and the weaning child would take its place along with the other age groups on or near the 100 percent line.

* See Chapter IV.

FIGURE 15. Silhouette Hypothesis with Take Home Food Test Data Added.



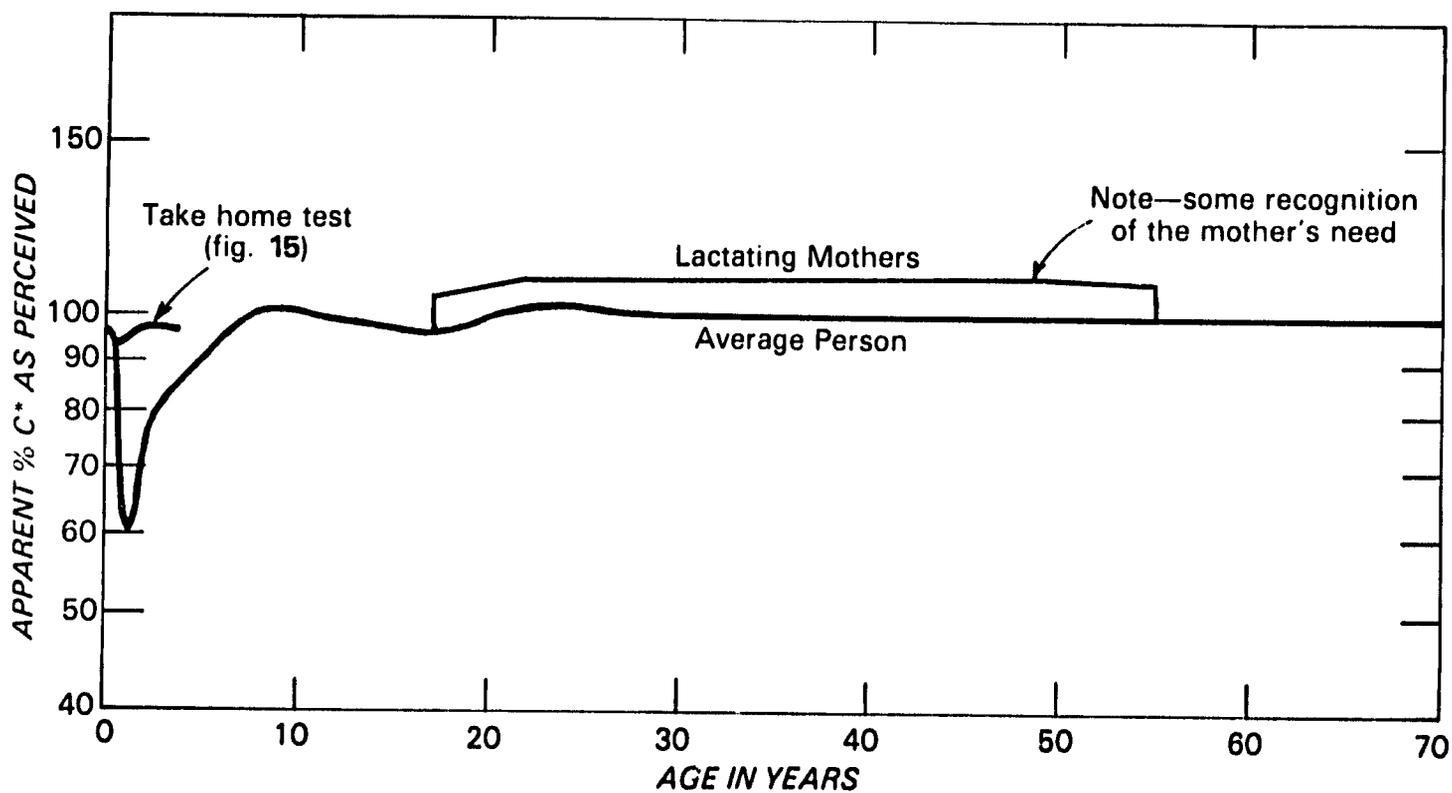
*Percentage fulfillment of individual calorie needs.

FIGURE 16. Calorie Distribution Function.

Based on hypothesis concerning prevalent perception of food needs during the life cycle

Conditions:

1. Assume no special growth requirement.
 - a. No extra growth calories for the young.
 - b. No extra need for lactation.
2. Normalize to the average 30 year old male.
3. Perception of individual is based on silhouette.



*"C" is percentage of calorie need fulfilled.

But this way of perceiving food needs and directing intrafamily food allocation is wrong, and is concluded to be a highly significant factor in the overall nutrition problem in Tamil Nadu. Program planning, particularly in the area of nutrition education, should recognize this factor and be guided accordingly. Fortunately, the operation of this faulty perception is not all pervasive and universal. As a starting point in overcoming it, the survey data indicate that, in the aggregate, there is some recognition of a need for additional food for the lactating mother. She receives about 10 percent more food than her counterpart woman who is neither pregnant nor lactating, which is a start on the 30 percent additional food she requires.

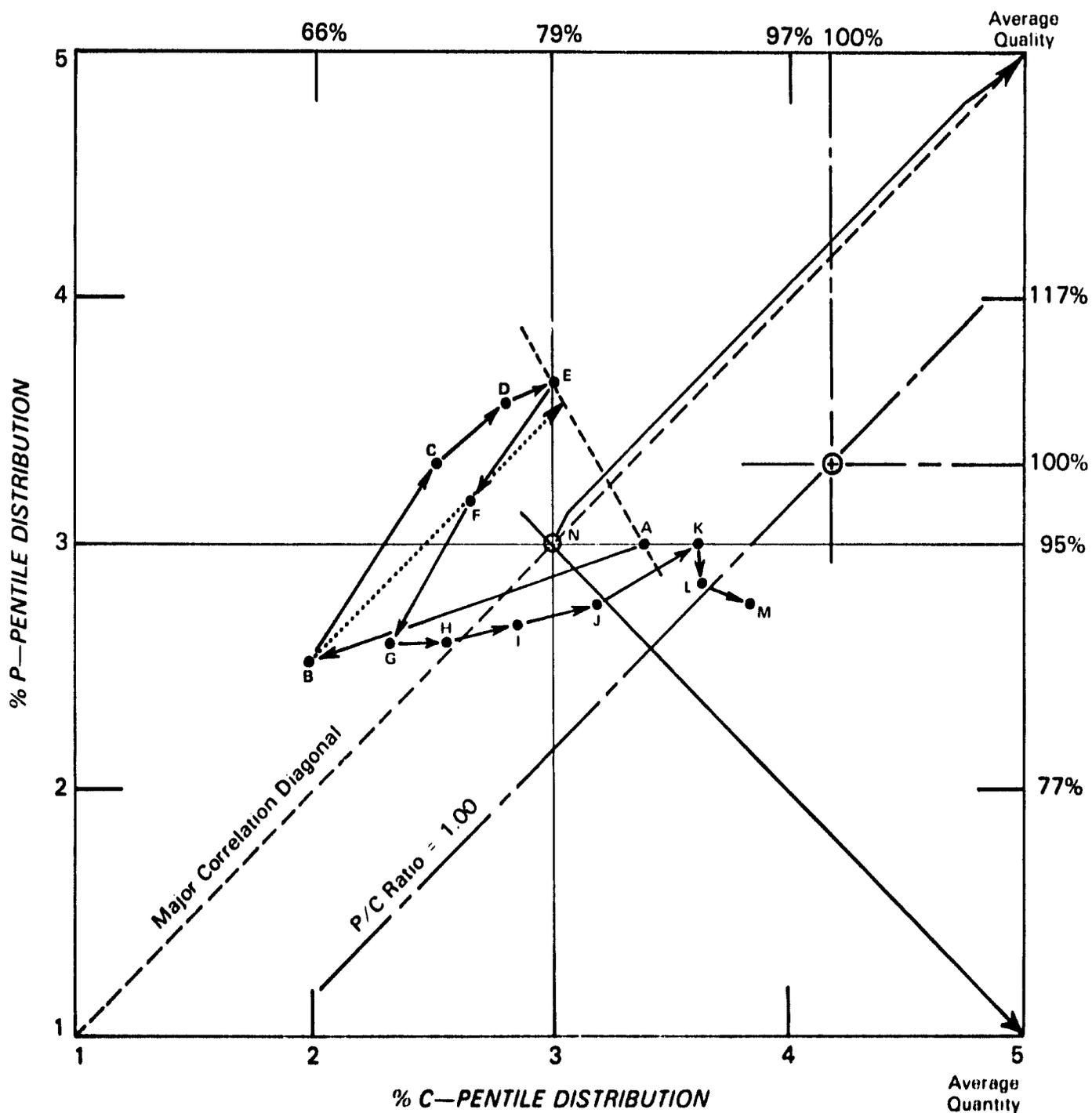
Whether or not the silhouette hypothesis proves in the long run to be correct, it is imperative that a continuing project on nutrition program planning and evaluation include further study of the factors underlying intrafamily food distribution and how they relate to the practical problems in that area.

Some planning implications -

Analysis of the survey data included development of a series of 15 charts, one for each of the 13 Districts, one for Madras City, and one for the State overall, showing adequacy of diet in terms of calorie and protein needs fulfilled for 13 age groups. Charts for the State, Madras, and for North Arcot and Tiruchirappalli Districts have been included here as Figure 17 A through D. These charts are based upon rank ordering and distribution of 12,912 individuals from the third round consumer survey into pentiles of percentage of individual calorie needs met and individual protein needs met. The two pentile distributions were sorted into subsets for the districts, and the individuals in each district sorted into age subsets of the two factors (%C and %P). The sorted data were then plotted (all of these operations were done by computer) on pentile distribution charts of the kind shown in Figure 9. Details of the chart layout were explained in Chapter IV.

On each chart, the positions of the 13 age groups are shown, connected with arrows to form a map of the changes in nutritional status as the individual (in each case, the hypothetical average individual representing the subset that is the subject of the chart) proceeds through the life cycle. As might be expected from other presentations of data on the age relationships to calorie and protein need fulfillment, the district charts display a characteristic type of pattern. Starting with the 0 to 6 months

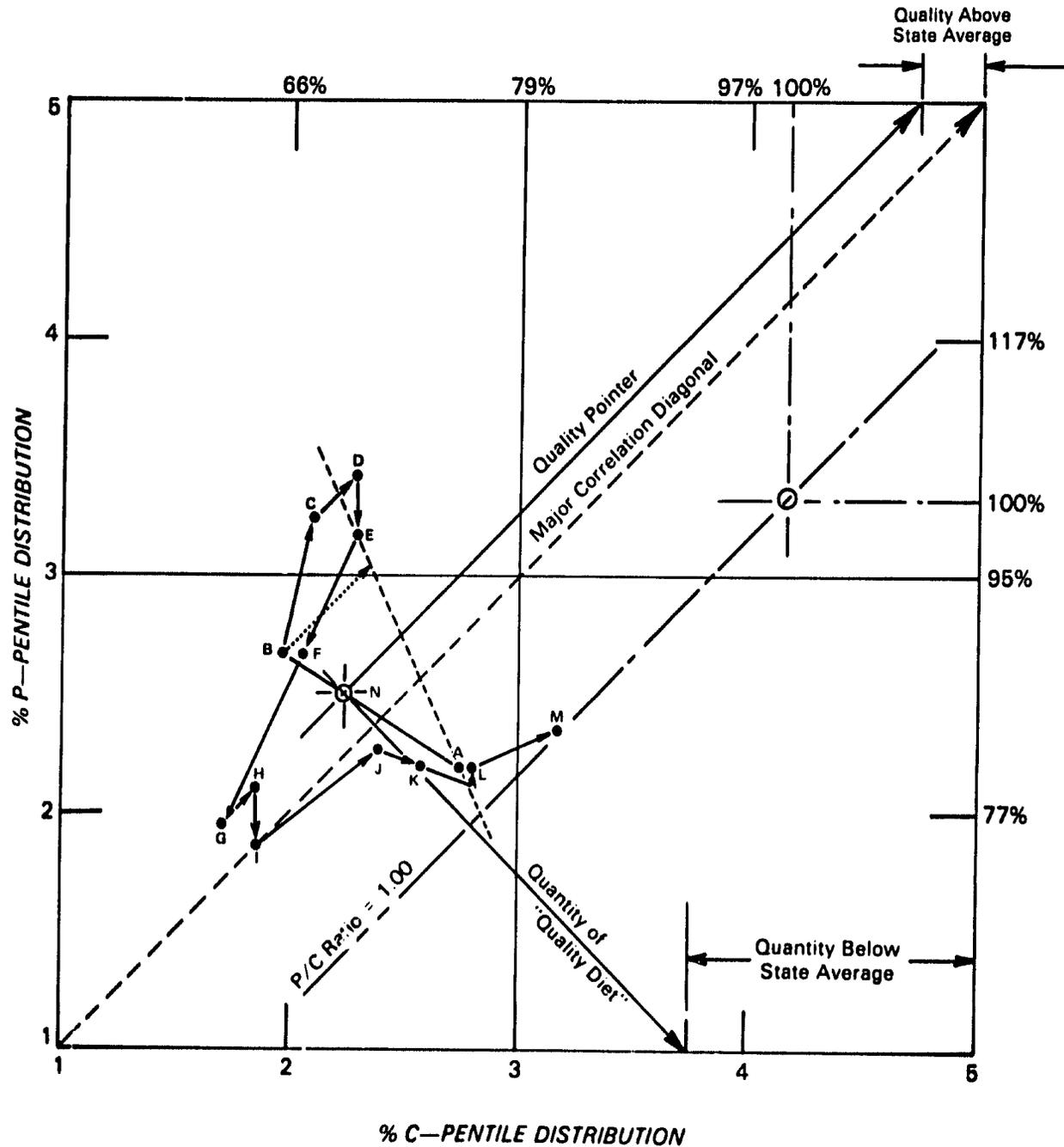
FIGURE 17A. Dietary Adequacy and Intrafamily Distribution Pattern by Pentile Analysis—T. N. (State).



LEGEND

- | | | | |
|---|----------------------|---|----------------|
| A | 0- < 6 months | H | 20- < 25 years |
| B | 6- < 18 months | I | 25- < 30 years |
| C | 18- < 30 months | J | 30- < 40 years |
| D | 30 months- < 5 years | K | 40- < 50 years |
| E | 5- < 10 years | L | 50- < 65 years |
| F | 10- < 15 years | M | 65+ years |
| G | 15- < 20 years | N | average |

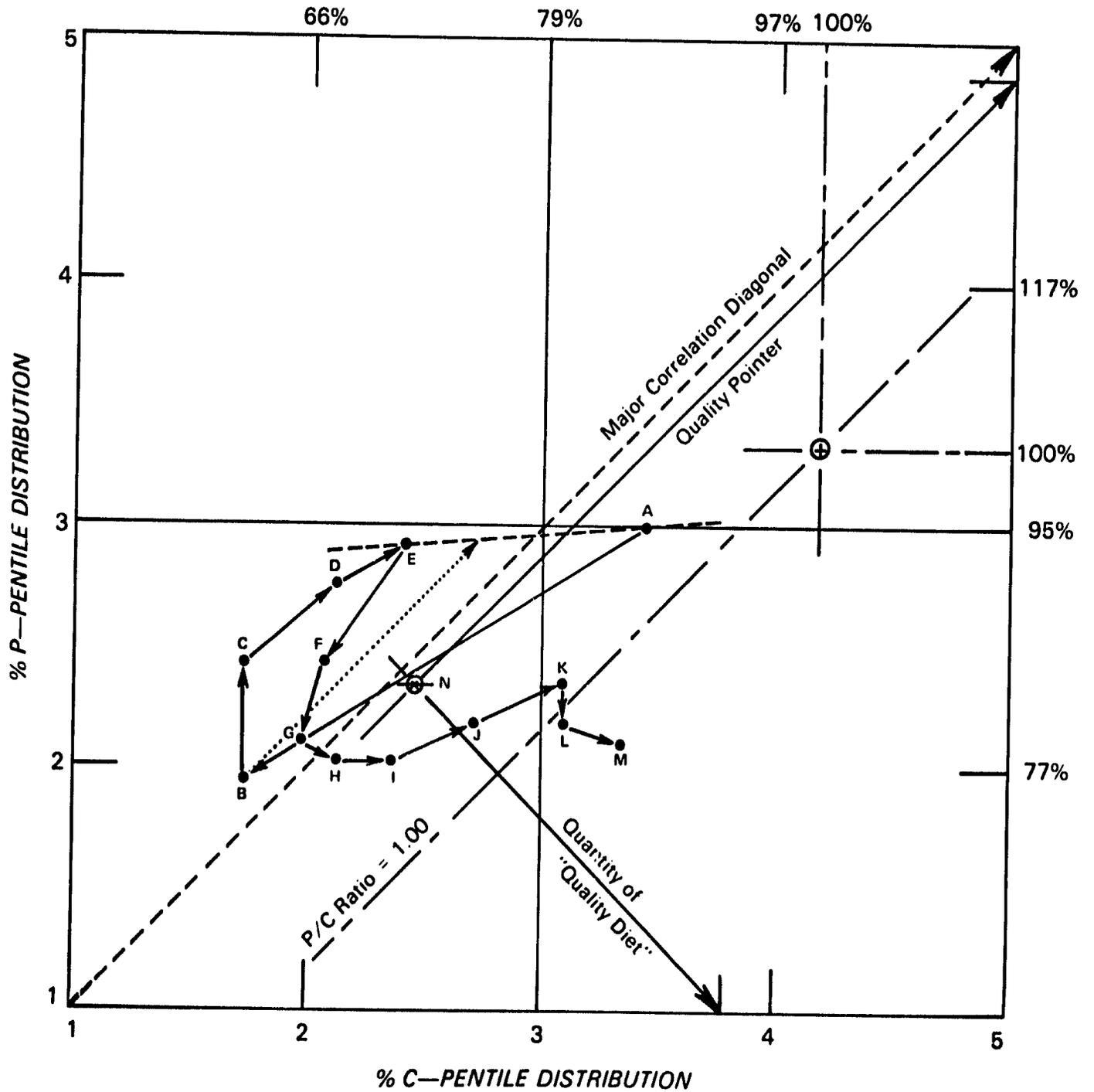
FIGURE 17B. Dietary Adequacy and Intrafamily Distribution Pattern by Pentile Analysis—Madras City



LEGEND

- | | |
|----------------------|----------------|
| A 0-<6 months | H 20-<25 years |
| B 6-<18 months | I 25-<30 years |
| C 18-<30 months | J 30-<40 years |
| D 30 months-<5 years | K 40-<50 years |
| E 5-<10 years | L 50-<65 years |
| F 10-<15 years | M 65+ years |
| G 15-<20 years | N average |

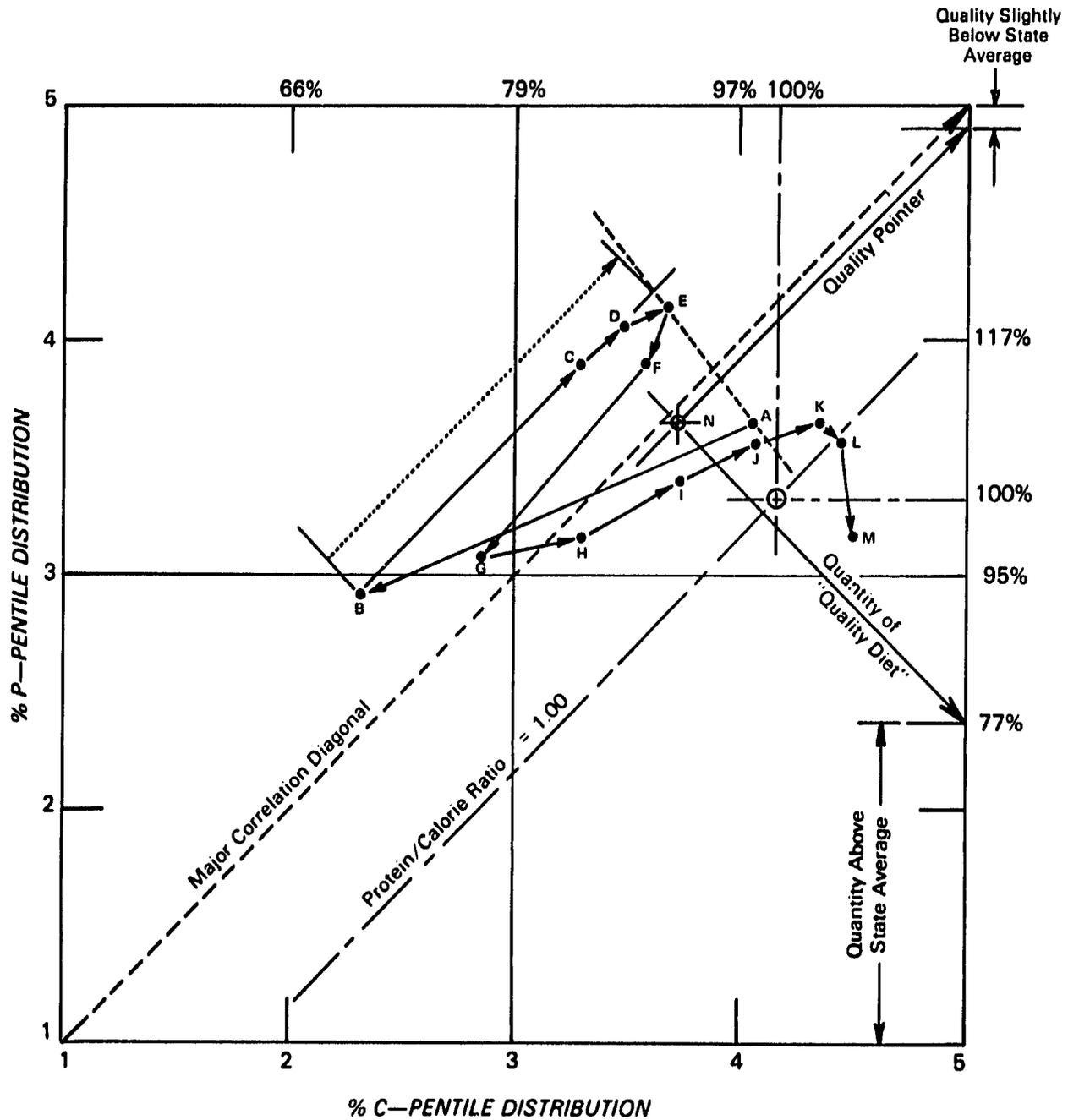
FIGURE 17C. Dietary Adequacy and Intrafamily Distribution Pattern by Pentile Analysis—North Arcot District



LEGEND

- | | | | |
|---|--------------------|---|--------------|
| A | 0-<6 months | H | 20-<25 years |
| B | 6-<18 months | I | 25-<30 years |
| C | 18-<30 months | J | 30-<40 years |
| D | 30 months-<5 years | K | 40-50 years |
| E | 5-<10 years | L | 50-<65 years |
| F | 10-<15 years | M | 65+ years |
| G | 15-<20 years | N | average |

FIGURE 17D. Dietary Adequacy and Intrafamily Distribution Pattern by Pentile Analysis—Tiruchirappalli District



LEGEND

- | | |
|----------------------|----------------|
| A 0-<6 months | H 20-<25 years |
| B 6-<18 months | I 25-<30 years |
| C 18-<30 months | J 30-<40 years |
| D 30 months-<5 years | K 40-<50 years |
| E 5-<10 years | L 50-<65 years |
| F 10-<15 years | M 65+ years |
| G 15-<20 years | N average |

age position, the path may be described roughly as proceeding through a clockwise loop completed at age 20, then turning back on itself to form a curving tail in the direction of higher percentage of calorie fulfillment, with an elevated point in protein need fulfillment at age 40 or 50. Examination of the rest of the 15 charts discloses similar configurations in each.

The specific use of these charts in the planning process is in the determination of the amount and quality of supplementary food that can be expected to be consumed by the weaning child —the unquestioned primary target of current and proposed nutrition programs— participating in a feeding program at a mother and child center or balwady, or in a take home distribution. Other sources of information must be utilized for a determination of the amount of additional food, above that programmed for the target child, needed to cover use by the rest of the family in programs such as the take home distribution. The following section of this report attempts a solution to this derivative problem.

It is concluded that the perception of food needs according to sex and age, as represented by the silhouette hypothesis, establishes the limit of benefit to the target child allowed by family custom and understanding. Under most favorable conditions, the target child could be expected to attain its rightful position on the extended food allocation curve (Figure 15 in line with the 0-6 months and 5 to 10 years age groups. For all practical purposes, this position was attained for the test children in the Take Home Test. In achieving this goal only about 30 percent of the distributed food went to the target child, on average. The balance of the food went into the general food supply of the family, in the aggregate situation; this represents an additional cost to reach the planned nutrition goal in a take home distribution scheme.

To determine the amount of food to be programmed for actual consumption by the target child, a line is drawn between the positions on the chart of the 0 to 6 months old and the 5 to 10 year old; then the distance is measured, parallel to the main correlation axis, from this line to the position of the target group, in this case the 7 to 18 month old group, which contains most of the weaning children. On the State aggregate chart (Figure 17A) for example, this measured distance covers the span from 64 to 80 percent of calorie needs, or an indicated 16 percent supplement. Assuming the average target child to be two years old, this would require that supplementary food providing approximately 200 calories (with a minimum of 10 percent of calories from utilizable protein) be programmed

for actual daily consumption by the child. Adjustments in food allocation to other age groups to bring them in conformity with an acceptable pattern of intrafamily food distribution can be determined by the same method.

This technique recognizes the firm constraints placed upon food reallocation within the family by custom and accepted practice. One of the major efforts of future nutrition education programs should be to foster necessary changes in the way food needs are perceived, and to effect desired changes in intrafamily food distribution, taking into consideration the available resources, the best interests of the family as a whole, and of the society in general. At best, significant progress toward such a goal will be difficult, since it involves change in old and well established cultural concepts.

CHAPTER VI

FOOD BEHAVIOR, NUTRITION KNOWLEDGE, AND IMPLICATIONS FOR NUTRITION EDUCATION

The term food behavior used with increasing frequency as the TN Nutrition Study progressed reflects the growing recognition that in dealing with the TN food and nutrition situation, we are facing a major problem in behavioral change. The multiple concepts contained in the term provide a realistic assessment of the magnitude of the problem and allow it to be addressed in terms of its component parts such as economic, cultural or social food behavior as well as other variables used in describing the TN consumer.

Choices of food, notions about the functions of various foods in the living body, ideas about what is good or bad for the eater —whether at all times or at certain stages of growth and development, or in relation to health and disease— and association of specific foods with social status are the expression of deeply ingrained behavioral patterns that are part of the local culture. As such, particularly in societies having a low level of literacy and general education, food concepts are held with great tenacity and resistance to change. Not only are many of the ideas and practices at variance with modern knowledge of foods and nutrition, some of them even pernicious in their effects, but the cultural setting is not at all conducive to successful teaching of the conventional knowledge of nutrition in the conventional way. A knowledge, therefore, not only of what the food concepts are but how these concepts are formed* provides the best route for achieving necessary and desirable changes in behavior - the end product of effective education.

Parts of the consumer survey questionnaire were designed to elicit information about the general state of factual knowledge of foods and to identify concepts that would have a bearing on the nutritional status of the population at large and of the target groups in particular. This search for information was conceived as a contribution to establishment of guidelines, for both content and approach, for planning nutrition education programs for villagers and the urban poor. Questioning dealing directly

* Various chapters in the Anthropology Volume (2-B), particularly those addressed to nutrition in the "life cycle" provide useful insights into the sources of behavior patterns associated with food.

with nutritional knowledge was minimal, confined to asking whether the respondent had ever heard of the words "vitamin", "protein", "calorie", "minerals", "calcium", or "iron" and, if so, what was the source of information and what foods, if any, were the words associated with. Questions about food preferences, avoidance, and use, also including reasons why and sources of information, were framed with special reference to the family as a unit, to infants and children, and to pregnant or lactating women. Findings and comments concerning each of the categories of questions follow. Data are from the third round of the consumer survey.

Knowledge of Individual Nutrients -

Responses to queries about the words "vitamin", "protein", "iron", "calories", "minerals", and "calcium" were minimum in number, with answers coming from only about 150 households of the nearly 2500 surveyed. Multiple responses* were evident only in the cases of the words "protein" (254) and "vitamins" (360).

Protein - Twenty six foods were mentioned as sources of protein, including some practical duplications such as raw, cooked, and parboiled rice. Of the 254 responses, 71 named cereals (58 rice, 13 wheat); although this 28 percent of the responses included the principal source of protein in the diets of Tamil Nadu citizens, it must be assumed that this answer does not indicate knowledge of the kinds of foods that are relatively rich sources of protein. There were 51 mentions of legumes, 37 of meat, fish and eggs, and 27 of liquid milk; thus, 45 percent of the items mentioned were foods which may correctly be classified as protein-rich foods.

Vitamins - Of the 360 responses embracing the 33 different kinds of foods recorded, 181 were vegetables and fruits and 143 were meat, milk, fish, and eggs. On this basis, about 90 percent of the responses were appropriate answers, and many of these must represent specific ideas that had been learned about foods.

* These more numerous responses probably reflect the attention which has been given to these words in the mass media in recent years.

Calories - The 147 responses included 24 kinds of foods, but only 53 (34, rice; 19, wheat) were foods ordinarily appearing in the diet as major sources of calories. It seems clear that the word calorie, or its equivalent, has little significance in local communications, and there is little reason to believe that the specific concept it conveys has any place in the food culture.

Minerals - The 151 responses, involving 24 different foods, included 89 that are ordinarily thought of as important sources of minerals in the diet; fruit, 18; leafy vegetables, 20; vegetables (unspecified), 25; and milk, 26. The data on the individual minerals, calcium and iron, are not currently available but can be obtained from the data bank.

Questions on Food Use, Attitudes, and Opinions -

It was noted above that only about 150 households responded to the questions about specific nutrients. Distribution of responses to questions about food use, attitudes, and opinions is shown in Table 17. These are discussed in the order of their appearance in the table.

Families - The family respondent was asked to name any foods that were being avoided in the household, and to give a reason from among the following: "heaty", "cold", "gas producing", "religious", "traditional", "not liking", "not good for health", "not economical", or "others (specify)". About 1160 of the nearly 2000, responses, considerably more than half, concerned foods of animal origin. Table 18 shows the number of times each of the animal foods was mentioned, and a tabulation of the reasons for avoiding them. The avoidance picture is dominated by beef and pork, for reasons that are purely cultural. In addition to the reasons "religious" and "traditional", "not like" occurs with such high frequency that it must also be assumed to be culturally conditioned for the most part. On the other hand, avoidance of milk, eggs, fresh fish, and mutton represents economic deprivation of something that is desired. Overwhelmingly, the reason for avoidance was "expensive". Ignoring, for the moment, whatever economic value there might be in the scavenger role of pigs, these data suggest that efforts to increase production of animal source foods should be concentrated on fresh fish, milk, eggs, and mutton, from the point of view of both acceptance and economy.

Table 17. Pattern of Responses to Questions on Food Use

Population Group	Number in Sample	Number of Responses				
		Foods Avoided	Foods Desired	Herbs & Medicines Given	Foods Given	Supplements Given
Families	2484	1987	---	---	---	---
Infants, 0-12 mos.	690*	---	945	210	---	822
Weaned children (1-5 years)	1607*	106	1923	56	1980	---
Children, 6-15 years.	3172	74	2030	33	---	---
Pregnant	161	29	---	19	---	34
Lactating	954	418	1468	36	---	79

* Approximate, since sample cuts across these age groups.

Table 18. Family Avoidance of Animal Products

Food	No. Times Mentioned	Reason for avoiding				
		Expensive *	Religious	Traditional	Not Like	Others
Beef	376	0	168	111	92	5
Mutton	166	116	9	23	0	18
Chicken	23	8	0	1	7	7
Eggs	115	95	3	3	6	8
Milk	36	36	0	0	0	0
Fresh fish	104	67	5	7	19	6
Dried fish	29	1	0	0	21	7
Pork	308	1	118	78	104	7
	1157	324	303	223	249	58

*i. e., "not economical", or can't afford.

The concepts of "heaty" and "cold" foods are often applied to the detriment of good nutrition. Avoidance of six vegetable foods because they are "cold" is summarized in Table 19. Exclusion of two of the foods listed, ash gourd and bottle gourd, is of little consequence nutritionally, but the other four foods —as well as many others which would show up in a more extensive and thorough investigation— would make significant contributions of essential nutrients in the amounts ordinarily consumed. One of the important long-range objectives of nutrition education should be to impart factual nutrition knowledge in such a way that it would be recognized as a rational, useful basis of food selection and would lead, in time, to voluntary abandonment of some of the less desirable notions of the "hot-cold" theory.

Table 19. "Cold" Foods Avoided

Food	No. Times Mentioned	No. Times "cold" is Reason
Ash gourd	54	45
Bottle gourd	77	33*
Ladies fingers	24	21
Pumpkin	92	65
Radish	11	8
Yam	20	13

* "not like", 21; "traditional", 16.

Other foods may be rejected for reasons that, on the surface at least, appear to be quite spurious. In the present listing, potatoes were listed as being avoided 52 times, plantains 26 times, and bananas 12. In 86 of the 90 instances, the reason given was "gas producing" (indigestible). This was a surprising finding, since these foods are widely used, bland, and when properly prepared (ripe in the case of bananas eaten raw) are considered to be highly digestible. This sort of rejection of foods containing important amounts of much needed carbohydrate, and in the case of potatoes, a significant amount of high quality protein and water soluble vitamins, is deplorable. Practical nutrition education of the public requires means of counteracting misinformation about foods wherever found and, equally important, should teach proper methods of food preparation whenever that need is disclosed.

Infants under one year of age - Virtually all of the children in this group were still being breast fed. Three questions were asked: What foods were desired for supplementing the infant's diet, but not actually given (with reason therefor)? What supplemental foods were actually given? What herbs and medicines, if any, were given to the child? Table 17 shows that there were 945 responses to the first question, 822 to the second, and 210 to the third. There were many multiple responses to questions one and two, with a total of 48 different foods mentioned. The items mentioned with greatest frequency have been listed in Table 20. Of the 876 responses to the first question, 854 gave "expensive" as the reason

for not giving the infant the desired food. The data in Table 4 show that, with one or two apparent exceptions, all of the foods mentioned in response to both questions are quite suitable for feeding infants. Coffee at first glance might seem a strange food for infants*, but when one realizes that coffee is the carrier for all of the milk that comes into a substantial proportion of low income households, its use as an infant food is understandable and evidences a concern for the infant's nutritional needs.

Table 20: Food Supplements for Infants up to One Year of Age: Desired and Actually Given

Food	Foods Desired: No. Times Mentioned	Foods Actually Given No. Times Mentioned
Biscuits	71	65
Baby food	276	76
"Bourne Vita"	11	--
Egg	13	--
Fruit	47	--
General tonics	105	--
"Horlick's"	121	4
Liquid milk	207	285
"Ovaltine"	25	--
Banana	--	12
Cooked rice	--	183
Coffee	--	66
Gruel	--	40
Iddli	--	38

Perhaps the most significant item in the data of Table 20 is the desire, expressed 105 times among 876 responses, to be able to give "general tonics" to infants. This suggests failure to recognize nutritional needs that are not being fulfilled, and a turning toward medicines —and a popular concept of tonics of perhaps "magic" significance— to solve a health problem that primarily demands adequate amounts of suitable food for the rapidly developing infant. Of the 210 responses on medicines and herbs actually

* It is noteworthy that in a "tea habits" survey conducted in North India in 1969 to determine the feasibility of fortifying tea with Vitamin A, about 40% of the respondent families reported giving their children tea about 2 months of age. Tea is almost never served without milk.

given to the child, "gripe water" was stated 139 times. This represents a folk medicine approach to a problem that is essentially one of food usage and sanitation.

Weaned children, 1 to 5 years - In the 106 responses to the question asking what foods were avoided, 36 foods were identified as being withheld from children in this age group. Most of the foods on the list were mentioned only one or two times. High frequencies occurred only with mutton (mentioned 26 times) and fresh fish (11). Dominant reasons for not giving the food were "indigestible" and "not healthy"; "cold" was mentioned 16 times and "expensive", 5. "Self" at 47 times and "elders" at 31 times dominated the sources of knowledge upon which the food practice was based. A review of the foods listed shows that, with a few exceptions, the foods properly prepared, could be given to children in this group and would benefit them nutritionally.

Table 21 is a comparative list of the food items most frequently mentioned in response to the two questions: (a) "Are there any foods that you wish to give your child since you consider them good for his health but are, for some reason, not giving at present?" and (b) "Please tell us any foods you gave the child when it was weaned." The food items most frequently mentioned, with frequencies, have been displayed in parallel columns in Table 21. Of the total of 1861 responses to "foods desired", all but 18 were not given for the reason "expensive". The only questionable item, from a nutritional point of view, is the 201 "general tonics" responses. In this case, even more significantly than with the infants under one year, such a response quite likely indicates lack of understanding of the role of sufficient food in the health and growth of a child. Both lists represent a gratifyingly large indication of an appreciation, in the aggregate, that a great many foods are beneficial to young children. One of the challenges to a nutrition education program will be to show how the benefits of the proprietary commercial products -- BourneVita, Horlick's, and Ovaltine, mentioned a total of 399 times -- can be provided for the child from available, relatively inexpensive, familiar foods.

* The desire (and need) for a supplementary infant food with the evident acceptability(status?)of widely advertised "international" products appears repeatedly. To a degree, the Indian product Balamul is an equal status product. Such products need identification with the state-wide or national nutrition efforts planned.

Table 21. Comparison of Responses on Foods Desired but not Given with Foods Actually Given to Weaned Children, One Through Five Years

Food Item	Would Like to Give, but Don't	Do Give
Apple	76	1
Biscuits	100	141
Baby food	46	155
"BourneVita"	59	3
Bread	27	9
Bun	--	11
Egg	157	4
Coffee	12	77
Fruit	195	12
General tonics	201	--
Gruel	--	170
"Horlick's"	246	22
Iddli	1	84
Kali	--	24
Milk	460	506
Mutton	82	--
"Ovaltine"	94	--
Sambar bath	--	26
Tiffin (food unspecified)	5	22
	1861 (out of 1923)	1267 (out of 1980)

The small number of responses (56) to the question on what herbs or medicines were actually given to the weaned child were dominated by general tonics, 28; allopathic medicines, 12; and gripe water, 8. In all probability, adequate nutrition properly identified with the culture could eliminate the need for these administrations in most cases.

Older children, 6 to 15 years: The small number (74) of responses to the question asking what foods were avoided involved 35 different foods. Reasons given and sources of advice identified gave no evidence of a nutritional basis for food avoidance. No single food or small group of foods dominated the list: largest frequencies were fresh fish, 7; curd, 5; and gruel, milk, mutton, and "sweet dish", 4 each. In no case was "expensive"

given as a reason; most frequent reason (24) was "don't like", and nearly all of the rest were culturally conditioned responses: "cold", 14; "undigestible", 7; and "not healthy", 17. Likewise, the reported sources of advice were of local behavioral origin, not from educational sources; of the 58 responses recorded, 41 were "self", 14 were "elders" and 3, "doctors."

On the question of foods desired for the children, but not given, 1873 of the 2030 responses were concerned with 11 of the 37 foods mentioned, in the following frequencies: apple, 83; biscuit, 27; curd, 20; egg, 196; fruits, 313; milk, 455; mutton, 167; the three commercial products mentioned above, a total of 404*; and "general tonics", 208. With the exception of a mere 6 "don't likes", "expensive" was the reason in every case in which these foods were mentioned. With the exception of general tonics, for the reason already stated, these desired foods would have made important contributions to the childrens' nutrition.**

Lactating mothers - The domination of cultural traditions over food behavior was more sharply demonstrated by the responses to the questions concerning this group than with any other. Fifty-five different foods were included among the 419 responses to the question on what foods were avoided. Those mentioned frequently are listed in Table 22, along with the principal reasons and source of advice which directed the behavior. From the point of view of a nutritionist, the indicated behavior is largely irrational, representing further challenge for a nutrition education program.

On the other hand, the responses to the question about what foods were desired, but not given—all but 10 of 1468 responses stated "expense" as the reason for not taking the food—evidenced a fairly high degree of nutrition awareness. Fully half of the responses stated animal products, meat, fish, milk, and eggs, as desired; the three commercial products

* The power of advertising (and status symbols) is demonstrated by these products, but to no useful purpose in the present context, since they are so completely out of reach, economically, of those persons who express a desire for them.

** The potential of identifying a low cost supplementary food, made from indigenous materials, with the "tonic" concept should be explored.

Table 22. Foods Most Frequently Stated as
Avoided by Lactating Mothers*

(Total Number of Responses: 419)

Food	Number of Times Mentioned	Principal Reasons	Dominant Source of Advice or Information **
Ash gourd	28	cold	elders (24)
Banana	31	gas producing, not healthy	elders (30)
Bottle gourd	18	cold	elders (17)
Fresh coconut	15	gas producing	elders (12)
Cooked rice	10	cold	elders (10)
Curd	9	cold	elders (9)
Egg	15	gas producing	elders (14)
Fresh fish	15	gas producing, not healthy	elders (12)
Jack fruit	59	gas producing, not healthy	elders (53)
Ladies finger	17	cold	elders (15)
Mango fruit	50	gas producing, not healthy	elders (38)
Pumpkin	22	cold	elders (18)
Potato	15	gas producing	elders (12)
Total	304		

* It is interesting to compare the data in this table with anthropological observations. See particularly Vol. II, Section B., p 224 et seq.

** Number in parenthesis is the number of times the advice came from the indicated dominant source.

were mentioned 192 times, and general tonics, 197. Thirty-eight different foods were mentioned, and 85 percent of the responses represented good foods that would have been highly beneficial if used. Of the foods actually given as supplements, there were 79 responses covering a group of 24 different foods. Forty-six of them were among meat, fish, milk, and eggs, and 6 out of the 79 were items of little or no nutritional value. The reason "good for health" was given for 58 of the choices, and the source of advice was identified as doctor, 20 times; elders, 48; and self, 11. There is evidence here of a striking ambivalence in this sample group at large: foods avoided showed no influence of nutritional knowledge; foods desired but not given and supplementary foods actually given were, for the most part, excellent choices from a nutritionist's point of view. Unfortunately, the data on pregnant women were not available for incorporation in this report, but are in the data bank. There is little reason to believe that these data would do other than reinforce the picture of food behavior that has emerged.

Implications - One conclusion that comes from all of this material is dominant and inescapable. Deep seated, long standing cultural patterns dictate food behavior, receptivity to new knowledge, and acceptability of change. Educational programs and efforts must recognize this, strive to understand the cultural patterns and family authority structure, and be willing to accommodate to these ruling influences as the price of success in fostering desired changes in behavior.

The key element in this body of information is best illustrated in Table 23. This shows that reported factual knowledge about foods and nutrition is presently derived almost entirely from formal schooling and public information media, while actual behavior is dictated largely by culture and traditional household authority. Finally, the relatively small proportion of responses to these questions about nutrition knowledge, food attitudes and behavior points up the real magnitude of the educational problem facing the State.

Table 23. Distribution of Responses to Questions on Sources of Knowledge or Information

Sources of information	Number of responses	
	Knowledge about specific nutrients	Information guiding food practices
Culture, traditional authority ("elders")	33	489
Medical practitioners	5	129*
Formal schooling	343	0
Practical experience and insights (friends, relatives, self)	88	164
Communications media (books, radio, newspapers & magazines)	414	4
Total responses	883	786

* Includes 79 responses dealing with herbs and medicines

CHAPTER VII

NATIONAL DEVELOPMENT, NUTRITION PROGRAMS, FAMILY FOOD SUBSIDIES, AND POPULATION TRENDS

Family Food Subsidy

Although there appears to be little direct, concrete data on the subject, there is widespread opinion among program evaluators and others that a substantial fraction of most food distributed in programs to benefit specific target individuals actually becomes a family subsidy, directly or indirectly. One of the few bits of direct evidence bearing on this point has been obtained in the Take Home Food Test (see Volume II, Section C of this report), in which it was found that about one-third of the distributed food was applied with considerable effectiveness to the target group, while the remainder went into general use in the households of the children in the test.

For some time, there has been speculation in India and the developing world generally, that school lunch programs are indirect family subsidy programs. The basis for this is simply the logical extension of normal human behavior: under influence of the prevailing ideas about relative equity for the individual in a strong and loyal family structure, one would naturally expect the child fed at school to relinquish part of the food he normally receives at home. Even if the child participant in the Midday Meals Program gives to his family an amount of food equal to the amount he receives in school, he still benefits by receiving a daily portion of food of excellent nutritional value, while the food released by him at home, even though likely to be of lesser nutritional quality, provides much needed calorie benefit to the family.

The planner must give serious consideration to the proposition that virtually all programs for distribution of food to specific target groups become family subsidy programs also. * While only limited proof of such a generality can be given at this time, there are enough indications to justify incorporating this factor in any feeding program for weaning and preschool children. Under most circumstances one would expect the planner, seeking proper allocation of scarce resources,

* See this Report Volume II Section D, "A Study of Feeding Programs in Tamil Nadu", pp 1-2.

to direct a strenuous effort to insure that distributed food went to the target recipients and not the family generally. The present study of food practices and behavior in Tamil Nadu suggests that such an effort would be mostly frustrated and might jeopardize acceptance of the intended program itself. More appropriately, the effort could be spent in a determination between effective supplementation of the target child's diet and recognizable benefit to the rest of the family. The goal should be optimize distribution of the subsidized food between target group and families.

The typical intrafamily food distribution practices as previously pictured along with the silhouette hypothesis, explain local perception of food needs.* They also provide a means for estimating the fraction of food designated for weaning and preschool children that would be diverted to a family subsidy if no restraint were placed on such redistribution.

Estimation of family food subsidy -

The method used to make this estimation is based upon the findings from the Take Home Food Test pictured in Figure 15 and use of the three dimensional charts. (Figures 17 A through D are the examples shown) to determine the amount of food that can be expected to be consumed by the target. If weaning children in either the 7 to 18 months or 19 to 30 months age groups are the target beneficiaries, probable consumption is estimated by a vector drawn parallel to the main correlation diagonal from the position of the target group to its intersection with a line connecting the chart positions of the 0 to 6 months group and the 5 to 10 year group, which lie on the food allocation curve (silhouette function). Projection of these line segments to the percentage calorie fulfillment axis of the chart yields a measure of the probable consumption of supplementary food.

Calculation of the estimated family subsidy for a number of Districts is demonstrated in Table 24. For this sample calculation it is assumed that, as in the Take Home Food Test, the amount of food provided is equivalent to 33 percent of the daily calorie need of the target child.

* This Volume, Chapter VI.

Explanation of Column Headings, Table 24

A = Percentage calorie need fulfillment (%C) of target individuals as normally distributed (median values).

B = Expected %C limit from vector drawn on 3-dimensional charts, as in Figures A through D, from position of target group, parallel to main correlation diagonal to point of intersection with the line (vector) connecting the positions of the 0-6 months and 6 to 10 year groups.

(This is proposed as the limit to which the nominal family will permit individual subsidy before intrafamily redistribution of food takes place.)

C = Col. "A" plus assumed average calorie supplement (33%C) for normal child feeding program.

D = Net family subsidy. (equals the lesser of C-A or C-B; usually C-B)

E = Percentage of supplemental food used as a family subsidy,
 $100 \times D/33$.

F = Estimated percentage of supplement not going to target child:

$$F = E \times (4.0 - f)/4.0,$$

where $f = 0.3$ AEQ (adult equivalent) for 7-18 months age group,

$= 0.4$ AEQ for 19-30 months group, and

$4.0 =$ number of AEQ in average family.

TABLE 24
ESTIMATE OF FAMILY SUBSIDY FROM
FOOD DISTRIBUTION PROGRAMS

Rank*	District and Target Group**	(see legend, facing page)						
		A	B	C	D	E	F	
—	Tamil Nadu	B	64	80	97	17	52	48
		C	70	78	103	25	76	68
14	Madras	B	62	70	95	25	76	70
		C	67	68	100	32	97	87
13	North Arcot	B	59	74	92	18	55	51
		C	59	70	92	22	67	60
8	Tirunelveli	B	66	79	99	20	61	56
		C	83	78	114	31	94	85
4	Coimbatore	B	61	83	94	11	33	31
		C	70	84	103	19	58	52
1	Tiruchirappalli	B	73	88	106	18	55	51
		C	81	89	114	26	79	71
2	Thanjavur	B	72	90	105	15	45	46
		C	85	90	118	28	85	77

* District rank in percentage of calorie needs fulfilled (individual)

** Target Group B · 7-18 months
C 19-30 months

According to this calculation, from about one-third to virtually all of the supplemental food, depending upon the intrafamily food distribution pattern found for the District subset, will become a family subsidy. Although in this example the picture is clouded by the values for North Arcot, there is some indication of a correlation between use of the supplement as a family subsidy and failure to achieve a satisfactory level of fulfillment of calorie needs, again as measured by District samples. It may be determined from column "F", as $100 - F$, that the target child receives varying amounts of the supplement intended solely for him according to program plans, the percentages received ranging from a low of 15 (19-30 months group, Tirunelveli) to a high of 69 (7-18 months group, Coimbatore). Reason for the consistently lower values in column F, when compared with column B, may not be immediately apparent. The percentage of supplemental food used as family subsidy (E) is higher than the percentage of supplement not going to the target child (F) because the child's normal share of the family food, apart from what he receives directly in the feeding program, includes a portion of the supplement that was converted to family subsidy.

It is assumed that the present findings concerning intrafamily food distribution and the amounts of food designated for specific target groups, and converted to a family food subsidy are verified by further investigation, the implications for program planning and evaluation are of great moment. Evaluation studies on the scale of the Coimbatore Take Home Test should be made for each major feeding program, to determine directly how the supplement foods are distributed between target recipient and the family plate. Moreover, though one of the long-range goals of nutrition education should be to supplant the "silhouette hypothesis" concept of food needs by an understanding of biologically determined food needs, the faulty perception disclosed by this analysis represents preponderant food behavior in Tamil Nadu. Therefore, it is bound to have profound effects on results of the planning process, and every effort should be made to use it to best advantage.

Child Survival and Protein Shift -

The identification of a take home food program designed to reach the weaning infant as a primary target requires a careful examination of the nutrition status of the population at several age levels. It is clearly evident that the protein requirement of the weaning infant is more poorly met than the recipient of the Midday Meals ration who is of school age and who has already achieved the distinction of survival. The need of the latter is more directed to calories than protein while the weaning infant with appropriate attention to size requires a ration higher in protein but also much higher in calories.

The proper adjustment of rations to meet the requirement of the primary target and, therefore, the shift of expensive protein in terms of need and priority is a major task for the planner. While the weaning infant requires a ration containing 15 percent or more protein calories, the school lunch recipient needs no more than 10 percent protein calories. The appropriate shift can provide a substantial saving. A way to achieve this shift with minimum effort is to produce Balahar as a basic product then feed it as such to the weaning infant and dilute it with any available grain for the Midday Meals Program.

Nutrition Programs, Family Food Subsidies, and Population Trends

There is a widely prevalent view among demographers and nutrition advisers that nutrition programs designed to increase survival of children will within a reasonable time, produce a definite downturn in average family size and the rate of population increase. As evidence of the soundness of this hypothesis, attention is usually directed to the experience of highly industrialized Western nations. Attractive and logical though the idea may be, it has always been a source of uneasiness among some planners. One of the strongest forces underlying this disquietude is the recognition that development conditions in the West have been so radically different, there is little reason to expect that a similar result would occur automatically in developing nations. In the West, a whole complex of favorable circumstances underlay the dramatic reduction of family size during the first half of the present century.

These circumstances include, first and foremost, the rapid transition of both agriculture and industry from labor intensive to capital intensive operations, made possible by a tremendous natural resource base. The resultant dramatic trend toward mechanization and automation was accompanied by a distribution of income and purchasing power more nearly equitable among all participants than the world has witnessed up to that time. This situation in the United States was not unique; a similar development process had been under way in Western Europe for a long time and presently is in full swing in Japan.

Continuing with this brief review of highlights in U. S. development between 1900 and 1950, some important secondary factors should be noted. Foremost among these is compulsory education. Since early in the century, throughout the country it had been required by law that all children enter and remain in school through the secondary level. Concurrently, higher education expanded rapidly and produced relatively huge numbers of highly trained professionals in science and technology. An inevitable consequence of this process was an unprecedented improvement in individual and national productivity, a high employment

level and an association of improved quality of life with consumer comforts. After World War II, changes in family structure accompanied by changing influences on personal decision-making resulted in families limiting their numbers on the basis of attainment of a desired level of affluence for each member, rather than on an optimal subsistence basis. Old, structured family values broke down rapidly as urbanization and industrialization accelerated.

Even the most cursory look at the situation in South India,* reveals little in common with the situation just described for the West.† Therefore, one must approach with extreme caution any movement which proposes to slow and ultimately to reverse the trend in family size and population growth primarily through nutrition improvement. Planners and decision makers must recognize that stabilization of population depends on a large complex of factors and that pursuit of a single factor, such as nutrition improvement, is likely to result in disaster rather than improvement in the quality of life.

One of the carefully drawn objectives of the Tamil Nadu Nutrition Project was to look at the nutrition and family size relationship in the context of such a complex system. For the long run, economic development and redistribution of purchasing power with its consequent experience of improved security must be regarded as prime necessities for voluntary limitation of family size. However, there is no reason to believe that these forces can become effective at all in the compressed time frame characteristic of developed countries. On the contrary, an equivalent result will require a much longer time. This requisite is not available before disaster strikes. Therefore, secondary factors which can become effective in a shorter time must be brought into play in support of nutrition development;‡ foremost among these is the movement toward com-

* Unfortunately, the industrialized world's view of developing country needs has been severely distorted. Virtually all private sector aid and investment and far too large a proportion of public agency aid has been based upon U. S. and European models of an economic and industrial society. Consequently it has, for the most part, reached and benefited a mere 5 to 10 percent of the population in a typical beneficiary nation.

‡ General education, the secondary factor of greatest interest in the present context, must achieve substantial progress before a high rate of economic development and any significant redistribution of income can be expected to take place.

pulsory general education. Creation of, one of the most significant, though indirect, effects of general education and nutrition understanding, will diminish the incentives which prompt poor people to have inordinately large families. Concurrently, ignorance and fear of family planning will tend to be dissipated.

An opposing view -

The optimistic outlook alluded to above has its counterpart. Some persons concerned with food subsidy and nutrition programs have expressed the fear that successful operation of child feeding programs represents a strong incentive for some participating families to produce additional children that they might ordinarily not have, in order to increase their food supply. These are the persons who have articulated the fears of those who would like to join the optimists but dare not. In reviewing results of this project, an attempt has been made to describe the conditions under which participation in a food distribution program would tend to encourage family enlargement.

Family food subsidy as an inducement to have more children - The point was made earlier that an element of family subsidy is inherent in most, if not all, feeding programs. The subject was approached from the point of view that the family food subsidy — contrasted with the declared intent of feeding the individual target child — consisted of a fraction of the distributed food supplement that was added to the general food supply of the family and shared by all. On a theoretical basis, it was assumed that the target child would receive only enough of the supplement to bring his nutritional intake up to a par with that of his old siblings; the rest would be added to the family food. The theoretical construction which explains intra-family food distribution — the silhouette hypothesis — offers a point of departure for further investigation of the dynamics of food transactions under the influence of a distribution program.

Some crude calculations drawing upon data of the consumer survey indicate that, under a particular set of assumptions, a balance in the range of 50 to 150 calories per day might accrue to the family with a lactating mother and her child participating in a food distribution program at a

* See Chapter II in "Towards a Learning Society", Report of the Task Force on Education, Science and Technology, 1972-1984. Plan Document No. 1, The Perspective Plan for Tamil Nadu. State Planning Commission, Madras, July 1972.

a mother and child care center. It would be ridiculous to suppose that the family involved would be able to predict that kind of small windfall except by experience; but the effect of such a subsidy might be to influence the birth of additional children. Ordinarily, the subsidy amount would seem trivial, but the mere existence of any surplus over the child's minimum needs could be sufficient to swing the balance if there also were other, not quite decisive reasons for having the next child. More important, the miniscule subsidy might negate efforts that otherwise would be made to avoid having the next child.

There is an additional factor that may be presumed to be interacting with a culturally determined pattern of intrafamily food distribution to yield a family food subsidy in programs involving take home food. The consumption allowances upon which the amounts of food programmed are based, drawn from recommendations of FAO or the ICMR, may be higher than is appropriate or necessary for consumption at the time and in the amounts scheduled. The obvious ability of most of the subsistence classes of Tamil Nadu to survive and maintain continuity of families on grossly inadequate diets may reflect generations of biological selection for adaptability to low dietary intakes. Such dietary intakes may be so low that a population not so adapted, and thrust without preparation into a similar situation, would not survive. It would seem necessary, therefore, to carry out continuing field studies to determine the limits of a food subsidy which while supplying the designated target child, would not provide enough incentive to make the additional child worth producing.

Once a family had attained the ritual and old age security brought by the assurance of two surviving sons and or two daughters, anticipated family economic gain would be the basic motive to make these small food subsidies an effective inducement to have more children. Given opportunity for gainful employment from the age of eight or ten, as in the case of agricultural laborer or leather worker families, or rug weavers, for example, an opportunity to have several children enrolled successively in a mother and child care center program, then a balwady feeding program, and finally a school lunch program through several primary years would have definite economic advantages to families of the poorer classes. Such seemingly fortunate circumstances would be a rather strong inducement to family enlargement; the situation would also have the unfortunate side effect of tending to lock such families into a limited sphere of opportunity for economic and social gain. Without employment opportunities, however, the situation would become disastrous and would seem to militate against family enlargement. The pressure of compulsory general education might provide enough disincentive to invite family planning but would also require more employment opportunity and a more rapid development of the nuclear family.

The limited success of the family planning effort reported in the Khanna Study* has been attributed in large measure to failure to account for economic motives. In a review of a recent book addressed to this problem, it is stated, "The author shows convincingly that almost the hope of a rise in status of the lower-class people in the village is to have a big family of sons, who could either work land for the parents and so develop savings with which to acquire more land, or migrate to the city and send back emigrant's remittances."** The optimistic view, that nutritional programs to increase child survival and improve their health will lead to a leveling of population growth, does not appear to be tenable. Nutrition programs alone, family planning programs alone, and programs combining the two do not seem certain to lead us to the desired results. It appears obvious that a highly complex system is an operation, and that additional factors and influences, such as general education, nutrition education, and parental security, must be brought to bear on the problem.

Family planning responses in the consumer survey -

Because of the sensitive nature of the questions on family planning, none were asked until the fourth round of the consumer expenditure and food habits survey. At that, the questions were asked only after completion of the entire questionnaire as in rounds one through three. Only about 50 percent of the persons interviewed responded at all to the questions. Many of the failures to respond were the result of interviewer judgment, as in the case of households comprised of couples obviously beyond the childbearing age.

A number of interesting insights came out of the approximately 1200 responses that were obtained. Most said they favored family planning, most said they favored the current family planning program, but practice of any form of family planning or contraception was stated by only 1 out of 8 respondents. In response to a question about the number of children desired, most said three, as if it were a stock answer to the

* Reported in detail in *The Khanna Study: Population Problems in the Rural Punjab*. John B. Wyon and John E. Gordon. Harvard University Press, Cambridge, Mass., U. S. A., 1971.

** *The Myth of Population Control: Family, Caste, and Class in an Indian Village*. Mahmood Mamdani. Monthly Review Press, 1973. Reviewed by K. E. Boulding in *The New Republic*, March 3, 1973.

question and a part of the conventional wisdom. In fact a large proportion of respondents already had more than three, and almost undoubtedly would have still more. The inescapable conclusion from such data is that the public is very much aware of the family planning program and its message, but is not responding with the desired action.

Nutrition and national development -

National development, whether proceeding against the background of a European, North American, Middle East or any other socioeconomic system, has ideally a number of common elements. These elements include mobilization of capital, appropriately scaled industrial development, advancement of the market economy, including the processing or manufacture and distribution of foods and consumer goods, stabilization of land tenure in a scheme which promotes agricultural efficiency, technical advancement of agriculture, an adequate system of general and specialized education, effective programs to improve the nutritional status and general health of the population, a scheme for allocation and continuous inventorying of natural resources, and last but not least or alone, substantial progress toward equity in distribution of income and purchasing power. Putting all of these elements together in a scheme with proper balance and timing is a monumental task for national planners. Programs of nutrition improvement on a national, state, or regional level are tied, directly or indirectly, to every other element of this development process. The present effort requires identification of those elements which are most important in their interaction with the nutrition effort for a successful outcome. A successful outcome includes not only the desired achievements in increased survival of children and improved general health, but must also be compatible with overall, long-range development objectives.

Relationship to the Child Development Center -

The inescapable conclusion is that successful reduction of population growth rate is more complicated than just the incorporation of a nutrition component into a family planning program. There is a delicate balance between a subsidized food program which encourages the production of more children by adding to the family food supply and one which reaches the target — say the weaning child— but doesn't contribute enough to the family plate to make the additional family member economically worthwhile. This delicate balance appears to be controlled by several factors: general education, nutrition education, the availability of gainful employment of the additional child beginning at age 8 to 10, and indirectly, therefore, a close tie with all elements of a national development program.

Fundamentally, however, the problem is tied to parental security and, therefore, presents again a basic problem of behavioral change. The techniques of family planning in India which, to a significant degree, appear to be of minimal success, employ a communication and marketing approach which is at once anxiety producing and anxiety discharging but not in a way calculated to achieve the objective of population control.

Constant admonition to limit families is anxiety producing. Constantly repeated, such anxiety production (warning of dire consequences in the face of strongly motivated, culturally rooted behavior) tends to shut off communication. The results of this are clearly seen in the responses to family planning questions in the TN Nutrition Survey. On the other hand, the purchase of condoms, the most widely distributed birth control device in India, apparently dispels anxiety — but it is the purchase and not necessarily the use. The effectiveness of a distribution system cannot be measured as sales — it must be measured by acceptability of the function. We know little about the frequency of use of condoms, in planning terms acceptability of function, which in turn measures effectiveness.

Child production, however, is security-motivated for whatever reason the child is produced: economic reasons, prestige, or care of superannuated parents. Attention to nutrition requirements in a Child Development Center (CDC), along with other components in a general health package is an approach to increasing chances of survival, hence, a security enhancing action. But again, the climate for such security communications must be optimal and optimization must incorporate biologically-oriented nutrition education directed not only at parents but at decision controllers*. It must seek to correct in an appropriate context the misconceptions that prevail in relating malnutrition associated diseases to sins (doshams) and wrongly paired hot/cold food concepts. Such a package can be organized and delivered to supply not only the means for child survival but also a credible guarantee of survival to the parents. The resultant reinforcement of security is the factor which can change behavior.

Thus, the proposed CDC's carry the promise not only of nutrition improvement but also of population rate decline. Experimental work designed to ascertain the optimal components of the CDC package are critical elements of the nutrition planning continuity.

* See Table 23 . Distribution of Responses to Questions on Sources of Knowledge or Information.

CHAPTER VIII

OBSERVATIONS ON VITAMIN AND MINERAL NUTRITIONAL STATUS:
VITAMIN A, CALCIUM, AND IRON

Although the emphasis in data analysis and model development has —quite appropriately, we believe— been placed on problems of protein nutrition and calorie adequacy, the existence of serious vitamin and mineral deficiency in Tamil Nadu is acknowledged. Accordingly, certain portions of the consumer survey data were examined in an effort to help contribute to the understanding of vitamin and mineral nutrition problems and to determine whether any significant inputs to nutrition program planning might be drawn from this aspect of the study.

One of the two measures of household diet adequacy used in this food system study was the thirty day recall inventory of food procurement by each household. The summation of these data represents the overall food supply of the consumer survey sample and, to the extent that the sample is representative of the overall population, it conforms in both quality and quantity to general food usage in the State at the time of survey.

This general inventory of the available food supply was divided into twelve nutritional categories for other analytical operations, but the subdivision was seen as also appropriate for calculating the approximate contents of vitamin A, calcium, and iron of the average diet, and an approximation of the folic acid content as well. Contents of these nutrients in each food group were calculated as weighted averages of published values for the individual foods comprising the principal components of each group. Calculations were based upon the compilation of data prepared by the National Institute of Nutrition. *

The data on vitamin A, calcium, and iron are presented in Table 25 as nutrient availabilities in a 1,000 calorie average portion of the total food

* C. Gopalan, B. V. Rama Sastri, and S. C. Balasubramanian, "Nutritive Value of Indian Foods," National Institute of Nutrition, Indian Council for Medical Research, Hyderabad, 1971.

TABLE 25. Approximate content and distribution of Vitamin A, Calcium, and Iron in the total food supply of the Round 3 Consumer Survey sample.

Food Group	Percentage of total calories	Nutrient availability per 1000 calories of overall food supply *			Percentage distribution of available nutrients **		
		Vitamin A	Calcium	Iron	Vitamin A	Calcium	Iron
1. Rice, paddy	57.90	5	14	4	1.4	4.6	21.8
2. Millet, maize, ragi	2.30	11	80	7	3.0	26.3	38.0
3. Bajra, jowar, wheat, barley	8.30	15	7	1	4.0	2.3	5.4
4. Dhals, legumes, nuts	5.07	14	13	1	3.8	4.3	5.4
5. Leafy & succulent vegs. & fruits	1.62	210	14	2	56.8	4.6	10.9
6. Starchy vegetables	1.09	16	8	0.4	4.3	2.6	2.2
7. Fish	0.98	20	60	0.6	5.4	19.8	3.3
8. Milk, curd, cheese	2.08	45	62	0.1	12.2	20.4	0.5
9. Meat, poultry, eggs	0.77	17	5	0.1	4.6	1.6	0.5
10. Fats & oils	4.19	0	0	0	0	0	0
11. Condiments, herbs	0.75	14	16	2	3.8	5.3	10.9
12. Jaggery, gur	<u>2.62</u>	3	25	0.2	<u>0.8</u>	<u>8.2</u>	<u>1.1</u>
	97.67				100.1	100.1	100.0
Total nutrient availability per 1000 calories		370	304	18.4			

Units: Vitamin A - micrograms of beta-carotene; Calcium and Iron - milligrams.

* incorporating the 12 food groups in the first column, with calorie contributions as shown.

** from each food group. These are percentages of the totals at the bottom of the three center columns.

supply. In Table 26, a comparison of recommended allowances (ICMR, 1968) with actual nutrient availability to the average person at each of five different ages is shown (values for 15 and 25 years are for males). The data listed for pregnant and lactating women show the same average amount of calories received by each group; although this apportionment may be slightly in error, it was the only one possible from the source used since data on pregnant and lactating persons were pooled. These availabilities were measured according to calorie intakes, determined from 24-hour recall of food consumption by individuals, for the average person* at each age level.

Vitamin A

As shown by Table 25, the amount of Vitamin A available to the average person at each of these ages is extremely inadequate, ranging from one-fifth to one-third of the recommended allowances. In view of the widespread and serious pathology associated with Vitamin A deficiency in Tamil Nadu**, the message conveyed by these figures must be taken seriously even if one refuses to accept the actual numbers on the basis of being too low to be believable. However, a similar computation based upon data on daily food consumption in Tamil Nadu, from the Diet Atlas of India (1971), would show equal or lower values for Vitamin A. The real significance of these data lies in Table 25, where it should be noted that the leafy vegetables group of foods (no. 5), representing less than two percent of total calories, provides 50 to 60 percent of the Vitamin A in the food supply.

* Note: Distinction is made between intake of the "average person" of an age group and the "average intake per person" for the group. Because of uneven distribution, with the well-nourished receiving much greater than average shares of food, the "average intake per person" tends to mask dietary inadequacies and picture the general population as adequately fed. On the other hand, the intake of the "average person," the one at the median level, reflects the true state of nutritional deficiency.

** See "Nutrition Atlas of India," C. Gopalan and K. Vijaya Raghavan, National Institute of Nutrition, ICMR, Hyderabad, 1971, and M. C. Swaminathan, "Prevention of Vitamin A deficiency by administration of massive doses of Vitamin A," Proc. First Asian Cong. Nutrition, Hyderabad, 1971, pp. 696-701.

TABLE 26 Comparison of ICMR (1968) Allowances for Vitamin A, Calcium, and Iron with Availability From the Food Supply. (Data from Round 3 Consumer Survey.)

Age	CALORIES		VITAMIN A		CALCIUM		IRON	
	Allow- ance	Received	Allow- ance	Availa- bility	Allow- ance	Availa- bility	Allow- ance	Availa- bility
1 year*	1000	600	1000	220	450	182	15	11
2 years	1100	770	1000	285	450	234	15	14
5 years	1400	1050	1200	390	450	320	15	19
15 years**	2600	1700	3000	630	650	515	25	31
25 years**	2500	1900	3000	700	450	580	20	34
Pregnancy (2nd half)	2500	1920	3000	710	1000	585	40	35
Lactation (up to 1 year)	2900	1970	4600	730	1000	600	30	36

* weaned

** data for males

Units: Vitamin A - micrograms of beta-carotene
 Calcium - milligrams
 Iron - milligrams

NOTE: Data in the "calories received" column are the intakes for the average persons of the ages listed, as determined from the 24-hour recall of food intake.

The utility and effectiveness of using leafy vegetables for treatment of children suffering vitamin A deficiency has been clearly demonstrated.* In the light of such findings, there would appear to be no way of turning aside from an effort to identify inexpensive (or no-cost) indigenous plant materials that might be used as normal dietary substances for the general prevention and alleviation of Vitamin A deficiency, and to devise ways, through education and research, to gain acceptance of such materials as part of the normal diets of virtually everyone, including weaning children. The form that such effort might take is suggested below, under "planning implications."

Calcium

Since it is widely accepted in human nutrition that most normal adults adapt readily to low intakes of calcium, the data suggest that most adult males and adult females who are neither pregnant nor lactating may be expected to be in calcium equilibrium. Weaning and preschool children, and probably adolescents of both sexes, are in a less fortunate position. The small skeletal structure of Indian children, in comparison with European children, may be in part at least an adaptation to low intakes of calcium. The increased calcium demands of pregnancy and lactation—if not met by sufficient calcium in the diet, and in spite of the demonstration that many Indian women achieve and maintain calcium equilibrium on an intake of only 300 milligrams per day— must frequently impose a strain that overburdens the adaptation mechanisms of the body, with a consequent utilization and loss of calcium from the skeletal structure.

Although calcium intakes of the majority of persons in Tamil Nadu fall below the recommended allowances, the average intake for all India may be only 300 milligrams per day**, but it has also been estimated at about 400 milligrams per day for poor income groups. ***

* C. Nageswara Rao and B. S. Narasinga Rao, "Absorption of dietary carotenes in human subjects," *Am. J. Clin. Nutr.* 23, 105-109, 1970.
Vinod R. Lala and Vinodirii Reddy, "Absorption of betacarotene from green leafy vegetables in undernourished children," *Am. J. Clin. Nutr.* 23, 110-113, 1970.

** C. Gopalan, Some recent studies in the Nutrition Research Laboratories, Hyderabad. *Am. J. Clin. Nutrition* 23, 35-51, Jan. 1970.

*** I. S. Shenolikar, Absorption of dietary calcium in pregnancy. *Am. J. Clin. Nutrition* 23, 63-67, Jan. 1970.

There is some evidence that this level (certainly, at least, the 400 milligrams) is adequate for most persons, but with an average intake of only 300 milligrams, many of the individuals whose intakes are below average must be in a serious deficiency state. Examination of food resources which may be applied to the need for additional calcium should be part of a general move toward dietary improvement.

The proposal to fortify salt with five percent of calcium sulfate (as the dihydrate), if the program could be made to succeed, would be a substantial contribution. At the estimated average daily intakes of 15 grams for an adult and 4 to 6 grams for a preschool child *, the daily intake of calcium from fortified salt would be about 175 milligrams for the adult and 60 milligrams for the child. For the average pregnant woman, receiving 1,620 calories daily as estimated in the present sample survey, the normal availability of calcium from the food supply (Table 25) would be 495 milligrams, or 50 percent of the ICMR (1968) allowance. Use of calcium fortified salt would bring the availability up to 670 milligrams, 67 percent of the allowance. Corresponding numbers for the lactating mother would be 575 milligrams (58 percent) and 750 milligrams (75 percent) if fortified salt were used. For a five year old average child, receiving 1,050 calories, which represents an availability of 320 milligrams of calcium (70 percent of recommended allowance), use of four grams of calcium fortified salt daily would bring the availability of calcium up to 380 milligrams, 85 percent of the allowance. Whether use of calcium fortified salt would be of significant benefit to the primary target group, weaned children in the 6 to 18 month age range, is problematic and will remain so until the normal salt intake of this group is determined.

Notwithstanding the potential contribution of salt fortification to increased calcium availability, other avenues to that objective must also be explored actively. There is yet no assurance that a salt fortification program will be successful in reaching an acceptable number of its target users, nor will it be possible to sustain the program unless it quickly attains a satisfactory level of cost-effectiveness. **

* National Institute of Nutrition, Hyderabad, Annual Report, October 1969 - September 1970, p. 24.

** Cost-effectiveness implies satisfaction of those social, cultural and political constraints which determine acceptance of a proposal that is clearly cost beneficial, which means only that it is favored on a purely economic basis.

An obvious other approach is to identify those available foodstuffs that could augment calcium intakes through increased consumption by target group members, and to plan and execute programs which would bring about the desired additional consumption. A quick perusal of food composition tables (in "Nutritive Value of Indian Foods," ICMR, 1971) shows that among the cereals, ragi is calcium rich; also relatively high in calcium are many of the pulses, milk, and fish; many of the leafy vegetables are very high in calcium, and since they are also very low in caloric density, carry a desired amount of additional calcium in a minimal quantity of total solids.

Milk is usually the most desired traditional source of dietary calcium, but in Tamil Nadu suffers the crippling disadvantage that the supply is grossly insufficient for the need, and the cost places it out of reach of most target group subjects. Fish likewise suffers the disadvantages of low and geographically restricted availability, high cost, and lack of acceptance by many people, for religious or other reasons. Ragi could make a significant contribution of additional calcium if it were used preferentially for meeting calorie deficiencies or, depending on supply, substituted for a portion of the normal consumption of rice or other grains lower in calcium. The same situation holds with the pulses that are relatively high in calcium. As with Vitamin A, promoting increased consumption of leafy vegetables appears as the most practical and economical way of augmenting calcium intake from locally available foods.

Iron and Nutritional Anemia

In India as in most countries, both developing and industrialized, there is relatively little reliable information on the incidence of iron deficiency and nutritional anemia. There is sufficient evidence, however, of widespread occurrence that there is genuine concern about these problems in South India, and it is noted that corrective measures against nutritional anemia occupy a prominent place in public health programming.

As would be expected in a state in which the diet consists largely of cereals, recommended allowances of iron (ICMR, 1968) are much higher than in areas where consumption of meat is the rule. To obtain the same amount of iron absorbed, usual diets of Tamil Nadu must contain about

twice as much total iron as diets containing substantial amounts of food of animal origin. * Thus, although average diets (Table 26) appear to be at or above a level of iron adequacy for most age groups, the low and variable absorption of iron from so many of the diet items (plus the fact that about half of the individuals are below the average) suggests that there should be greater effort to increase iron intakes than a superficial view would indicate. Furthermore, averages for pregnant women and weaning children are well below the allowances recommended, an expected finding since these are the groups in which nutritional anemia is most frequently observed.

If one assumes that the proposal to fortify salt with iron were carried out—and it achieved virtually universal distribution and acceptance—contributions of dietary iron from this source would be 7.5 milligrams at 15 grams daily salt intake and 2.0 milligrams at 4 grams salt intake. However, some research results have showed the absorption of iron when the enriched salt is given with food is disappointingly low.** In view of findings such as these, along with continuing technical and acceptance problems, it would seem unwise to place much reliance on salt fortification at the present time. Solutions must be sought in other dietary measures.

Among the foods regularly providing most of the dietary calories, millet appears to be the richest source of iron. Increasing consumption of this grain at the expense of a part of the rice consumed, if necessary, could improve iron intake significantly. As with vitamin A and calcium, the readily available food sources of substantial amounts of additional dietary iron are selected green and leafy vegetables. Much research remains to be done in this area. While a great deal is known about physiological iron requirements, relatively little is known about the absorption of iron from various individual foods and the effects of the mixture of foods in a meal on iron absorption.

* "Nutritional Anemias," WHO Technical Report Series, No. 503, Geneva, 1972. pp. 12-13.

** Nat. Inst. Nutrition, Hyderabad, Ann. Rept., October 1968 - September 1970, pp. 24-28.

Considering the variety of nutrients essential for blood building, there can be no doubt that other factors than iron intake are associated with the prevalence of anemia in Tamil Nadu. Adequate protein nutrition, along with sufficient vitamin B-12 and folic acid, is necessary for the prevention of anemia. Again the nutritional significance of the green leafy vegetable group of foods is pointed up, this time as a source of essential factors for hemoglobin formation. Table 27 shows this food group as the most significant contributor of folic acid in the normal diet of the survey sample. There is little doubt that this group is also the major contributor of vitamin C.

Increasing intakes of leafy vegetables would make no contribution of vitamin B-12 to the diet, and would therefore be of little benefit in alleviating megaloblastic anemia in which B-12 deficiency is the cause. Even though South Indian diets are extremely low in foods containing B-12, folate deficiency has been declared to be a far more common cause of anemia than is B-12 deficiency. * On this basis, the use of more green leafy vegetables to contribute iron and folic acid to the diet could make substantial inroads on the problem of anemia. The biochemical interrelationships of iron, folic acid, and vitamin B-12 are complex ** and it should not come as a surprise if current research leads to a finding that vitamin B-12 deficiency is a much more significant contributor to the anemia problem in Tamil Nadu than was heretofore supposed. Regardless of such outcome, it remains that the intake of folic acid from the typical diet of the State is marginal at about 40 micrograms of free folate per 1,000 calories of an average mixture of foods in the diet. The I. C. M. R. (1968) Allowances for Indians call for 25 micrograms of free folate for infants up to one year, 50 to 100 for children and adolescents, 100 for adults, 150 to 300 during the second semester of pregnancy, and 150 micrograms during lactation. While not likely to afford such profound benefits as in the case of supplying pro-vitamin A, the folic acid supplied by generally increased consumption of leafy vegetables would be an additional and significant contribution.

* Requirements of ascorbic acid, vitamin D, vitamin B-12, folate and iron. WHO Tech. Rept. Series, No. 47, 1970.

** A. K. Saraya, V. P. Choudhry, and O. P. Ghai. Interrelationships of vitamin B-12, folic acid, and iron in anemia of infancy and childhood: effect of vitamin B-12 and iron therapy on folate metabolism. *Am. Jour. Clinical Nutr.* 26, 640-646, June 1973.

TABLE 27. Approximation of folic acid content in an average 1000 calorie portion of food supply of Round 3 Consumer Survey sample.

(Calorie distribution among the food groups is shown in Table 25)

Food Group	Folic Acid*		% Distribution	
	Free	Total	Free	Total
1. Rice	15.0	18.5	38	20
2. Millet, maize, ragi	2.9	6.5	7	7
3. Bajra, jowar, wheat, barley	3.4	8.1	8	9
4. Dhals, legumes, nuts	3.6	16.3	9	18
5. Leafy & succulent veg.	10.8	35.6	27	38
6. Starchy vegetables	0.7	3.0	2	3
7. Fish	1.3	1.8	3	2
8. Milk	0.2	0.4	0.5	0.4
9. Meat	1.6	2.0	4	2
10. Fats and oils	0	0	0	0
11. Condiments, herbs, etc.	0.3	0.8	1	1
12. Jaggery, gur	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>
	39.8	93.0	99.5	100.4

* from "Nutritive Value of Indian Foods", Nat. Inst. Nutrition, Hyderabad, 1971. Table 4, pp. 132-135.

Validity of Data on Vitamin A, Calcium, and Iron Intakes

The observations and conclusions based upon calculated intake of these nutrients are of such potential importance that it is necessary to obtain a realistic idea of the validity of the data used. Table 28 presents the results of an evaluation in which the survey data are compared with data obtained in studies in which careful records were made of food consumption by small numbers of subjects; in these studies the foods consumed by each subject were weighed and chemical analyses of individual nutrients were performed on corresponding samples of the foods.

The few discrepancies that are worthy of note are indicated by the numbers underlined in the table. Notwithstanding the few points of difference, the pattern of average intake of these nutrients as calculated from the survey data may be concluded to be quite valid. Much of the difference in amounts shown by the discrepant numbers may in fact derive from major differences in the diets themselves and from variation in ages of the groups compared.

Planning Implications

The widespread problems of nutritional deficiency of vitamin A, calcium, and iron call for effective public health measures and also for appropriate interventions in the food system. Generally speaking, public health programs are appropriate to discovery and treatment of those persons in which the deficiency is easily recognized as a pathological condition, while food system interventions should foster changes in food practices as the major preventive measure against nutritional deficiency disease. In actual practice there will always be overlap of these two kinds of programs. Present efforts to combat vitamin A deficiency in Tamil Nadu are a case in point.

The vitamin A prophylaxis program of the Government of India, in which Tamil Nadu is one of the seven participating states, is an example of a simple, effective, easily administered use of a pharmaceutical preparation to fulfill a dietary need. Particularly successful if initiated with children in the 1 to 3 year age group, a single, massive oral dose of vitamin A palmitate (300,000 I. U.) in oil given every six months has been shown to

TABLE 28. Validity of data on intakes of Calories, Vitamin A, Calcium, and Iron

Population Group and data source	No. of subjects	Age years	Calories	Vitamin A I. U.	Calcium mg.	Iron mg.
Weaning children						
Source A	*	2	770	285	234	14
Source B	55	under 3	764	-	265	13
Source C	26	0-2½	637	253	234	<u>27</u>
Preschool children						
Source A	*	5	1050	390	320	19
Source C	79	2½-5	868	378	218	16
Adolescents						
Source A	*	15(male)	1700	630	515	31
Source C	110	13-16	1500	600	<u>300</u>	26
Pregnant						
Source A	*	-	1620	600	490	30
Source C	89	-	1600	700	500	30
Lactating						
Source A	*	-	1620	600	490	30
Source C	123	-	1500	<u>1000</u>	400	30
Young adults						
Source A	*	25	1700	630	515	31
Source C	53	16-21	<u>1100</u>	<u>1100</u>	<u>300</u>	30

Source A - TN Nutrition Study, Round 3 Consumer Survey

Source B - TN Nutrition Study, Take Home Test, Food Weighment Study

Source C - Summary of studies conducted by the Sri Avinashilingam Home Science College, Coimbatore (Table V, p. 16, in Report of the Working Group on Nutrition, State Planning Comm., Tamil Nadu, April, 1972)

* based upon food availabilities from 30-day recall inventory of 2500 households and calculated calorie intakes from 24-hour recalls of food consumption by individuals in each inventoried household.

be effective in maintaining satisfactory vitamin A nutriture.*/ **
A particular advantage seen for this approach is that it is workable without any elaborate program of educating the parents of preschool children, and requires no effort or action on their part except agreement that the child shall receive the dosage.

The value of such a program for therapeutic purposes and emergency prophylaxis is indisputable, but intervention programs which utilize available local food resources and inculcate improved food practices to secure adequate vitamin A intakes are indispensable for nutritional improvement on a long-term basis, and to support national development and individual self-reliance.

Work of the Nutrition Rehabilitation Center at Madurai Hospital provides an excellent example of a therapeutic program based upon a simple dietary practice that can be readily learned and applied by villagers. The Center program is specialized: it treats keratomalacia in children by including a daily portion of a keerai containing 40 grams of carotene-rich amaranth leaves in their diets for a period of 10 to 15 days. Mothers remain at the Center with their children and are taught to prepare and serve the protective food. Each is discharged with instructions to continue the practice at home and thereby insure vitamin A adequacy in the diet of the cured child and the rest of her family on a continuing basis. The proposal of the Tamil Nadu Planning Commission to establish many such centers in the state promises to be an eminently practical and effective program to link emergency treatment of vitamin A deficiency to widespread adoption of an acceptable food practice that will prevent further occurrence of the deficiency.

To have enduring good effects on nutritional status, contribute to national development, and improve the well-being of the people generally, nutrition interventions must be based upon locally available resources and must generate willing participation, along with increased knowledge, competence and feelings of proprietorship on the part of the program beneficiaries.

* Nat. Inst. Nutrition, Hyderabad, Ann. Rept., Oct. 1969 - Sept. 1970, pp. 118-119.

** S. G. Srikantia and V. Reddy, Effect of a single massive dose of vitamin A on serum and liver levels of the vitamin, Am. J. Clin. Nutrition 23, 114-118, Jan. 1970.

Programs that use strange, unfamiliar foods and follow plans imposed from outside —no matter how well motivated the planners and administrators— rarely have lasting benefits and tend to fall apart as soon as the outside influences are withdrawn. This is certainly the usual situation unless the favorable conditions just described prevail. A minor case in point is the "Take Home Test." As a test it was useful and successful; as an intervention program it was not. Use of an unfamiliar —even though quite acceptable— weaning food which was no longer available at the end of the year long test period, insufficient time for the accompanying educational effort to become fully effective, and lack of time to develop independent local leadership left many of the participants in the test villages with an apparent feeling of having been given a desired benefit for a brief period, but then having it taken away again. The problem of more adequate feeding of weaning children was solved only temporarily for them. Fortunately, the anticipated resumption of this program will not be as a mere test, but as an open-ended pilot intervention covering a wide geographic area and using weaning foods formulated with familiar, local materials.

Intervention programs intended to make most effective use of local resources for diet improvement need a research and development component to guide and support the operational activity. In planning a program to use local edible plants for general improvement of vitamin A status —and possibly also of calcium, iron and other anti-anemia factors— the research and development team should include: a field botanist or horticulturist to inventory and identify currently or potentially useful edible materials, and to advise on methods of plant culture or gathering and preserving; a chemist who would assay the nutrient contents of materials and examine them for inhibitory or deleterious substances; a practical-minded social scientist to work on problems of acceptance by the target users; a home economist to study and evaluate methods of preparation and serving; a nutrition scientist to evaluate nutritional benefits; and a systems oriented planner or economist to determine cost-effectiveness. Members of the research and development team would provide most of the educational material for the operational activity. A specialized consumer education program would be the most prominent aspect of the intervention effort, and in all probability, the final determinant of success or failure.

Selected green leafy or other succulent vegetable material for use as vitamin A source might be either cultured in household garden plots or

gathered from plants and shrubs growing unattended in the village or in the countryside. Preparations might be used in either the fresh or dried state. In the fresh form they might be prepared as keerai, or added to rasam or sambhar; dried and powdered they might also be added to sambhar and rasam, to dhals, and of perhaps greatest significance, incorporated in ground cereal mixtures used as weaning foods and for preschool children. Proper drying of leaves rich in vitamin A (as beta-carotene) would have to be taught to householders. Sun drying would result in rapid destruction of carotene by action of ultraviolet radiation. It would be necessary, therefore, to dry leaves in relatively dense shade or indoors. Besides adding to the utility of the material, drying, powdering, and storing of surplus edible leaves would help insure availability of vitamin A when fresh leafy material is in short supply.

Dietary improvement based on research and education in the most effective use of locally available foodstuffs is, in our view, a kind of intervention which shows much greater promise of success and lasting benefit than the food fortification programs which have received so much attention during recent years but have achieved little success in practice.

CHAPTER IX

FOOD PRODUCTS, PROCESSING AND DISTRIBUTION

The Tamil Nadu Nutrition Study was concerned not only with nutrition but also with food products as well as their processing and distribution because of the marketing systems influence, among others, on the project. In this orientation, the food and nutrition system is considered as a dynamic, integrated process from production to consumption. Processing and distribution intervene between production and consumption although, in the subsistence structure represented by the food system of Tamil Nadu, much processing occurs in the home (cleaning, grinding, storage, precooking, etc.), and, thus, the system is relatively unsophisticated in comparison, for example, to a highly commercialized food system. Distribution, on the other hand, is common to all systems and a marketing oriented investigation seeks to discover the distribution channels which are favored by various segments of the population as well as the principal food items which are purchased through these different distribution channels.

The ORG Survey

The Operations Research Group (ORG) survey of the food processing industry in Tamil Nadu* was organized as a part of the TN Nutrition Study. Its purpose was to assess the importance of food processing in TN: the principal classes of food subjected to industrial processing, the extent and trend of industrialization or commercialization of the food system, and the characteristics of the distribution mechanism. The full impact of the valuable compilation represented by the ORG survey in terms of its use in constructing a meaningful model of the TN food system was not achieved. The survey was computerized but not programmed in such a way as to make linkages to the consumer survey simple; this must be left to the continuing program. However, the food processing industry in TN is relatively uncomplicated so far as its major role of providing calories and protein is concerned because the TN diet for the most part is uncomplicated. In the latter sense, understanding the consumer is paramount to understanding the food system, including its processing component.

* Vol. II Sec. E of this report.

Foods

Only a few foods are involved in a large way in industrial food processing in TN. Rice, vegetable oil, wheat flour, dhals and sugar provide the bulk of the calories and protein from processed food and from the food, generally, which is distributed to the entire population. These commodities represent nearly 75 percent of the product value of the food processing industry. The addition to tea curing, the baking industry (including biscuits, buns and bread) and tapioca starch manufacture (the starch is known in India as sago and is used chiefly as an infant and geriatric food) bring their value to about 92 percent of the total rupee value of the industry. Thus, such items as canned fruits and vegetables, carbonated beverages, confections and dairy products represent only 3 percent, in terms of rupee value or about 1 percent of the total calorie output of the food industry and, accordingly, reflect the involvement of relatively few of the 41 million citizens of TN.

The Distribution System

The TN retail distribution system is summarized in Table 2* and is remarkable for the sharp separation characterizing transaction on specific commodities. Three major sources of food acquisition are identified: (1) petty shops - retail stores which are stationary and a familiar part of the village and urban neighborhoods ("the neighborhood grocer" whose stock, in addition to staples, reflects the demands of his customers); (2) provision stores - these may be cooperatives or ration shops (controlling amounts of commodities distributed); they deal largely in specific commodities; and (3) street vendors, vegetable markets (green-grocers) and the "shandy". The latter is a travelling market** which may appear in a different village or neighborhood on a specific but regular day.

Statewide, almost 100 percent of the rice sold at retail is acquired through the petty shops. This channel also accounts for about 75 percent of the flour (wheat) and almost a third of the dhal. Oddly, no sugar is traded and only a small amount of cooking oil. In these respects, there is little difference between rural and urban practices.

* Chapter III.

** The shandy originated as a farmer's market specifically involved with dairy cattle transactions. It grew to incorporate draft animal transactions when such animals might be needed for short periods, for example, at plowing time. Slowly, other items were added while the market retained its travelling feature. Today, we are told, almost any item or service can be arranged for acquisition through the shandy.

The provision stores retail most of the vegetable oil (statewide - 87%) with a slight bias to urban accounting for rural, homegrown supplies. They also provide almost half of the dhal and almost all of the sugar. The rural shandy supplies significant amounts of everything - oil, flour, dhal and sugar; the urban shandy deals in a larger proportion of dhal which may reflect the many small buyers since urban distribution of dhal is greater through the provision stores - perhaps reflecting the relative urban affluence and the greater amount of protein in urban areas. A fourth source of food, home production, is obviously greater in rural areas and covers oil, flour, and dhal in substantial amounts.

The significant aspect of the distribution channels is the flexibility offered to the entrepreneur who might be interested in reaching malnutrition target areas. A most revealing aspect of the distribution system is the apparent lack of an institutional food sector, i. e. , a distribution service which might provide commodities and partly processed foods to institutions catering to target groups, for example, to a Child Development Center.

Food Preferences

Most of the foods of Tamil Nadu (other than the common staples) are listed in the Tamil Nadu Food Glossary. * An impressive variety of foods was derived from depth interviews although amounts obviously are low. Cereals include rice, grain sorghum, millets, maize and wheat; the pulses and legumes include all of those common to India; the local leafy vegetables are in considerable variety; root and other vegetables are common and widely used and nuts and fruits are familiar; meats and fish are mentioned though specific varieties are taboo in specific religions and all meats are shunned by vegetarians for economic or other reasons. Spices and flavors are popular and probably provide more variety in the average diet than the foodstuffs themselves.

Common cooked dishes and their methods of preparation are also shown in the anthropological reports.** In terms of familiar food forms, the dietary contains porridges, stews, soups, dumplings, deep fat fried items,

* The TN Nutrition Survey, Vol. II Sec. B (Appendix I), p. 270.

** *ibid*, pp 242-249

snacks, a variety of unleavened and fermented cakes and breads, sweets based principally on milk, pickles and highly spiced raw and cooked vegetables dishes.*

The overwhelming preponderance of rice in the diet multiplies the ways in which rice is prepared and its cultural superfood identity is clearly supported. Rice accounts for 57.4 percent of the calorie inputs of the Tamil Nadu food supply. While the preference for rice is not disputed, its cost makes substitution by other grains imperative as simple cost calculations reveal. Accordingly, as reference to a typical "Week's Menu for School Lunch"*** shows rice appearing three times and wheat (a grain of lesser social status) twice.

A revealing discussion on the social status of rice was reported in an interview by a staff anthropologist.*** The respondent when asked why she preferred rice said "because it was her custom". When pressed, she said, "rice was an ideal diet for the climate". When asked why she said the "western" doctor said so. When asked about the relative merits of wheat, rice and ragi, she said "wheat and ragi were more strengthening than rice, but wheat was seldom available." Finally, after testing many associations, she finally admitted that "lower people" ate ragi revealing the strong factor of social prestige in grain choices.

The point to be made is that wheat and ragi provide more protein calories when serving as the staple and in rural areas where ragi, for example, is the sole grain available to a large number of people for economic reasons, the reflection on nutritional status is apparent.

* The discussion of the prevalence of such a variety of items should not be confused with availability. The point to be made is that the food behavior does incorporate rich delicacies as well as simple staples. Where the means are available a rich diet can be accommodated. There are some obese Indians and calorie counting is popular among a select segment of the urban population.

** This volume, Appendix A, "Official Planning Document" p. 6.

*** Vol. II Sec. B., "Use of an Anthropologist", p. 158.

The data on food supplements for year old infants - preferred and actually given* - taken from questionnaire returns agree substantially with the anthropological data** reported from village interviews. While baby foods and "tonics" are recognized and desired, most mothers who provide something settle for rice unless milk is available. The knowledge of a "baby food" may be clear in some cases but as was shown in the discussion of intrafamily food distribution, any biological relationship which would reinforce proper feeding at critical periods is lacking.

The Practical Problems of an Infant Food

We have discussed the distribution of the preponderant foods, particularly rice. We have drawn the inference from food preference data, both quantitative and qualitative, that an infant food is desired by the consumer. We have identified the association of an infant food by the consumer with "international branded" baby foods and "tonics" while giving rice as the culture dictates. The problem now is how to satisfy the obvious nutrition deficiency and, at the same time, (1) meet the demands of mass consumption requirements, (2) adapt to pressures of culturally dominated action, (3) distribute the product at an acceptable price through existing or associated channels, and (4) organize a communication and product identification program based on the security provided by sound nutrition knowledge.

Food composition - Ideally, from the standpoint of food behavior, the infant food should be based on rice - yet both wheat and ragi properly prepared are better on a protein/calorie ratio basis for supplying need in the small volume represented by the child's stomach. The production of powdered and precooked foods may eliminate raw material differences, particularly if the final form of the food copies the "international" product and distributed in powder form.

Continuous processing - While thus far, products aimed at target groups have been cooked in conventional ways - central kitchens, continuous processing as a means both of providing a ready-to-eat product (as with

* This Volume, Chapter VII, p. 7

** Vol. II Sec. B, Chapters II and III

status baby foods) and providing a mass processing system which meets the mass consumption challenge, appears promising. Data from the field* conducted as part of the TN Nutrition Survey show extrusion (continuous processing) to be an acceptable replacement for current cooking procedures and product identities.

Distribution - While balwady distribution was tried in the continuous processing test, the planned Child Development Centers offer opportunities for both direct consumption by infants and mothers and for take home delivery.** The latter appears particularly effective in meeting the critical phase of infant malnutrition.***

Displacement of Balahar - While Balahar as a gradual indigenous displacement product for CSM is in production, its rate of progress is less than satisfactory so far as meeting subsidized feeding needs is concerned. An operation organized under the new Tamil Nadu Industrial Development Corporation offers an opportunity to displace Balahar by a carefully structured product while enlisting the cooperation and entrepreneurial enthusiasm of the private sector**** and retaining State Government control.

The following quotation***** is pertinent to the structure described here:

"Perhaps the most important point to stress in considering the manufacture and marketing of a nutritionally adequate product is that the target group almost always represents an economically

* Vol. II Sec. D, Part III, "A Test of Extruded Foods in Balwady Feeding Programs in Tamil Nadu" pp. 30-31.

** Vol. II Sec. C, "A Study of Take Home Dry Food as a Distribution System.

*** This Vol. Chapter VI, "Basis of Intrafamily Food Distribution.

**** It is important to note that when the Indian Government needed military rations, it initiated a new industry - food drying - by encouraging the private sector with production contracts. The child feeding plans represent no less a war need - The War on Hunger - and could be used to initiate a new industry - baby food manufacture. This could proliferate to meet other food needs.

***** Introduction, FAO-WHO-UNICEF Protein Advisory Group, Guidelines No. 10 (1971).

deprived segment of the population. In considering subsequent consumption systems, it is too easy to be limited in recommending enterprise due to the constraints imposed by the limited flexibility of the conventional poverty - malnutrition model."

"It is not until malnutrition is divorced from its poverty partnership and considered separately in the integrative marketing context, that novel enterprise structures become evident. Of particular importance are so-called joint sector enterprises (public - private) which are becoming increasingly feasible in areas of public affairs where the interface between applicable new technology and government responsibility is recognized and increasingly accepted as a challenge for action."

High priority tests of the system - The reduction to practice of a product, production and distribution scheme to provide the beginning of CDC food needs in a self-sufficient way is the next step needed to carry along the structured nutrition planning system, represented by the TN Nutrition Study. The scheme outlined has emerged from reliable consumer data and field testing. In this respect, it represents the best kind of planning and reflects the best definition of contemporary social marketing - "the delivery of a social change."

Finally, as an additional challenge, the test of the system must include a promotion component. As several experiences in India testify, high pressure advertising techniques applied as nutrition education achieve only superficial results. For the most part, they provide a reaction to words and create anxiety because the action called for is not clearly related to the culture of the target group. These techniques do not create enough of a basic understanding of the prescribed action so that a sustained behavioral change is promised and so that the anxiety which is generated is displaced by a feeling of security. Instead, the continuous generation of anxiety tends to shut the consumer off to further communication (the "cry wolf" syndrome).

The fundamental purpose of mother and child feeding programs, to which the entire nutrition effort is inextricably committed, is to increase the survival of children, to improve their quality and so generally to improve the quality of life of the community. Therefore, the creation of security^{*} and not anxiety must be the basic ingredient of the promotion program.

* This Vol. Chapter VII. p. 140

CHAPTER X

THE PLANNER AND THE ANALYST: A DIALOGUE ON THE TAMIL NADU FOOD AND NUTRITION SITUATION

Views of Planners - During the course of the Tamil Nadu Nutrition Study, key project team professionals had frequent contact with State and Central Government officials who were themselves planners or were interested in the results of planning. It was obvious as the impressions from these meetings accumulated that there was a broad spectrum of expectations from the project. It was as though each individual or group had a unique idea of what was being done and what was to be produced. This is really not surprising since a dynamic system of the kind being studied is best represented by a composite of views, ("a resonating hybrid") different from one vantage point to the next and changing with time and the uneven progress of its components across a broad and shifting front.

There was derived from these meetings, however, a series of questions which represent a consensus of the views of planners. These reveal the kinds of ideas which concern planners and how they think in terms of interventions in the food and nutrition system.

Functions of Analysts - Conversely, while the data analysis from the Tamil Nadu Study has not reached the point where all the variables mentioned have been examined in depth in a multivariate way, a good analyst develops insights, views and the courage to make what have been called "heroic assumptions."

The Dialogue - Herewith in the form of a dialogue are questions by a composite Tamil Nadu planner and answers by a composite Tamil Nadu systems analyst (P = Planner; A = Analyst).

- P. (1) What are the nature and extent of major nutritional deficiencies in Tamil Nadu with special reference to preschool children and pregnant and lactating mothers?

- A. The major deficiencies are calories and the grain associated protein, * also vitamin A, calcium and probably folic acid ** due to the lack of greens in the diet. Vitamin B12 is also deficient. On an intrafamily basis, the weaning infant (six months to two years of age) and the lactating mother are the major target groups. In addition, adolescent girls are a particularly deprived group. ***

These target groups appear consistently and their status is relatively independent of district, income, caste or extent of education.

- P. (2) To what extent does increase in per capita income of families lead to an increase in the amount spent on food?

- A. To the 70th percentile of the rural population, an increase in income leads to an almost quantitative increase in food purchases. Above that, the rural consumer exercises discretion. For the city dweller discretion is exercised earlier and in Madras, food expenditure remains surprisingly steady above the 50th percentile of the population. Here the demands for transportation, clothing and tools consume a large part of the budget.

- P. (3) Is increase in income of the family related to nutritional improvement, particularly of the child in the family?

- A. Only in a very qualified way. Higher family income does lead to more food and better nutrition for everyone. However, **** the target group specified in all but the top 10% of the families is still very poorly fed. The child is uniformly deprived; some

* Chapter III.

** Chapter VI.

*** Chapter VII "Silhouette Hypothesis"

**** See Chapter VII, "Silhouette" and Chapter III C.

cultural force is at work which can be reversed as indicated by the striking results of the take home food test in Coimbatore District. *

- P.** (4) Is it possible to evolve an acceptable program of agricultural production and cropping most adequate to the nutritional needs of the population?
- A.** Yes, but this represents "fine tuning" which is not the present need. Actually the current trend toward high yielding grain varieties is addressed to the basic need for more calories. An effort to encourage home gardens particularly for common greens (keerai) would help alleviate much of the vitamin problem. ** At present the need is for more food, so much more food (or so fewer people) that any move for more, preferably the most easily achieved one, is probably the best one.
- P.** (5) Is it feasible to develop and recommend a price policy for agricultural commodities responding to the nutritional and consumer needs in the region?
- A.** Price policies represent the most touchy means of controlling anything. Results frequently run counter to needs. The control must be felt on commodities sold in frequent but small quantities if the subsistence buyer is to be helped.

A purchasing cooperative may represent the right style of effort whether state or joint sector operated. The object would be to purchase a few key commodities in bulk for distribution in small units to those who can't afford to spend much at one time. If purchasing membership in the cooperative is based on need and a preferred position established for target group members, then the poor families will benefit and through connected behavior, the target group will benefit. *** Such a system would have purchasing members paying something, would provide some family subsidy and would identify the target group needing special treatment.

* Chapter VI, "Subsidy".

** Chapter VIII.

*** Chapter VI.

P. (6) Is the range of policy alternatives for subsidies and incentives to farmers, to adopt crops and practices advantageous for improved nutrient availability, effective?

A. To the extent that these programs will improve state well-being on a family basis, yes; the subsidy alternatives are good. However, such policies will have negligible effect on target groups. It may be possible to include some farmers in the purchasing cooperative mentioned in 5 in order to help redirect some of the effort to the benefit of the target groups.

P. (7) Are nutritious foods commercially viable and what is their elasticity of demand?

A. Nutritious foods such as Bal Amul are viable for, at best, the upper 20% of the population. Cost is the major reason given by the poor for not using them when they are acknowledged to be desirable. Some buying for status takes place, but buying for status and using are two different things. A local high status product, identified as an infant survival food, might be better. But a state subsidy program will be needed to get such a product to all target group members. In a society where 80% of all expenditure is for non-discretionary food, elasticity of demand is a fiction. There can be no expectancy of use of such a food unless it is well subsidized; also unless the family is subsidized, the target will not be reached.

P. (8) Is there a new emerging pattern of consumption for goods and services in rural areas due to improved agricultural incomes?

A. The data would indicate that an agricultural worker fares significantly better than his non-agricultural counterpart. The farmer tends to ship his higher quality food production to market but that retained for both the farmer and farm employees represents significantly more quantity than is available to others and somewhat lesser quality. Discretionary spending of any significant extent is still restricted to urban areas.

- P. (9) Is it possible to modernize and introduce new food processing capabilities for improved quality and quantity of nutrient availability?**
- A. Yes, it is possible but, the market must be kept in mind. A central processing unit either state or joint sector owned and operated offers probably the best chance for reaching target groups. The private sector component can provide know-how and enthusiasm (if paid) as well as a marketing network to distribute and popularize the product. The public sector can provide a guaranteed production and sales base for distribution in one or more schemes to reach target groups. If a good weaning food were developed it would be profitable for the state to offer it at cost or less to all families with a weaning child regardless of income or social status. While other family members would get some, the target would be reached.**
- P. (10) Is it feasible to recommend new marketing and distribution practices for foods and food products involving significant improvement in nutrient delivery for the population?**
- A. Only a qualified yes can be given to this question. The general population needs more of the same food it gets now. If vitamin A, calcium, vitamin B12, iron, folic acid, etc. were part of the special food package, it might be more worthwhile. A study of petty shop and shandy distribution would probably show how to reach most of the people. This is an important subject for distribution intervention tests. Only such tests can reveal how to reach the target groups at minimal cost. A comparison could be made, for example, to provide food at a significant discount to each target group member as opposed to take home food distribution as a strict give-away. In each case a family subsidy will be required and a way of regularly checking the progress of the target person.**
- P. (11) Does good nutrition bear on reduced fertility and morbidity rates?**

- A. Yes is the most probable answer. The data have not been fully analyzed; however, the better nourished families appear to have fewer deaths.
- P. (12) What combination of improved nutrition, health, and hygiene programs provides the best cost-benefit advantages with respect to "healthier and fewer babies?"
- A. A Child Development Center is probably the best choice now provided that it incorporates many pressures in its service package. The entire thrust of each component should be toward family security through child survival. The thesis is favored that if parental security can be assured by demonstrable survival of more children, the acceptance of family planning will follow. If this cause and effect relationship fails the danger of a super-population explosion and famine is certain.* It will take nearly a generation to prove the thesis, so several carefully formulated systems should be tested.

The planners must be willing to accept a surge (25% or more) of surviving children. The hump in the curve may extend over 8 to 12 years and peak in the 6th to 8th year. If the package of services is properly chosen, there may then follow a steady decline in birth rate such as seen in the developed countries when family security was reinforced.

- P. (13) What economic benefits for the state, and India as a whole, can be expected from an investment in nutrition improvement?
- A. The economic advantage accruing to Tamil Nadu and to India will not come for a generation or more.
- (a) A lower death rate will immediately add to needs, increase school costs and emphasize the requirement for a more dynamic economy.

* Chapter II.

- (b) Once the lower death rate is accepted it must lead to a lower birth rate (it is critical to accelerate this process).
- (c) Stronger, healthier children will reduce medical costs but increase the pressures on society to insure they will be occupied at peak effectiveness. These children will probably be less accepting of their lot than their parents.
- (d) The new survivors will be able to work longer at more complex jobs and will produce better quality goods. Man for man they can be expected to produce 50 to 200 % more quantitatively in terms of current rupee value. Such productivity will add to the tax base rather than subtract from it.

CHAPTER XI

CONTINUITY

Since a decision has been made by the Government of India and the Government of Tamil Nadu to continue the work initiated under the Tamil Nadu Nutrition Study Project, some recommendations concerning the ongoing project, growing out of the experience gained during two years of work, are offered here. The Governments are already proceeding with planning the organization and management of the renewed project, and have named key personnel. Except for mention of the kinds of professional specialties that should be represented on the completed staff roster, these recommendations deal only with substantive aspects of the work to be carried forward.

The intention at the beginning of the TN Nutrition Study in the latter part of 1970, was to create an organization and an approach to nutrition operations planning and program evaluation that would be imaginative, innovative, and effective beyond previously conducted studies. It was also intended and expected that the principal workers in such an effort would not be just technologists, but professionals with a strong philosophical bent, a sense of mission, and those qualities of mind that make for effective, unified interdisciplinary accomplishment. Despite the many difficulties, both internal and external, surrounding this complex and ambitious project, the people involved were in retrospect, moving rapidly toward this ideal. The work itself demonstrates that the original intent has been realized to a reasonably satisfactory degree. It is naturally anticipated that the people who continue the work, having contributed so much thus far, will carry on in the same spirit.

Composition of Professional Staff

- The continuing effort requires a core group of highly qualified professionals who can interact cooperatively and effectively in carrying out the primary tasks of surveying and data gathering, data processing, computerization, programming and analysis; also the primary tasks of evaluation and interpretation of findings, planning and execution of continuous program evaluations, and continuous search for and evaluation of new ideas for the most cost-effective interventions into the food system. The disciplines and areas of specialization that should

be represented in the core staff include: (1) questionnaire design and evaluation, (2) field survey management, (3) data coding, (4) data processing and data systems design, (5) computer programming and operation, (6) systems analysis and dynamics, (7) statistical analysis, (8) information systems management, and (9) operations planning and management. A carefully selected team might have all of these fields represented at a high level of professional qualification in a group of only four or five people.

- There should also be a supporting team of qualified specialists in a variety of fields, including: (1) nutrition, (2) food technology, (3) public health, (4) social anthropology, (5) behavioral science, (6) general and agricultural economics and econometrics, (7) process engineering, (8) agronomy and field botany, and (9) regional planning. Most of the members of such a group would be employed part time or as consultants, but some would also be full time staff members; with the specialists employed depending upon the relative scope and intensity of work needed in the various supporting disciplines.

Staff training - This function can best be accomplished by working with the existing data, using the methods and procedures that have been applied to third round data to produce corresponding data displays and analyses of rounds 1, 2, and 4 of the Food Habits Survey and of the Take Home Food Test.

Extension and Improvement of Data Base

- Work up to the present time has been limited largely to calories and protein as the primary indexes of nutrition status. There should be an extension of quantitative work to include other important nutrients, vitamin A for instance. Modified methods of measurement and computation would have to be developed.
- The team should establish a minimal data base for reference so that the effect of intervention may be measured. This probably should include the complete reorganization of the present data base to coincide with the 27 sampling regions of the National Sample Survey; the change would facilitate later survey work used to measure the effect of intervention and would permit integration with data from many years past.

- Cooperation and interaction with other surveying organizations within the State should be sought, with a view to establishment of a massive data bank available to all. For example, every year the tax collecting authority processes a tremendous mass of data on land holdings, agricultural production and practices. These data are real world information —not scientific or research studies— and will be invaluable in providing strong linkages between the consumer system and agricultural production, as well as with any proposals for indirect nutrition intervention through the agricultural system. The authority could also furnish a mass of data on a large segment of the population, all those who pay taxes on land; the kind of data thus available would be difficult and costly to get by other means.

- The nutrition project should train a consumer survey team and have a modest amount of survey work going on a regular basis. This activity will provide continuous update and refinement of relationships. It will help to improve survey instruments and techniques, and analytical processes.

Operational Orientation

- Since the primary objectives of the Tamil Nadu Nutrition Study, as well as its continuity, are to identify intervention points in the food system, invent new and better forms of intervention when possible, provide backup and advice to intervention program planning, and perform continuous evaluation of programs in operation, the group should be expected to have an activist outlook.

- Therefore, the group should propose interventions —when justified by its research findings— and participate actively in any pilot programs that are initiated as a result. The Take Home Food Test in Coimbatore was an excellent prototype of this kind of activity. Conduct of a pilot program should be according to a systematic work plan, initiated with development of baseline data for the region and for the target population; it is extremely important that the nutrition status and other relevant characteristics be determined so that there is a reference point from which to measure change resulting from the pilot nutrition improvement program. A development process should be built into the pilot intervention program. Before any actual food distribution takes place, estimates should be made of the expected effect on the target group members and those associated with them.

i. e, such items as family food subsidy would be included when there is reasonable expectation that some of the programmed food would be diverted away from the target individual of the family. This is the preliminary model of the intervention system.

- A plan for testing the effect of the program should be devised. The food distribution program is started as the next step; as results accumulate, the model is tested and refined. Needed adjustments in the program may be made in accord with the developing understanding of what is taking place, a new pilot run can be started with the modified model, or if serious flaws in program and model are disclosed, a different approach can be planned for subsequent testing.

- The Nutrition Project should establish professional connections with other planning support groups through the State. Part of the inter-group relationship should be to develop a set of cause and effect games that would simulate the resultant effects on the economy and society when single interest plans were pursued vigorously without regard to effects on implemented plans of other interests and the State as a whole. The objective would be to create a balance among programs in various development fields that would be of greatest overall benefit. Nutrition improvement fostered at the expense of general economic development, agriculture, education, public health and sanitation, family planning or other essential fields can be disastrous in a relatively short time under present conditions. An association of such analysts could, with a number of years of sustained cooperative effort and testing, make systems analysis and modeling into a truly useful art, one that would permit the students of systems dynamics among them to develop the determination and measurement of cause and effect to the point that it would be an invaluable technique for planning.

Some Interventions to be Tested

- There is no doubt that monitoring, evaluation, and forward planning assistance to the Child Development Center pilot program is one, if not the most important activity for the attention of the Tamil Nadu Nutrition group at this time. One of the tasks that demands understanding and accommodation is the role of the household decision maker in controlling the food behavior of the younger women and small children in the family.

- The hypothesis concerning intrafamily food distribution should be the subject of continuing investigation, to discover first, how well the observable, day-to-day behavior of people reflects the concept, and second whether the behavior can be modified, and if so, by what means.

- Support for planning a broader program on use of local materials for special nutritional purposes should have an important place in the work of the immediate future. Ways of expanding the activities of the Nutrition Rehabilitation Centers and introducing their simple practices into as many homes as possible could provide valuable nutrition assistance.

- Continue the work on central food preparation, the proliferation of convenient end products based on a common cereal ingredient offers promise of being the least cost subsidized system for mass interaction. The proper organization of this entire scheme, including distribution, needs careful study. What sectors of the economy should be involved.

- The most effective forms of nutrition education need careful pilot study and evaluation. To whom should nutrition education be addressed?

- Above all, continue the testing of nutrition and family planning linkages and the testing of nutrition and local and national development linkages.

APPENDIX "A"

OFFICIAL PLANNING DOCUMENT

The major thrust of this project, conceived and organized under the official title "An Operations Oriented Study of Nutrition as an Integrated System in the State of Tamil Nadu", is to facilitate the process of program planning to achieve stated broad nutrition objectives of the Government of Tamil Nadu. The appropriate frame of reference, therefore, is the applicable sections of the Perspective Plan on Health, Nutrition, Family Planning and Sanitation for Tamil Nadu: 1972-1984.

The following text is a transcription of those sections of the Plan which deal specifically with nutrition. These are excerpted from Plan Document No. 3 (August 1972), Report of the Task Force on Health, Family Planning, Nutrition and Sanitation, 1972-1984, State Planning Commission, Ezhilagam, Madras-5.

First, this statement appears on page 3 of Chapter I, "Goals of Health Policy":

NUTRITION

"1.11. The nutrition programme will be directed at the vulnerable sections of the population--in particular, pre-school children, pregnant and nursing women through "Kulanthaigal Kappagams" which are to be increased to 12,500 and through 15,300 pre-primary sections in appropriate primary schools. These feeding programmes will meet at least a third of the daily requirements for calories and nutriments of 26,00,000 children below six years of age, who constitute 50 per cent of the target population of the Perspective Plan for nutrition. The school-feeding programme will be continued and strengthened. Nutrition education will be imparted from the nursery through secondary schools to the University level with separate curricula for professional, personnel and extension services."

Chapter II, "Health, Family Planning, Nutrition and Sanitation in Retrospect", reviews briefly the factual background underlying the proposals developed to serve each of these areas. The statements on nutrition, pages 13-14, follow:

NUTRITION

"II.26. The parameters which define the present state of nutrition are:

- (a) The dimensions of the population to be fed;
- (b) Average consumption of calories and proteins and other nutrients by different segments of the population;
- (c) Growth of the vulnerable population in terms of height and weight;
- (d) Nutrition-related morbidity; and
- (e) Infant and child-mortality.

All these are undoubtedly related, and earlier attempts to measure the incidence of malnutrition did not integrate these variables in any purposive manner so as to elicit or advance any imminent course of action.

II.26.1. Nutrition Norms: The average calorie intake of children below three years is at 700, 500 short of the recommended level of 1,200 calories per head per day. Similarly, the shortage in the case of pregnant and lactating mothers is nearly a third of the recommended requirements, which are 2,500 for pregnant women and 2,900 for lactating mothers. The average consumption of the general adult population is of the order of 2,200 calories, which is again 600 short of the recommendation.

II.26.2. Levels of consumption of protein by the adult population amounts only to two-thirds of the minimum recommended. Though the protein intake of children is marginally below the recommended level, an excess of calories can here make up for the

protein gap. The gap between the intake and requirement is more pronounced in the lower income groups. Judged from the National Sample Survey data for consumption expenditure in Tamil Nadu, nearly 55 per cent of the households spend less than 79 paise per day per head on food, which can barely provide a per caput 2,200 calories from the cheapest available food. Sub-normal consumptions of other nutrients is evidenced by the incidence of nutrition-related morbidity.

II.26.3. Height and Weight: The average weight of a child at birth in Tamil Nadu is only 2.73 kg. Several anthropometric studies reveal that the very poor growth rates of Indian children after six months can be traced to malnutrition.

II.26.4. Morbidity: Morbidity statistics from a children's hospital show that nearly 20 per cent of the incidence of disease among pre-school children can be causally related to nutrition deficiency. Likewise, another set of statistics shows that a third of all deaths among pre-school children can be attributed to secondary disorders arising from malnutrition. A medical survey of 40,000 school-children shows that 36 per cent of them suffered from malnutrition. Every other pregnant and lactating mother in Tamil Nadu is anaemic.

II.26.5. Mortality: Infant mortality is a true measure of a community's health; pro contra, child health is the foundation of its eventual well-being. The infant mortality rate in Tamil Nadu is of the order of 122 per thousand live births in 1972 as per the Sample Registration Survey. Nearly a third of the deaths occur in the age-group below five years, and of these, 50 per cent occur within the first year. This reflects the state of maternal and child nutrition."

The specific planning proposals concerned with nutrition are contained in Chapter VIII, pages 51-57, which are here transcribed:

CHAPTER VIII

NUTRITION

"VIII.1. The integration of the educational, medical, nutritional, public health (including family planning and maternity and child health) services is imperative.

VIII.1.1. Malnutrition in the early years reduces the productive capacity of adults. Physically, they lack the energy and stamina which are essential for satisfactory work. Furthermore, malnutrition might lead to mental retardation in the young. Chronic and severe malnutrition in childhood increases the chances of children becoming poor readers and poor writers. This, in turn, may lead to defects in neuro-integrative functioning, school failure and subsequent sub-normal adaptive abilities. Malnutrition lowers community resistance to disease resulting in higher incidence of morbidity, which has extensive social consequences. Accident rates are higher among the malnourished groups, who tire easily and quickly. Apathy, lethargy and lack of initiative are the common characteristics of poorly fed groups. In the past, this apparent sluggishness was frequently attributed to laziness, indolence, an attitude of fatalism or the other so called "ethnic traits". Certain nutritional deficiencies, such as acute inadequacy of Vitamin A, can ultimately result in blindness. The blind become a drain on society with little or no opportunities to contribute to it. And this could be easily prevented by spending a few paise on each individual. The medical costs necessary to treat the final effects of malnutrition, either through hospitals or health centres, are many times greater than the cost of providing the necessary nutrients to prevent the malnutrition initially. A solution to the problem of malnutrition is so urgent that it

cannot wait upon a satisfactory level of economic growth. People have to be told about the types and quantities of food that they and their children need and how to produce nutritive foods at minimal costs. Nutrition has as much to do with hoping for a better standard of life for those at work or for others in the home or elsewhere as it has to do with making most of what there is.

VIII.1.2. Many people attempt to have more children than either they or society can afford in order to be sure that at least one or two will survive. The fear is well founded because infant and child mortality are still high in Tamil Nadu and in the country at large. If massive measures were taken to secure the survival of the first two children through better nutrition, parents might feel less impelled to provide against mishaps in this manner and would correspondingly be more receptive to the underlying aims and methods of family planning.

VIII.1.3. A long-range nutrition programme for the State will have to cater to the nutritional requirements of the following groups: (a) Children below 30 months; (b) Pre-school children, 2½ to 6 years of age; (c) Pregnant mothers; (d) School-children; (e) Adolescent boys and girls; and (f) Adults.

VIII.1.4. Tamil Nadu is way ahead of other States in school nutrition with the midday meals scheme which is in operation in 30,603 elementary schools, catering for 18.2 lakh pupils for 200 days in a year. It must be continued with improvements in the nutritive quality of the food and better nutrition education. Well-planned menus secure both of these objectives as a model menu cited below will show:

A WEEK'S MENU FOR SCHOOL LUNCH

- Monday:** Tamarind rice, greens poriyal, tomato/papaya or any other seasonal fruit, C.S.M. payasam.
- Tuesday:** Wheat uppuma, greens kootu, tomato/papaya or any other seasonal fruit, C.S.M. payasam.
- Wednesday:** Dhal, rice greens poriyal, tomato/papaya or any other seasonal fruit, C.S.M. payasam.
- Thursday:** Wheat uppuma, greens kootu, tomato/papaya or any other seasonal fruit, C.S.M. payasam.
- Friday:** Lime rice, greens kootu, tomato/papaya or any other seasonal fruit, C.S.M. payasam.
- Saturday:** Wheat uppuma, greens kootu, tomato/papaya or any other seasonal fruit, C.S.M. payasam.

COST AND QUANTITY OF FOODSTUFFS

Per Child Per Meal

	Quantity in grams	Cost in paise
Rice or	75	4.1
Bulgar wheat	75	Gift Item
Red gram	20	2.3
Greens	50	1.0
C.S.M.	20	Gift Item
Jaggery	10	1.1
<u>Papaya</u> /Tomato	20	0.6
Oil	10	Gift Item
Labour	-	0.9

The cost works out to 8.2 paise for one day. Since rice is served only every other day, the cost comes to 4.1 paise per day on an average.

LONG-TERM PROGRAMMES FOR ADOLESCENT BOYS AND GIRLS

The nutritional requirements of the adolescent have received scant attention, except perhaps when the adolescent is also a mother. Yet boys and girls grow faster in adolescence than at any other time except in infancy and their nutritional needs are accordingly the greatest at that stage. They need more protein, calcium, iron, riboflavine and ascorbic acid than their adult counterparts.

VIII.1.5. The following table gives the quantities of foods required for a meal for adolescent boys and girls.

Foodstuffs* (all quantities in grams)	Boys		Girls		Cost in Paise
	Age in years				
	12-15	16-18	12-15	16-18	
Milk or curds	40	40	40	40	0.04
Pulses	25	25	25	25	0.04
Green, leafy vegetables	30	30	30	30	
Fruits	20	20	20	20	0.04
Other vegetables	25	25	25	25	
Roots and tubers	25	25	25	25	
Cereals	150	150	120	130	0.12(Girls) 0.15(Boys)
Oils	10	15	10	15	0.06(Girls) 0.09(Boys)
Sugar or jaggery	5	5	5	5	0.01

* Egg or groundnut: Two or three times a week.

Interesting weekly menus could be developed utilising different foods which may be served up attractively.

Nutritional education programmes should also be organised for adolescent boys and girls at high schools, in training establishments and in work canteens.

VIII.1.6. Similarly a nutrition programme for adults needs to be planned as a long-range effort. The demand for calories and nutrients, except vitamin A and iron for women, diminish slightly after the peak period of growth in adolescence, while demands for protein, calcium, ascorbic acid and Vitamin A remain constant during adulthood. The nutritional status of an adult reflects his contemporary food habits, previous dietary history and is a pointer to his future health and efficiency. Poor eating in earlier years has residual and adverse effects on the body--some remediable, some lasting and others that get worse with time. Statistics in India indicate that 60 per cent of the population are underfed. Nourishment to the cells and organs of the underfed must be sufficient to support the functioning of the body and its renewal. During 1964, more than 4.5 million people were treated for malnutrition in hospitals and dispensaries and of these patients, 3,511 died. In planning an overall nutrition programme for Tamil Nadu, the per capita daily food requirements of adults as well as children need to be considered. The Indian Council of Medical Research has tabulated suitable kinds and quantities of daily intake of vegetarian and non-vegetarian foods, by sex and activity. The tables make useful resources for planners of agricultural production and nutritional programmes. Although men are not so nutritionally vulnerable as their children or their child-bearing wives, they are important people who must be kept well fed, for their own sake, for the sake of their families and in the interests of full national development. Nutritional programmes for all people should include nutritional education and demonstration.

PROJECT NO. 42

KUZHANTHAIGAL KAPPAGAM/PRE-PRIMARY SECTIONS

VIII.2. There are 7.9 million children below six years in Tamil Nadu. Of these, approximately 55 per cent subsist below the poverty line. This means the feeding programmes will have to cover nearly four million children among whom 1.72 million are likely to be below three years.

VIII.2.1. The first programme proposed is to feed pre-school children in the Kuzhandaigal Kappagams (Balwadis) integrating the efforts made under the Applied and other schemes of the Women's Welfare Department of the State Government. This Nutrition Programme, CARE and Demonstration Feeding, Family and Child Welfare should cover all the 1,707 Kuzhandaigal Kappagams (Balwadis) functioning in the State with a uniform programme of feeding, care and education, which will be based on the quantities of protein and calories to be administered daily; the weekly menus based on local foods; the cost of food; other overheads to support the cooking and feeding operations without reliance on voluntary contributions; and the simultaneous provisions for health care.

VIII.2.2. The next step will be the progressive expansion of the Kuzhandaigal Kappagams from 1,707 and 12,500 by 1984 with consequential or appropriate changes in menu and costs. These Kuzhandaigal Kappagams with 60 children each will cover 7.5 lakhs of children. The rate at which they can expand by 1984 is limited due to financial and human constraints. It is therefore proposed to reach the pre-school children, through the existing primary school system which is well extended. This can be done by attaching pre-primary sections to selected primary schools along with a meaningful 2-3 hour educational programme using the school facilities without disturbing the school programme itself. This strategy will cover 9.18 lakh children in the 15,300 primary schools with 60 children each.

COST

(In lakhs of rupees)

	Capital	Recurrent
1972-73	6.52	268.35
1973-74	6.52	268.35
Vth Plan	32.63	3397.15
Vlth Plan	32.63	6333.02

PROJECT NO. 43

EXPECTANT AND NURSING MOTHERS

VIII.3. Educational and feeding programmes for expectant and nursing mothers have to be organized together with health care and pre-natal and post-natal attention. The nutritional aspects of these groups will become the responsibility of the health sector when nutritionists are appointed and take up position.

VIII.3.1. Nutritional rehabilitation programmes are necessary to educate the mothers so that they can spot common signs of malnutrition among pre-school children and treat them by simple, low-cost, locally available and nutritive foods. Nutrition rehabilitation centres will arrange demonstrations to show people how nutritive diets can improve their children's health within four to six months and how children ought in fact to be fed. This will also become the responsibility of the health sector. To this end the programme will be integrated with that of family planning in the health sector.

excerpted from: T.N. Planning Document No. 3

COST

(In lakhs of rupees)

	Capital	Recurrent
1972-73	5.6	129.38
1973-74	5.6	129.38
Vth Plan	-	646.90
VIth Plan	-	129.38

PROJECT NO. 44

EDUCATION, RESEARCH AND EVALUATION

VIII.4. Intensive motivation through organized, consistent, continuous and convincing educational inputs is required to obtain changes and adjustments in personal habits so as to align the latter to plan objectives and targets. Nutrition education has in fact to start from early childhood. It has then to be continued through the primary, middle and secondary school years, adolescence and adulthood. In order to incorporate nutrition education in the school curriculum, suitably trained and motivated teachers are needed. Accordingly all colleges of teacher education will offer a full course in nutrition education. Teachers already in position will receive short orientation-training during summer vacations utilizing existing nutrition bureaux, medical and home science colleges. All students in colleges will also be required to take a short course in nutrition. The available media of publicity--newspapers, magazines, cinema, the radio, films, posters, exhibitions, fairs and camps--which are currently in use for education in family planning, the green revolution, small savings and community development projects and campaigns will also carry the messages of popular nutrition and health education to the masses. The job chart of all extension and health workers in rural and urban areas will henceforth include the education of the families under their care in nutrition and health.

VIII.4.1. Role of Diet in Treatment of Disease: Nutrition education and the followup of patients need to be further emphasised in hospital work. It is, therefore, necessary to establish nutrition clinics and appoint dietician-cum-nutritionists at least in the district polyclinic hospitals and polyclinic centres and the curricula used for the training of medical and paramedical personnel need to be revised with an added orientation element from nutrition education.

Since the nutritional norms cannot be progressively improved without supporting programmes for diversified and increased food production, processing and distribution, all the inter-related professions--agriculture, animal husbandry and technology--must include nutrition education in their training programmes.

VIII.4.2. Research endeavours in the immediate future must become responsive to the need for alleviating hunger and malnutrition. The broad areas of end-oriented research should have a vital bearing on the proposed programme.

They include topics such as:

- (1) the nutrient requirements and the metabolism of different segments of the population in various stages of life;
- (2) devising well-thought out methods for assessing the nutritional status of communities;
- (3) the setting up of a correlation between family size and nutritional status with a view to devising norms from internal evidence;
- (4) food quality, composition and safety;
- (5) food patterns and habits;

- (6) the evolving of desirable food service systems;
- (7) the ecology of nutrition;
- (8) extension methods in nutrition education for use in urban and rural areas;
- (9) the testing of diet prescriptions from indigenous medical systems;
- (10) the evaluation of sponsored nutrition programmes.

VIII.4.3. Research work in different institutes has demonstrated that, by creating awareness in and motivating rural communities, effective programmes of nutritional rehabilitation could be worked by the village communities themselves, using local food resources. Such efforts must cover a wider spectrum and should be strengthened on a permanent basis.

VIII.4.4. Evaluation ought not to be a mere formality gone through at the term end of the programme, but should be so built into the operations that the programme is maintained at a steady and evenly successful pace. Evaluation must form part of the feeding programmes and the extensive expertise available must be utilized for this purpose. Evaluation data must include an analysis of statistics from health, agriculture, trade and commerce, employment and those gleaned from interviews, visits records, reports, observation of markets and eating places, others bearing on changes in attitudes and food practices; anthropometric, dietary and clinical data; training of personnel and number of the population served. In order to achieve uniformity among such diverse evaluation criteria and procedures, a formalized evaluation pro forma has been outlined in Annex I to the Chapter.

COST

(In lakhs of rupees)

	Capital	Recurrent
1972-73	-	-
1973-74	-	-
Vth Plan	-	10.00
VIth Plan	-	20.00

INTER-DEPARTMENTAL COLLABORATION

VIII.5. Nutrition is a multi-faceted discipline, intimately related to agriculture, animal husbandry, fisheries, health, education, rural development and social welfare. All the departments have thus a vital role to play in nutritional activities and furthering the goals of the programme. To this end, it is recommended that a meeting be held at the Ministerial level of the following departments at periodic intervals. The meetings can be very purposive and fruitful if they come in the wake of a specific programme of action for each department. For instance:

1. The Health Department should:
 - (a) Employ dieticians in large hospitals;
 - (b) Map out the geographical areas where malnutrition is highly prevalent and organize ameliorative measures on an emergency footing;
 - (c) Impart a nutrition bias or orientation to the training programmes of medical and paramedical personnel;
 - (d) Enforce more stringently food laws like the Prevention of Food Adulteration Act, the Catering Establishments Act;
 - (e) Organize a "Nutrition Week" in association with campaigns for related subjects: for example, family planning; and

2. The Education Department should:

- (a) Introduce nutrition studies in the curriculum at all levels of education including that for teacher training;
- (b) Scrutinize science text books for nutrition topics, check their authenticity and bring out new books where necessary;
- (c) Increase the number of children fed under the mid-day meals programme. Interest college planning forums, social service associations and National Service Corps in the programmes and secure their assistance for raising funds.
- (d) Organize sale of quality milk to hostels and canteens on a no-profit basis;
- (e) Employ dieticians in large catering institutions like hostels;
- (f) Produce films on nutrition;
- (g) Maintain cumulative health and nutrition records for school-children;
- (h) Allot marks weighted for the health status of students; and
- (i) Urge colleges and Universities to take up the study of nutrition projects.

3. The Rural Development Department should:

- (a) Give in-service training in nutrition to all functionaries and village-level workers in particular;
- (b) Organize intensive nutrition drives in conjunction with campaigns for family planning, small savings and others;
- (c) Organize competitions in food production, food storage, cooking and food
- (d) Use mobile nutrition units for nutrition education; and
- (e) Establish community food preservation and baking centres.

4. The Social Welfare Department should:

- (a) Train all workers in nutrition;
- (b) Organize nutrition education activities in Mahalir Manrams;

excerpted from: T.N. Planning Document No. 3

- (c) Organize competitions in food production, food storage, cooking and food preservation; and
- (d) Emphasise nutrition in all welfare and relief activities.

5. The Agriculture Department should:

- (a) Formulate production plans and targets based on nutritional needs in collaboration with other departments;
- (b) Increase quality along with quantity in food production, by giving price incentives to farmers as nutrition premia;
- (c) Test new varieties and strains for nutritive value and acceptability before release for large-scale cultivation, utilizing the services of Home Science College in the district or neighborhood;
- (d) Appoint nutritionists on the governing bodies of Agricultural Universities, Councils and Boards;
- (e) Promote kitchen gardens, poultry and livestock units and pisciculture; and
- (f) Supply milk, milk products and eggs at concessional prices to school canteens."

APPENDIX "B"

MINIMUM NEEDS PROGRAMME

SOCIAL WELFARE DEPARTMENT, TAMIL NADU

Appendix "A" contains the portions dealing with nutrition excerpted from Planning Document No. 3 of the State Planning Commission of Tamil Nadu.

This appendix is a transcription of a more detailed proposal of the Social Welfare Department. Directed specifically to nutrition problems of the pre-school child in the rural areas, it proposes to deal with those problems through the medium of approximately 8000 Child Development Centers, one for every village Panchayat. The intention to approach nutrition problems in a setting in which related problems — health care, education, sanitation, and others— are treated is noteworthy.

In a very real sense, this is the primary document to which the report of the Tamil Nadu Nutrition Study is addressed.

Note: As of late June, 1973 the indications are that the proposed preschool feeding in the Fifth Plan will have to be scaled down drastically from the level proposed in this Minimum Needs Programme of the Social Welfare Department. With a contribution from the Centre Government of funds sufficient to provide food for an additional 3.5 lakhs (350,000) of children —the total number of preschool children reached by the program will be 600,000 to 700,000, not the 3 million it is desired to reach.

* * * * *

TAMIL NADU

SOCIAL WELFARE DEPARTMENT

MINIMUM NEED BASED NUTRITION PROGRAMME FOR PRESCHOOL CHILDREN IN THE FIFTH FIVE YEAR PLAN

This note outlines in brief the approach and the strategy that should govern the implementation of Minimum Need-Based Programme for preschool children belonging to the weaker sections of the community during the Fifth Five Year Plan in our State. Of late, we have been becoming increasingly aware of the baneful effects of malnutrition and the urgent need for combating malnutrition amongst the various vulnerable sections of our population. It is now well-known that if malnutrition is not tackled at the preschool stage, irreversible damage will be done to the physical and mental growth of children. Malnutrition, apart from leading to blindness and mental retardation of the young, leads to defects in neuro-integrative functioning, school failure and subsequent subnormal adaptive abilities. Malnutrition also lowers the resistance of children to diseases, leading to high incidence of morbidity with far reaching social consequences. There is, therefore, an irrefutable case for extending our nutrition programmes to cover all the vulnerable sections of our population. In this context, the following observations of Ernest Michane are very apt and significant:

"...To attack the problems of illiteracy and ignorance without, at the same time attacking the main nutritional deficiencies which prevent development of the learning capacity, seems at least, futile. To build up a body of general health services without beginning at the beginning, i.e. at the build-up of the human body, is simply uneconomical. To increase food production without taking care of the real intrinsic value of the foodstuffs already produced or the potential for increased quality within the existing qualities is just wasteful. To put funds in job-creating activities without, at the same time, building up the potential productivity increase of the working population by means of an improved food standard is counter-productive. I am convinced that gains in the fields mentioned are, in fact, more cheaply achieved through measures in the field of nutrition than through any quantitative expansion of traditional public services or activities for health, education, employment or food production (which is, of course, no argument for not expanding these services). Yet

speaking in terms of economy seems both superficial and cynical in this context. Should the provision of a nutritionally high standard food in sufficient amount constitute a basic human right for the individual and, consequently, a basic obligation of the modern society? Is it not, in these days, anachronistic to legislate on universal free education, general health insurance and hospital services, full employment and the like without first creating the human basis for all this, an adequate supply of food for the people?" (Extract from paper presented to a symposium on "Nutrition as a Priority in National Development", sponsored by the Dag Hammarskjold Foundation, at Uppsala, Sweden, July 1971.)

2. The Statewide Food Habits Survey conducted by the Tamil Nadu Nutrition Project and the consumption survey of the Southern Region conducted by ORG on behalf of the Protein Foods Association indicated that 3 million children below 6 years are undernourished and out of this 1.66 million children are malnourished, i.e., consuming less than 50% of the nutrition required. While our approach should be to cover this entire group of 3 million preschool children who are undernourished, yet at the same time, special attention should be given to the grossly malnourished 1.66 million children who will have to be nutritionally rehabilitated before they are treated as part of the general stream qualifying for the overall nutrition programme in the State.

3. As against the figure of 3 million preschool children requiring some kind of State sponsored nutrition or the other, only about 3.52 lakhs of preschool children are already being covered under the various nutrition programmes in vogue in the State. Out of this, about 2,10,000 preschool children are being covered under the Special Nutrition Programme in the urban slums in the major cities of this State. In other words, only about 1.42 lakhs of preschool children are being covered in the rural areas. There has thus been an urban bias in the implementation of nutrition programmes for preschool children in our State. While the importance of covering preschool children in urban slums need not be decided yet, at the same time we should not forget the magnitude of the problem in the rural areas. Thus, our main approach in the Fifth Five Year Plan in the sphere of nutrition and nutrition education should be to cover the vulnerable preschool children in the rural areas.

4. It is now increasingly realised that it will not be desirable to approach the problems of child welfare in a piecemeal fashion and that some sort of package approach in the sphere of Agriculture (such as I.A.D.P. and I.A.A.P. programmes) and Animal Husbandry (Intensive Cattle Development Programme) is called for. In other words, our emphasis should not be on health alone to the exclusion of nutrition, on nutrition alone to the exclusion of health, or on health and nutrition alone and to the exclusion of other services, but that our approach should be to provide all the early childhood services in a comprehensive programme through one administrative-cum-institutional funnel. In this, we are indeed fortunate in having a fairly extensive network of preschools in our State and these preschools are widely diffused in the rural areas in all the Districts. Our strategy should, therefore, be to channelise the early childhood services in a comprehensive and package manner through the preschool in the rural areas. In short, it is proposed to make the preschool in every village the nucleus for dispensation of all the early childhood services in an organised and integrated manner. In this framework each preschool (now known by different names such as Balwadies, preschools, Kuzhandaigal Kappagams, etc.), will be redesignated as a Child Development Centre (CDC). (The word Nutrition Rehabilitation Centre could also be used, but we are avoiding it). The Balasevika in charge of each Child Development Centre will be redesignated as Child Development Organiser (CDO) or Child Welfare Organiser (CWO) and the Ayah in each Child Development Centre will be redesignated as Child Development Assistant (CDA).

5. It has to be conceded that the total number of preschools in our State at present is quite inadequate when related to our total needs and when related to the comprehensive programmes that we have in view for the Fifth Five Year Plan. If each Child Development Centre has to become the nucleus of all the early childhood services in a package manner, then each village panchayat must have a Child Development Centre. As against 13,062 village panchayats in the State at present, only 2,074 village panchayats are now covered by at least one preschool. It is proposed to open 3,000 new preschools (CDC) during 1973-74. This would mean that at the end of the Fourth Five Year Plan and on the eve of the Fifth Five Year Plan we will have in position 5,074 Child Development Centres. In order to achieve our objectives in the sphere of nutrition during the Fifth Five Year Plan we will have to open 7,988 preschools (CDC) during the Fifth Five Year Plan. The strategy will not merely consist of opening 7,988 preschools in a mechanical manner during the Fifth Five Year Plan. If each preschool is to function as a

nucleus for all early childhood care services, then the entire motivation underlying the existing Balwadies or preschools and the new ones that are going to be opened during the Fifth Five Year Plan will have to undergo a radical change. The existing Balwadies or preschools just function as "kind-dole centres" and thus do not have any short term or long term nutrition goals in view. Our experience in regard to the Nutrition Rehabilitation Centres, recently started in Madurai District, has shown that it is possible to achieve startling results by proper re-orientation of the nutrition programmes. It has been shown that if Balasevikas are properly trained, it will be possible to reduce the number of children who are malnourished and to bring the children below the age of five to normal heights and weights. The emphasis under the Nutrition Rehabilitation Centres Schemes is on nutrition education of the entire community in every village and especially of the mothers. Scientific approach to nutrition and nutrition education now animating the Nutrition Rehabilitation Centre should provide the motive force for the already existing preschools and the new preschools to be opened during the Fifth Five Year Plan. It is this shift of emphasis and re-orientation of thinking underlying the administration of Balwadies that justifies the redesignation of the preschools as Child Development Centres in the Fifth Five Year Plan. Balwadi is a static concept; Child Development Centre is a dynamic concept.

6. Thus, the main objectives of the Nutrition Programme during the Fifth Five Year Plan will be as follows:

- (a) To raise the nutritional status of the over 3 million preschool children who are now undernourished;
- (b) To give intensive attention to 1.66 million grossly malnourished preschool children (hard-core children) and thereby raise their nutritional status;
- (c) To reduce the nutrition related mortality and morbidity amongst children in the age group of 0 to 6;
- (d) To increase the weights and heights of children and bring them up to accepted optimum standards vis-a-vis age;
- (e) To create the necessary institutional-cum-administrative framework with proper motivation for propagation of nutrition education and especially that of mothers;

- (f) To provide all the early childhood care services, such as nutritious food, immunisation services, health services, family planning services, etc. through the Child Development Centres in every village. In other words, feeding programmes will be properly integrated with health care, immunisation, nutrition education, protected water supply and sanitation to form the package;
- (g) To devise an appropriate delivery system from the State level to the village level for realising the above objectives;
- (h) To monitor and to evaluate the programme right from the inception of the programme so that evaluation is done not on a post-mortem basis but on a continuing basis as an integral part of the programme. Only then it will be possible for us to have a self-correcting setup.

7. In achieving the above-mentioned objectives, a two-pronged attack will be necessary:

- (a) As we mentioned earlier, on the eve of the Fifth Year Plan there will be 5,074 preschools in position. They will have to be converted into Child Development Centres with an additional staff to be detailed below;
- (b) To open 7,988 new Child Development Centres during the Fifth Five Year Plan with supporting technical and administrative staff. (The year-wise phasing of opening of these Centres is not being dealt with in this note).

8. Given the above-mentioned objectives and given the strategy of routing all the early childhood care services through the Child Development Centres in every village, the next point for consideration is the organisational hierarchy and the administrative arrangements that we have in view.

ORGANISATION AND ADMINISTRATION

1. At the Village level

9. There will be a Child Development Centre for every village Panchayat. 7,988 Child Development Centres will be opened during the Fifth Five Year Plan. This, together with the 5,074 Child Development Centres already in position on the eve of the Fifth Five Year Plan will account for 13,062 Child Development Centres at the end of the Fifth Five Year Plan. All early childhood services will be routed through the Child Development Centres in every village in a package fashion. Each Child Development Centre will have a Balasevika who will be redesignated as Child Development Organiser and an Ayah to be redesignated as Child Development Assistant. Each Child Development Organiser will get an honorarium of Rs. 100/- and each Child Development Assistant will get an honorarium of Rs. 25/- per month. Each Child Development Organiser will be in charge of nutrition and nutrition education of mothers, besides running the preschool.

10. Each Child Development Centre, apart from dealing with under-nourished children, will also give special attention to the hard-core children, i.e., those who are grossly malnourished. Every under-nourished child will be fed at the rate of 25 paise per day for 300 days in a year. Every hard-core child (grossly malnourished child) will be fed at the rate of 40 paise per day for 100 days. Since there are 1.66 million hard-core children to be covered, they will be fed at the rate of 40 paise each child per day for 100 days. Whether locally produced food will have to be given or extruded food will have to be given can be determined later within the financial ceilings indicated above and in the light of practical considerations like availability of various kinds of food.

2. At the Block level

11. Every village panchayat in a block will be covered by a Child Development Centre. Depending upon the size of the block, there will be 40 to 100 Child Development Centres in each. In order to supervise and coordinate the activities of the Child Development Centres in each block, it is proposed to sanction a Paediatrician in the scale of

Rs. 525-25-600-30-690-900/- with the following supporting staff:

- One Nutritionist on Rs. 425-20-525-25-700/-
- One Public Health Nurse on Rs. 400-15-475-20-575-25-650/-
- One Assistant on Rs. 250-10-300-15-450/-
- One Jeep Driver on Rs. 150-4-170-5-225/-

12. The Paediatrician will visit every Child Development Centre in the block and give suitable technical advice to the Child Development Organiser and also supervise the activities of each Child Development Centre. He will also do systematic follow-up work to see the improvement in the heights and weights of the children in each Child Development Centre and also assess their health in general. The Nutritionist in each block will help the Paediatrician in his work and also supervise the Child Development Centre in each village from the nutritional (rather than health) point of view. The Public Health Nurse will assist the Paediatrician in the physical examination of each child in the Child Development Centres. A certain amount of family planning propaganda can also be combined with this work.

13. The pay and allowances of all the staff at block level excepting that of the Paediatrician who will be a self-drawing Officer will be drawn by the Block Development Officer. In order to assist the Block Development Officer to do this work, an Assistant is being proposed for each block.

14. Each Public Health-cum-Nutrition Team in every block will be provided with a jeep or a station wagon with a Driver.

15. Provision has also been made for one Last Grade Government Servant at block level.

16. Each block will be provided with equipment such as weighing machines, infantometers, etc., at the rate of Rs. 1,000/- per block.

3. At District level

17. At district level one Assistant Director of Social Welfare with gazetted rank will be appointed for each district to coordinate and supervise the work done by the Public Health-cum-Nutrition Teams in the blocks and also to review the work done in the district as a whole. The Assistant Director of Social Welfare will also supervise the work of the District Women's Welfare Officer in each district. Each Assistant Director will be assisted by an Accountant, an Assistant and a Typist. Provision has been made for two Last Grade Government Servants to each Assistant Director at district level.

4. At State level

18. At State level the Director of Social Welfare will be in overall charge of the programme. As the Director of Social Welfare will be saddled with many items of work it has been proposed that the post of a Joint Director of Social Welfare (Nutrition) in the scale of Rs. 1,200-100-1,500/- may be created to assist the Director of Social Welfare.

5. Evaluation and monitoring cell in the headquarters

19. An evaluation cell will be set up in the office of the Director of Social Welfare as part of the nutrition programme in the Fifth Five Year Plan. It is now admitted on all hands that, unless an evaluation system is built into any programme, it will not be possible to take self-rectifying follow-up action, nor will it be possible to find out whether the project is proceeding along the right lines and whether the objectives contemplated are being achieved. The proposed evaluation cell will study the results of the nutrition programme and also evaluate the efficiency of the programme. The Joint Director of Social Welfare (Nutrition) programme will be technical head of this evaluation cell and will be assisted by the following staff:

One Statistical Officer on Rs. 575-25-600-40-1,000/-
One Sociologist/Anthropologist/Extension Educator on
Rs. 525-25-600-30-690-35-900/-

One Assistant (statistical) on Rs. 400-15-475-20-575-25-650/-
 One Computer on Rs. 250-10-300-15-450/-
 One Stenotypist on Rs. 210-5-245-10-325 plus special pay.
 Two Last Grade Government Servants on Rs. 130-3-160-4-180-5-195/-

Provision has also been made for two electric calculators for analytical work.

6. Publicity

20. Unless arrangements are made for publicity in a streamlined fashion, it will not be possible to carry the message of nutrition to the rural millions. As an important adjunct to nutrition education and propaganda it has been proposed that whole time publicity staff may be created. It has been proposed that the State may be divided into 4 zones for the purpose of nutrition publicity and propaganda as follows:

No. of the Zones	Districts covered	Headquarters
1	Madras, Chingleput, North Arcot, and South Arcot	Madras
2	Coimbatore, Salem, Dharmapuri and The Nilgiris	Coimbatore
3	Tiruchirapalli, Thanjavur and Madurai	Tiruchirapalli
4	Ramanathapuram, Kanyakumari and Tirunelveli	Madurai

Each zone will be under the control of a Regional Publicity Officer in the scale of Rs. 525-25-600-30-690-35-900/-. He will be assisted by a Programme Assistant and a Project Operator. Each Regional Publicity Officer will be given one mobile van for nutrition education and propaganda with a film projector and slides.

21. At State level the work in regard to publicity and propaganda will be coordinated and supervised by the Joint Director of Social Welfare (Nutrition) under the overall control of the Director of Social Welfare.

22. The assistance of CARE and other international agencies can be sought and we can assume a certain amount of help. All modern mass media and communications can be effectively utilised for nutrition education and propaganda.

7. Training

23. The success of any programme, particularly a nutrition programme in an underdeveloped State like ours caught in a low equilibrium trap, depends not just on the availability of resources or on the dosage of inputs, important as they are, but on the quality of human element. It will not be too much to say that the quality of the technical, administrative, and paramedical staff who are going to be in charge of the implementation and supervision of the programme is more important than even the availability of inputs or equipment and the extent of their sophistication. Staff should have the requisite technical know-how and the proper motivation for carrying out the allotted tasks under the programme so as to see that the objectives and targets under the programme are realised without any shortfall and within the time limit fixed therefor. This underlines the importance of training of staff at every level and especially that of the Child Development Organisers. Since the Child Development Centre is going to be the nucleus for channelisation of all early childhood services, particular attention will have to be paid to the mechanics of training of Child Development Organisers under the programme. Each Child Development Organiser will have to be trained at least for a period of three months (except where the person had previous experience running a Balwadi) and financial provision has been made accordingly. The other details regarding their training can be worked out after these proposals are approved in principle. The training will be so organised that persons working in the Balwadies will be given first preference.

24. An Expert Committee will have to be appointed to finalise the syllabus for training of Child Development Organisers. The same

committee could also be requested to draw up an authoritative manual for the trainers and the trainees which will serve as practical guide books during the course of implementation of the programme.

25. A lump sum provision has also been made for training of the Joint Director of Social Welfare, Assistant Director's staff of the evaluation cell, Paediatricians and the staff of the publicity wing, paramedical staff and other administrative-cum-supervisory staff.

26. To sum up, the following will be the overall financial implications of the proposals outlined above:

Schemes	Financial implications during Fifth Five Year Plan, i.e., from 1.4.74 to 31.3.1979.
	(Rs. in lakhs)
I. Centre level	4,105.92
II. Block level	1,069.50
III. District level	20.72
IV. Regional level	7.66
V. Headquarters	3.02
VI. Training Programme	30.37
Total	Rs.5,237.19 lakhs

27. Details relating to each item can be seen in the Annexures appended to this note.

28. If the above proposals are approved, it will be possible to make significant headway in tackling the problems of malnutrition amongst the preschool children in our State. This should not be taken to mean that if we succeed in that we would have tackled all the problems of malnutrition in our State. Even if we cover all the preschool children, the problems of malnutrition amongst school-going children and amongst the adult population as a whole will still remain. But that is clearly beyond the scope of this note.

29. The above proposals are based on the cardinal assumption that all the various nutrition programmes now being administered by various departments would be properly integrated and brought under one unified administrative setup under the control of the Social Welfare Department at Secretariat level and under the control of the Director of Social Welfare at field level. In this unified setup, the several nutrition programmes like the applied nutrition programme, Demonstration Feeding Programmes, Family and Child Welfare Project, will be properly integrated with the proposed Child Development Centres. Apart from raising the nutritional status of over three million undernourished preschool children (including the 1.66 million hard core children) in our State, implementation of the above proposal will also generate employment to a significant extent. (For details please see the annexure.)

30. It is emphasized that this scheme is flexible in its budget, implementation and time-table, etc.

A B S T R A C T

SCHEMES	Financial implications for five years (Rs. in lakhs)
I . Centre level	4,105.92
II . Block level	1,069.50
III . District level	20.72
IV . Regional level	7.66
V . Headquarters	3.02
VI . Training Programme	30.37
Total	Rs. 5,237.19
	Rupees 52 crores

I. CENTRE LEVELRECURRING EXPENDITURE ON STAFF ON CONTINUING THE
EXISTING PRESCHOOLS ACCORDING TO THE NEW PATTERN -

No. of Balwadies	No. of Balasevikas (C. D. Os.)	No. of Child Development Assistant	Pay per Month	Expenditure during the Fifth Five Year Plan i. e. from 1/4/74 to 31/3/79 (Rs. in lakhs)
5,074	5,074	--	*70	213.10
5,074	--	5,074	25	<u>76.11</u>
			Total	289.21

* At present the Balasevika get an honorarium of Rs. 30/- p. m.
Hence the difference of Rs. 70/- has been taken into consideration.

NEW CHILD DEVELOPMENT CENTRES

7,988	7,988	--	100	479.28
7,988	--	7,988	25	<u>119.82</u>
			Total	599.10

FEEDING CHARGES

.13,062	50 Children	25 paise per day per child for 300 days	--	2,449.12
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INTENSIVE FEEDING OF HARD CORE CHILDREN

Rate per day	No. of Feeding Days	No. of Children to be Covered	Cost for Five Years (Rs. in lakhs)
Rs. 0.40	100	16,60,000	664.00

NON-RECURRING

Utensils (Cooking at Rs. 300/- per centre for 13,062 Centres)			39.18
Shed at Rs. 500/- each			<u>65.31</u>
		Total	768.49

GRAND TOTAL Rs. 4,105.92 lakhs.

II. BLOCK LEVEL

Sl. No.	Name of the Post and Scale of Pay	No. of Posts	Cost for Five Years (Rs. in lakhs)
1.	Paediatricians (525-25-600-30-690-35-900)	374	419.72
2.	Nutritionist (425-20-525-25-700)	374	167.04
3.	Public Health Nurse (400-15-475-20-575-25-650)	374	155.50
4.	Assistant (250-10-300-15-450)	374	82.13
5.	Jeep Driver (150-4-170-5-225)	374	43.08
6.	Travelling Allowance at Rs. 1000/- per Block	374	18.70
7.	Contingencies at Rs. 5,000/- towards maintenance of jeep, purchase of stationery and Rs. 2,000/- for purchase of medicines by the Paediatrician		130.00
8.	Equipment (weighing machine and Infrometer) at Rs. 1,000/- per block	374	3.74
9.	Peons (Rs. 130-3-160-4-180-5-195)	374	48.69
		Total	1,069.50

III. DISTRICT LEVEL

Sl. No.	Name of the Post and Scale of Pay	No. of Posts	Cost for Five Years (Rs. in lakhs)
1.	Assistant Director (Rs. 575-25-600-40-1000)	13	7.29
2.	Accountants (Rs. 300-10-350-15-500)	13	3.82
3.	Assistants (Rs. 250-10-300-15-450)	13	3.43
4.	Typists (Rs. 210-5-245-10-325 plus special pay)	13	2.75
5.	Peons (Rs. 130-3-160-4-180-5-195)	26	3.38
6.	Travelling Allowance and Daily Allowance		0.05
		Total	20.72

IV. REGIONAL LEVEL

REGIONAL CENTRES FOR PUBLICITY

Sl. No.	Name of the Post and Scale of Pay	No. of Posts	Cost for Five Years (Rs. in lakhs)
1.	Regional Publicity Officer (Rs. 525-25-600-30-690-35-900)	4	2.24
2.	Van Driver (Rs. 160-5-240)	4	0.64
3.	One Mobile Van for Nutrition education and propaganda with film projector and slides at Rs. 75,000/-	4	3.00
4.	Maintenance (Rs. 5,000 p.a.)	4	1.00
5.	Programme Assistant (Rs. 350-15-500-20-600)	1	0.37
6.	Project Operator (Rs. 250-10-300-15-450)	1	0.26
7.	Travelling Allowance and Daily Allowance		<u>0.15</u>
		Total	7.66

V. HEADQUARTERS

EVALUATION AND MONITORING CELL

Sl. No.	Name of the Post and Scale of Pay	No. of Posts	Cost for Five Years (Rs. in lakhs)
1.	Joint Director of Social Welfare (Rs. 1,200-100-1,500)	1	0.86
2.	Statistical Officer (Rs. 575-25-600-40-1,000)	1	0.56
3.	Psychologist (Rs. 525-25-600-30-690-35-900)	1	0.44
4.	Assistant (Statistical) (Rs. 400-15-475-20-575-25-650)	1	0.42
5.	Computer (Rs. 250-10-300-15-450)	1	0.21
6.	Steno-typists (Rs. 210-5-245-10-325 plus special pay)	1	0.21
7.	Last Grade Government Servant (Rs. 13½-3-160-4-180-5-195)	2	0.20

**TN Soc. Welfare Dept. -
Minimum Needs Programme**

NON-RECURRING

	Cost for Five Years (Rs. in lakhs)
Calculators, two (Electric)	0.12
Total	3.02

VI. TRAINING PROGRAMME OF BALASEVIKAS

No. of Trainees	Stipend	Duration	Cost (Rs. in lakhs)
A. 13,062	Rs. 60/-	3 months	23.51
Amount to be paid to the institutions at the rate of Rs. 30/- (Rs. 10/- p. m.) per trainee			3.91
Travelling allowance per trainee at the rate of Rs. 15/- per head			1.95
Total			29.37
B. Training of Joint Director (Nutrition), Assistant Director of Social Welfare, Paediatrician and Regional Publicity Officers, etc.			1.00
Grand Total			30.37