The Determinants of Individual Diets and Nutritional Status in Six Villages of Southern India

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Abstract

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Nutritional status of selected households in six villages in southern India was assessed by dietary recall, anthropometry, and clinical assessment. The findings were related to agricultural, economic, and social characteristics of the households and villages, and were used to evaluate program and policy options for improving nutritional status in the zones the villages were chosen to represent.

Village diets were primarily deficient in energy, calcium, and certain vitamins (β-carotene, B-complex, and ascorbic acid). Protein was adequate, both in quantity and quality. Therefore, research and development programs designed to increase total food production (to increase energy availability) and nutrition education programs to increase the consumption of dairy products and selected vegetables or fruits (to increase calcium and vitamin intake) would be appropriate.

Nutritional status of young children (1-12 years) was given special attention in the analysis. Family size, landownership and mothers' education were all shown to influence one or more measures of the nutritional status of this group. With the exception of calcium, nutritional status was not influenced by net household income. This questions whether development policies aimed solely at income growth would be sufficient to alleviate deficiencies in this group.

Agroclimatic and socioeconomic characteristics of both individual villages and zones in which they are located were the major determinants of differences in nutritional status among households. The basic cereal grain in the diet and the degree of cash cropping were found to be major factors in nutritional status. Consequently, nutrition programs should have a zonal or village focus rather than an individual or class focus, with the exception of young children.

Contrary to the results of other studies, no significant seasonal variation was found in either nutrient intake or anthropometric indices. Therefore, new technologies that involve increased labor requirements during the rainy season (the food-deficit season in other studies) would not be detrimental to nutritional status in the zones studied.

Résumé

Ryan, J.G., Bidinger, P.D., Rao, N. Prahlad et Pushpamma, P. 1984. (*Facteurs déterminants de l'alimentation et de l'état nutritionnel individuels dans six villages du sud de l'Inde.*) The determinants of individual diets and nutritional status in six villages of southern India. Research Bulletin No.7. Patancheru, A.P. 502 324, India: International Crops Research Institute for the Semi-Arid Tropics.

L'état nutritionnel des ménages choisis dans six villages du sud de l'Inde a été évalué à travers l'anthropométrie, l'appréciation clinique et les enquêtes sur la nourriture consommée dans les vingt-quatre heures précédentes. Les correspondances ont été établies entre les résultats d'une part, et les caractéristiques agricoles, économiques et sociales des ménages et des villages, d'autre part. Par ailleurs, les résultats ont permis d'évaluer les divers programmes et politiques destinés à l'amélioration de l'état nutritionnel dans les zones représentées par les villages choisis.

Les résultats ont aussi révélé des carences importantes en énergie, calcium et certaines vitamines (B, β-carotène et acide ascorbique) au niveau des villages. Cependant, la consommation de la protéine était suffisante, tant en qualité qu'en quantité. Ceci souligne l'intérêt de la mise en place des programmes de recherche et de développement destinés à augmenter l'ensemble de la production alimentaire (et donc la disponibilité de l'énergie), ainsi que l'intérêt des programmes d'éducation en matière de nutrition, afin d'accroître la consommation des produits laitiers, légumiers ou fruitiers (augmentation de la consommation des vitamines et du calcium).

Dans cette analyse, un accent particulier a été porté sur l'état nutritionnel de jeunes enfants (1-12 ans). La taille de la famille, la propriété foncière et le niveau d'instruction des mères influencent tous un ou plusieurs aspects de l'état nutritionnel de ce groupe. A l'exception du calcium, cet état nutritionnel n'a pas été influencé par le revenu net des ménages. La question se pose donc si des politiques de développement orientées seulement vers l'accroissement du revenu seraient suffisantes pour alléger les carences constatées dans ce groupe.

Les caractéristiques agroclimatiques et socio-économiques tant au niveau des villages particuliers qu'au niveau des zones où ceux-ci sont situés, constituent les facteurs déterminants des différences de l'état nutritionnel entre les ménages. D'autre part, la céréale de base de la nourriture ainsi que la part des cultures de rente sont les facteurs majeurs qui influent sur l'état nutritionnel.

Il est donc nécessaire que les programmes de nutrition mettent l'accent sur la région ou le village plutôt que sur l'individu ou la classe, à l'exception de jeunes enfants.

Contrairement aux résultats des autres études, aucune variation saisonnière notable de la ration nutritionnelle et des indices anthropométriques n'a été observée. Ainsi, de nouvelles technologies qui font appel appel à la main-d'oeuvre importante pendant la saison des pluies (la saison de déficit alimentaire, selon d'autres études) n'auraient aucun effet préjudiciable sur l'état nutritionnel dans les zones étudiées.

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Introduction

The genesis of this study was research by Ryan et al. (1974 and 1975), Ryan and Asokan (1977), and Ryan (1977) that addressed the question of what human nutritional priorities ICRISAT should incorporate into its research, particularly in plant breeding. The major conclusion emerging from that work--which relied on both aggregate data and a review of diet- and nutrition-survey results in semi-arid tropical (SAT) countries--was that agricultural research in the SAT should concentrate upon improvement of crop yield stability. Such an approach would enhance total food production and help check or reduce food prices. As poor people spend more than half their incomes on food and have a high marginal propensity to consume more as their incomes rise, this strategy would enable them to consume more food, with the resulting rise in their real incomes.

The downward revisions in some recommended nutritional allowances based on metabolic studies and nutrition surveys, had led to the rejection of the "protein gap" philosophy that was prominent in the 1960s and the early 1970s. The major nutrition problem was redefined to mean a general food problem--not just a protein gap but a protein/energy gap. Hence, strategies that make more food available would be the most appropriate way to improve human nutrition, particularly among the poor who are the most nutritionally deprived. For plant breeders to focus on enhancing protein content and protein quality of food grains, at an apparent sacrifice of yield, had come to be viewed as a much lower priority than was thought in the 1950s and the 1960s. To improve the protein content of diets, where dietary energy was a major limiting factor, would result only in the protein being partly converted into energy and not being available for muscle and tissue development. Overcoming calorie deficiencies by providing sufficient food of the usual composition, if it were nutritionally balanced, would alleviate most protein deficiencies as well.

In the mid-1970s few nutrition studies were available on the Indian SAT--the region of concern to the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). None of these studies had attempted to understand the determinants of dietary intakes and nutritional status, or to include nutrients such as vitamins and minerals. We felt the need to verify whether the SAT regions of India presented a nutritional picture similar to that of other areas at other times on which the earlier conclusions on research priorities rested. We also decided to examine, apart from protein and calories, all the important nutrients including vitamins, minerals, and amino acids such as lysine and the sulfur amino acids. The amino acids were of particular interest to ICRISAT in view of the earlier emphasis--in ICRISAT's crop improvement programs--on exploiting the genetic variability in sorghum, pigeonpea, and chickpea for improving protein quality.

This study analyzes the human nutrition situation in six typical Indian SAT villages, involving 240 households and approximately 1200 people. The unit of analysis is the individual; characteristics of the household, village, and region in which he/she resides, and the agricultural seasons during which his/her status were measured. Only in this way can the real nutrition problem be defined and the target groups for devising policy identified (Pinstrup-Andersen 1981). The earlier analysis, which primarily considered the aggregate and/or average situations, ran the risk of overlooking the vulnerable groups at the lower end of the nutritional status distribution. We wanted to ensure that the decision to lower the priority assigned to improvement of protein content and quality in ICRISAT's crop improvement programs was correct, and that the pendulum had not swung too far in the other direction to the detriment of nutritionally vulnerable groups (WHO 1976).

Functional classification of the populations at risk, and identification of the determinants of undernutrition and malnutrition are essential if appropriate policies are to be devised to rectify nutritional deficiencies and/or imbalances. Evaluation of the ex ante and ex post impact of intervention or technology policies also requires such an understanding.

This bulletin also focuses on the effect that the extreme seasonality of SAT agriculture has on nutritional status. This important aspect has been overlooked by most Indian studies (Schofield 1974). Recently, Chambers (1982) and Longhurst and Payne (1979) have emphasized the adverse health and nutrition effects of a unimodal wet season on rural populations of developing countries. Since ICRISAT is primarily concerned with the development of labor-using agricultural technologies in the Indian SAT, where the monsoon is mostly unimodal, there is a danger that the Institute may in the process exacerbate health and nutrition problems. This could occur through creation of greater demands for food energy in seasons when supplies are lean.

Another primary objective is to determine the relative importance of the agroclimatic region, features of the household, socioeconomic status, and the demographic characteristics of individuals in explaining variations in individual nutritional status, as measured by both dietary and anthropometric methods. The role of cash and food-grain crops is also considered.

A study of how each member of the household spends his/her time during three to four typical days of the year is included in this paper in order to examine the relationship between nutrition, health, and the allocation of time between agricultural and household activities.

The first section of the paper describes the methodologies employed in (1) the selection of villages and households; (2) conduct of dietary, anthropometric, clinical, and time-allocation studies; and (3) analysis of the data. Then follows the body of the study which describes the composition of diets, nutrient status including the effect of using measured protein content of village grain samples in place of standard values, determinants of intakes of nutrients, anthropometric indices of nutritional status, determinants of various anthropometric indices of children, and finally, an analysis of time allocation by members of the household. The final section features the conclusions.

Methodology

Village Selection

Six villages covered by ICRISAT's Village-Level Studies (VLS) were chosen as the location for this diet, nutrition, health, and time-allocation study. These six villages were selected in 1975 on the basis of background data compiled at the state, district, taluk (county), and village level. Based on exploratory visits, two typical villages were selected in each of the three agroclimatic regions of SAT India for the VLS. The villages were chosen to represent characteristics typical of the taluks they belong to in terms of cropping patterns, land-use, irrigation, etc. (Binswanger and Jodha 1978). In order to select villages representing the traditional situation, those which had special programs or more than normal support or resource transfers from outside, or those located near towns and highways were not considered. Some 12 to 20 villages were visited before each of the six villages was finally selected for study.

Village selection was facilitated by the collaboration of the All-India Coordinated Research Project on Dryland Agriculture (AICRPDA) research stations

and the local agricultural universities: scientists working in these organizations were of considerable help in selecting the villages. Officials from district offices of the department of agriculture and zilla parishads (town councils) also assisted in the selection of villages, and in initiation of field work in the three districts of Mahbubnagar in Andhra Pradesh; and in Sholapur and Akola in Maharashtra. The selected villages are shown in Table 1 and their locations in Figure 1.

Table 1. Selected villages in ICRISAT's Village-Level Studies.

State	District	Taluk	Village	Distance from Hyderabad (km)
Andhra Pradesh	Mahbubnagar	Kalwakurthi	Aurepalle	70
Andhra Pradesh	Mahbubnagar	Atmakur	Dokur	122
Maharashtra	Sholapur	Mohol	Shirapur (Sholapur)	336
Maharashtra	Sholapur	North Sholapur	Kalman	348
Maharashtra	Akola	Murtizapur	Kanzara	528
Maharashtra	Akola	Murtizapur	Kinkheda	523

General information on selected villages is presented in Appendix Table 1.

Household Sampling Procedures

At the time of the census in May 1975, the total number of households in the six selected villages were: Aurepalle, 476; Dokur, 313; Shirapur, 297; Kalman, 423; Kanzara, 169; and Kinkheda, 143. From these households, a sample of 40 respondent households (30 cultivator and 10 labor) were selected to ensure representation of all categories of households--labor, small farmers, medium farmers, and large farmers. Details of the number of households in each socioeconomic or farm-size category, together with their sampling fractions, are presented in Table 2.

For labor households, a random selection was made from among those who owned less than 0.2 ha of land or no land at all, and those whose main occupation or source of income was agricultural labor. In view of the different man:land ratios, the wide variation in average size of operational landholdings, and land-productivity differences among the selected villages, it was not felt desirable to have a common criterion for classification of farm-size groups in all villages. For instance, the average size of operational landholding varied from 2.6 ha in Dokur to 10 ha in Kalman. Further, nearly 69% of the households in Dokur had landholdings of less than 2.0 ha. The corresponding proportions in Kalman and Kinkheda were 14% and 35%, respectively. The proportions of the total operated area accounted for by farms less than 2.0 ha were 24% in Dokur, 3% in Kalman, and 9% in Kinkheda. Similarly, households operating 8.1 ha or more accounted for 6% of the total farm households in Dokur, 44% in Kalman, and 18% in Kinkheda. Operational landholdings of large farmers

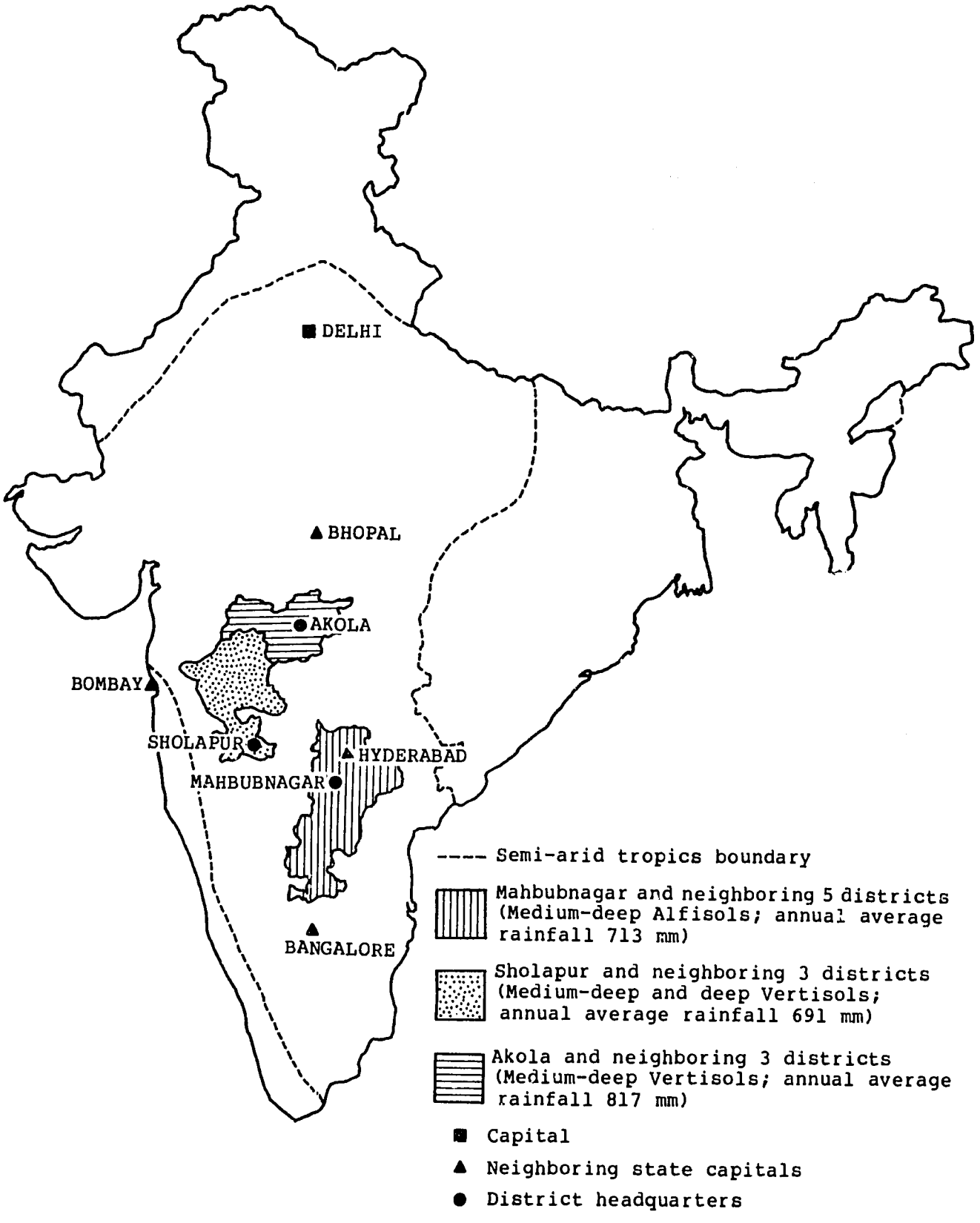

Figure 1. Agroclimatic zones used for village selection in India.

accounted for 39% of the total operated land area in Dokur; 64% in Kalman; and 57% in Kinkheda.

Table 2. Total number of households in various categories in the six selected villages.

Details	Aurepalle	Dokur	Shirapur	Kalman	Kanzara	Kinkheda
Number of households:						
Laborers	146 (30.7)[1]	76 (24.3)	97 (32.7)	156 (36.9)	54 (32.0)	55 (38.5)
Cultivators	322 (67.7)	226 (72.2)	183 (61.6)	211 (49.9)	109 (64.5)	83 (58.0)
Others[2]	8 (1.7)	11 (3.5)	17 (5.7)	56 (13.2)	6 (3.6)	5 (3.5)
Total	476 (100.0)	313 (100.0)	297 (100.0)	423 (100.0)	169 (100.0)	143 (100.0)
Sampling fractions (%):						
Laborers	6.85	13.16	10.31	6.41	18.52	18.18
Cultivators	9.32	13.27	16.39	14.22	27.52	36.14
Others	0	0	0	0	0	0
Total	8.40	12.78	13.47	9.46	23.67	27.97

1. Figures in parentheses are the percentage of households in each category.
2. Includes artisans, shopkeepers, traders, etc.

The criterion for defining farm-size categories was determined by the size composition of landholdings in each village (Table 3). To ensure equal representation of the different farm-size groups, the cultivator group was first divided into three strata, with each stratum having an identical number of households. From each stratum 10 households were selected at random, thus ensuring an equal sampling fraction in each farm-size group.

An agricultural economist with a rural background and who spoke the local language was stationed in each village to interview the panel of 40 households every 3-4 weeks, and to undertake a number of agrobiological investigations. He also acted informally as a participant-observer. His work was supervised through periodic visits by senior staff from the ICRISAT Economics Program.

Data were regularly obtained on cropping patterns, use of inputs, family labor, draft power, incomes, expenditures, assets, liabilities, crop yields, and input and output prices. In addition many ad hoc studies were undertaken as and when the need arose. Examples include measurement of pest, disease, and weed incidence, farmers' attitudes to risk, extent of nodulation in legumes, and experiments on cropping systems.

Table 3. Operational-size[1] categories used to classify farm holdings.

Villages	Small (ha)	Medium (ha)	Large (ha)
Aurepalle	0.20 - 1.21	1.22 - 3.24	>3.24
Dokur	0.20 - 0.89	0.90 - 2.11	>2.11
Shirapur	0.20 - 2.02	2.03 - 5.26	>5.26
Kalman	0.20 - 3.64	3.65 - 8.50	>8.50
Kanzara	0.20 - 1.82	1.83 - 5.26	>5.26
Kinkheda	0.20 - 2.02	2.03 - 4.45	>4.45

1. Operational size was defined as the area of owned land, minus the area leased or sharecropped to someone else, plus the area leased or sharecropped from someone else.

Diet and Nutrition Survey

In October 1976, a diet, nutrition, health, and time-allocation component was added to the VLS, in collaboration with the National Institute of Nutrition (NIN) and the College of Home Science of the Andhra Pradesh Agricultural University (CHS of APAU).

Three postgraduates in nutrition from CHS were recruited for conducting the field study. Of these, two were assigned to collect data in the four Maharashtra villages, and the third in the two Andhra Pradesh villages. Apart from gathering data on food consumption, the investigators also obtained data on time allocation from a subsample of the selected families.

The 24-hour dietary recall method was chosen for the estimation of food intake, although nutrition workers are generally agreed that this method would yield only approximate results (Swaminathan 1974). It is, however, known that extremely simple diets (such as these village diets) yield results of reasonably high validity. Four 24-hour dietary recalls were conducted at intervals of approximately 3-4 months from September, 1976, through January, 1978, on the VLS sample households. The actual dates of each of the four rounds are given in Appendix Table 2.

The recalls were conducted at random on the 40 sample households, and the data recorded on schedules (Appendix Table 3). If the day of the interview happened to be a fast day or a festival day, the investigator returned on another day to collect a "normal" recall. The information collected on fast days and festival days was excluded from the analysis as it was not of principal concern. For the very young, the contribution of breast milk to the nutrient intake was not added because estimation of breast-milk consumption is difficult.

Each investigator was supplied with a set of 13 nested aluminum vessels of graduated sizes ranging from 17 to 2300 ml capacity. They resembled those used by the villagers for cooking. These vessels were used to estimate the amount of raw, cooked, and left-over foodstuffs. Information on the type of preparation, actual ingredients used and their quantity, total quantity of food

cooked, the amount consumed by each family member, and the amount left over were recorded on the schedule designed for the purpose. Subsequently, individual consumption of each foodstuff was calculated in terms of grams per day, using a table showing approximate weights of all cereals, pulses, sugar, groundnuts, milk, and oil in various vessel sizes, and a table showing local measures used in each of the three districts (Appendix Table 4). An example of how the calculations were done is shown in Appendix Table 5.

The nutrient value of diets was calculated using information from Gopalan et al. (1976). The following nutrients were chosen for analysis: protein, energy, calcium, iron, β-carotene, thiamine, riboflavin, niacin, ascorbic acid, lysine, and sulfur amino acids. β-carotene was selected for analysis in the place of vitamin A for several reasons. First, there was almost no preformed vitamin A in the villagers' diets; what little was present came from meat and milk products. Secondly, β-carotene content was listed for nearly all the foodstuffs recorded in Gopalan et al. (1976). The value of preformed vitamin A in foods that contain it was recorded in International Units (IU). Finally, the recommended allowances for Indians were given in terms of either retinol (μg) or β-carotene (μg). It was far simpler to convert the IU of vitamin A, found in meat and milk products, to μg of β-carotene.

Lysine and the sulfur amino acids were the only essential amino acids analyzed, because one of the major aims of the study was to determine whether the diets were deficient in protein and those amino acids. This objective, in turn, was because ICRISAT was endeavoring to develop cultivars of cereals and legumes with enhanced levels of lysine and the sulfur amino acids.

The combined nutrient value of all foods consumed for the period of recall was calculated for each family member. The same values were then converted into percentages of Indian Recommended Daily Allowances--referred to hereafter as RDA (Gopalan et al. 1976)--for each of the seven age-sex groups or physiological states (Table 4). The RDA for moderate workers were considered for calculating the percentage of RDA (Appendix Table 6). Thus, both actual nutrient intake and percentage of RDA were obtained for all individuals. The results were then presented in terms of means, standard deviations, and the percentage of RDA attained by each age-sex group.

Table 4. Age groups and physiological states used for calculating recommended allowances.

1 - 3 years[1]	13 - 18 years, males
4 - 6 years	13 - 18 years, females
7 - 12 years	Adult males Adult females[2]

1. Infants below 1 year were omitted as rarely is a child below that age fed anything other than breast milk.

2. Pregnant and lactating females have been included in the adult-female category. Their different requirements were determined in each case.

For ease of interpretation and to economize on space, the RDA distributions were computed taking into account only the proportion of persons whose nutrient intake was either below 50% of RDA or above 100%. Commencing with Sukhatme's seminal paper in 1974, there has been an increasing debate on the relevance of using a single-valued RDA for a reference individual as the criterion for

Grinding grain for food preparation (above). Allocation of time by household members was monitored in this study through participant observation. Below, information is gathered on food consumption.

determining the nutritional adequacy of protein or energy in diets (Sukhatme 1981 and 1982; Sukhatme and Margen 1978; and Seckler 1979 and 1980). It would thus appear that intraindividual variation constitutes the most fundamental variation in both energy and nitrogen balance in man. "When intra-individual variation in energy balance is the fundamental source of variation and the successive values can be generated by an autoregressive process, such as Markov, it means that there is no absolute energy requirement for any day or period. It simply means that the individual is in homeostasis, and that his requirement is controlled by a regulated system." (Sukhatme 1982.)

Operationally, this implies that the critical level of RDA should be established two or three standard deviations below the RDA for a reference individual. It is only when a person's intake continually remains below such a critical level that functional impairment may result. Until that critical level is reached, an individual's requirements adapt themselves to his intake. Intakes can vary as a matter of course from week to week for the same individual with coefficients of variation of 10 to 20% without loss of function, body weight, or activity levels. Therefore, the critical RDA levels for protein, energy, and amino acids were set 50% below the RDA for the reference individuals in Gopalan et al. (1976) (Appendix Table 6). It is recognized that the use of the 50% RDA criterion is a rough approximation and that, ideally, the percentage should vary among nutrients.

Considerable losses in vitamins result from excessive use of heat and water for cooking, storage, washing, soaking, and exposure to light. A study by Pushpamma and Geervani (1981) estimates these losses to be between 20 and 70%, depending on the recipe and the method used for preparation, processing, and cooking. No attempt was made to adjust for such losses while assessing the adequacy of vitamin intakes among these villagers. To this extent, data on deficiencies of these nutrients are probably underestimated. As cooking generally enhances the availability of proteins--especially from pulses--failure to make a similar adjustment would lead to overstatement of the extent of protein deficiency in the subsequent analysis.

Anthropometry and Clinical Assessments

The clinical and anthropometric status of respondents in the Andhra Pradesh villages was assessed by a medical officer of the NIN. A Marathi-speaking doctor was specially recruited by ICRISAT to monitor the Maharashtra villages. He was initially trained at the Division of Field Studies of the NIN to measure heights, weights, arm circumference, and skinfold thickness at the triceps. He was provided with standardized anthropometric equipment and nutrition assessment schedules used by the National Nutrition Monitoring Bureau of the NIN.

The anthropometric measurements of all the members of a family were taken. Each member of the family was examined by the doctor for signs of nutritional deficiency during the four examinations that corresponded with the period of the four dietary surveys. Other abnormalities were also recorded in the nutrition assessment schedule (Appendix Table 7).

Weight was recorded to the nearest 1/10th of a kg, using a beam balance scale. The subjects had their clothes on when their measurements were taken. The clothing comprised light-weight sarees, "dhotis", and "kurthas" in the case of adults; and shirts, short pants or skirts in the case of children. The subjects were weighed without footwear. No adjustments were made to compensate for the differences due to clothes while analyzing the data. Infants and young children, who did not cooperate, were held by a family member and their weights recorded.

Height was measured to the nearest 1/10th of a centimeter using a vertical metal anthropometer. For infants and children who could not stand, recumbent length was taken using a metal "length board".

Arm circumference was recorded to the nearest 1/10th of a centimeter using a fiberglass tape.

Triceps skinfold thickness was obtained using Harpenden calipers and recorded to the nearest millimeter.

The four basic anthropometric indices were analyzed in several different ways, using both Hyderabad and Western standards. The Hyderabad data were supplied by the NIN and they represented "expected" heights and weights of girls up to the age of 19 and boys up to the age of 21 (Appendix Tables 8 and 9). These data were derived from Hyderabad children from diverse ethnic and socioeconomic backgrounds but belonging mostly to the high-income groups. As no specific standards exist for adult men and women of Indian origin, the uppermost weight- and height-for-age for each sex was used as the standard. The "expected height" and "expected weight" for age were nearly identical with the 50th percentile of the Harvard standards.

Weight-for-height (or weight-for-length in very young children) was calculated using standards derived from Harvard standards and cited by Jelliffe (1966). For adults, standards of the Society of Actuaries, which were modified by ICNND and Bridgforth, (Jelliffe 1966) were used. Appendix Table 10 lists the measurements, the age-group to which they apply, and the source of the standards for each measurement.

Time Allocation

Information on the allocation of time by each member of the family for different tasks in and outside the house was collected in three rounds: the first in November, 1976; the second in March, 1977; and the third in June-August, 1977.

A subsample of 12 households, three from each of the four landholding classes (laborers, small farmers, medium farmers, and large farmers), were selected by random sampling procedures. These four classes were, however, subsequently regrouped into three. As a result, of the 12 households studied, 6 were labor and small-farm households, 3 medium-farm, and 3 large-farm households.

All family members except children below 6 years were included in the time-allocation study. For analysis, respondents between 6 and 12 years were classified as children, and those above 12 years were separated into males and females. The investigator recorded the activities of each member of the family for a full day of 24 hours employing the method of participant observation. But all data, relating to the late evenings and early mornings, were obtained by recall, as well as some data obtained during midday.

Activities normally performed in these areas both in and outside the house were coded in 15-minute intervals from a list of 27 possible activities (Appendix Table 11). While tabulating data these activities were grouped into eight categories, as follows.

1. Agricultural
2. Domestic
3. Leisure
4. Personal care
5. Child care

To determine what priority ICRISAT should accord nutritional components in its research, particularly in plant breeding, data on individual dietary intakes and anthropometric measurements were collected in six villages of southern India. Measuring skinfold thickness using Harpenden Calipers (top left); checking for clinical symptoms of nutritional deficiencies (top right); determining height with the help of a vertical metal anthropometer (bottom left); monitoring how members of a household use their time (bottom right).

6. Schooling
7. Community
8. Religious and social

Sometimes, a member of the household may have been involved in more than one activity at one time. Several such joint activities are listed below.

a. Cooking and child care
b. Cooking and processing
c. Cooking and cleaning the house
d. Cooking and washing clothes
e. Cooking and repairing clothes
f. Cooking and tending animals
g. Cooking and collecting water
h. Serving and eating food
i. Serving food and repairing clothes
j. Processing and child care

Each of the activities listed above generally relates to the main category of domestic activities, except cooking and child care, cooking and tending animals, and processing and child care. In these three cases, the activity that requires the full attention of the family member was considered to be the main activity for the purpose of analysis. For example, the total time spent on a joint activity, such as cooking and child care, was classified as child care.

Methods of Analysis

The results of the diet and nutrition survey, and the anthropometric analysis for four regions, three farm-size categories, and two seasons are presented below. For the time-allocation data, season was not considered.

Regions. The six study villages were grouped into the following four regions:

Village(s)	Region
Aurepalle	Aurepalle
Dokur	Dokur
Shirapur and Kalman	Sholapur
Kanzara and Kinkheda	Akola

This grouping was based on dissimilarities/similarities in the agroclimatic and socioeconomic characteristics of the villages. The villages in Akola and Sholapur districts have similar characteristics and hence were considered as one region. Although Aurepalle and Dokur villages are in the same district, they were classified as different regions mainly because of variations in the extent of irrigation and in soil types.

Farm size. The original sample consisted of 10 households each from labor, small-farm, medium-farm, and large-farm households. The labor and small-farm households were categorized as one group for analysis. Hence, in all there were three farm-size categories: labor and small farm (20 households); medium farm (10 households); and large farm (10 households).

Season. Although the diet survey was conducted four times at intervals of between 2 and 6 months from September 1976 through January 1978, the results of the analysis are presented for two seasons: lean and surplus. These two seasons were formed by grouping the data collected from different rounds of the diet and nutrition survey. The categories "lean" and "surplus" were based on the availability of food from crop harvests, which in turn depend on cropping

patterns (Appendix Table 2).

In the regression analysis for the determinants of nutrient intake and nutritional status of 1-12 year-old children, the following variables were used: sex, age, family size, education of the mother, morbidity, degree of disability, birth order, the mother's participation rate in the daily labor market, caste rank, and net household income.

Sex. In the case of a male child, this variable took the value of unity, "0" otherwise.

Age. Age was first recorded by the economic investigators in May 1975, the time the initial household census was taken in each village. The age for each family member was provided by the adults in the family. These were updated every year. The subjects were grouped into the seven age-sex groups based on their age at the time of each round of the diet/health survey.

Family size. Family size was recorded as the total number of members comprising a family. It also included permanent servants and attached laborers.

Education of mother. The mother's education, the variable included in the regression analysis as a dummy, takes the value of unity if the mother has had any education and "0" otherwise. A majority of women in the villages had no education, and those who did, had had for the most part only 1-3 years of education.

Morbidity. Two types of morbidity were included in the study: nutritional and nonnutritional. Data on this variable were obtained from the clinical asssessment schedules, and it was used as a dummy variable. The presence or absence of nutritional and nonnutritional morbidity signs were taken into consideration. The variable took the value of unity if morbidity signs were evident, and "0" otherwise. The data on morbidity were probably among the least reliable.

Degree of disability. Degree of disability was used as a dummy variable. It indicates whether the child was suffering from any permanent disability and, consequently, unable to work--a fact ascertained from its parents.

The codes for the different degrees of disability were as follows.

<u>Code</u> <u>Description</u>

1. Can do any farm or domestic work
2. Can do only domestic work
3. Can do light farm work (e.g., watching)
4. Can do only light domestic work (e.g., sweeping and child care)
5. Cannot do any farm or domestic work (completely disabled)

If a child was recorded as a code 5 case, it means that it has been classified as "disabled" and takes the value of "0". If recorded under any of the other codes (1 through 4), it means that it has been classified as an "able" child, and the disability dummy takes the value of unity. Code 5 was also used for small children who were not disabled but were too young to work.

Birth order. To determine whether the order of birth had any effect on the nutritional status of the children, the birth order of each child was noted. The eldest child was given a value of 1, the second eldest a value of 2, and so on.

Participation rate of mother. The mother's participation rate in the daily

labor market was recorded for both peak and slack seasons. An average of the two was used as a variable in the regression analysis.

Caste rank. All castes within each village were ranked by the resident economic investigator and the local village leader (patwari). Modifications were occasionally made after discussions with ICRISAT's Principal Social Anthropologist, V.S. Doherty. Later, with the help of J.R. Behrman of the Economics Department of the University of Pennsylvania, a percentage categorization was devised to enable comparison of castes, and attain uniformity across villages, since not all had 12 castes represented. The complete caste categorization with the actual name of each caste and the traditional occupation for all villages is given in Appendix Tables 12-17. Table 5 provides an example of the method used to derive the caste rank. The caste ranks so derived were used as a variable. It indicates the percentage of the village population falling in a lower caste group than the household being observed.

Table 5. Example of new caste rank calculation (N=40).

Original caste rank	No. of families	Percentage	Range	Mean (new caste rank)
1	8	20.0	80.0 - 100.0	90.00
2	6	15.0	65.0 - 80.0	72.50
3	3	7.5	57.5 - 65.0	61.25
4	8	20.0	37.5 - 57.5	47.50
5	10	25.0	12.5 - 37.5	24.50
6	5	12.5	0.0 - 12.5	6.25

Net household income. Net household income consists of annual gross household income less the cost of crop production, cost of maintaining livestock and machinery, cost of raw materials, cost of family labor and owned bullocks, and interest paid on borrowed capital (Appendix Table 18).

Diet Composition

To obtain an overall picture of the predominant foods that comprise diets and the intakes of key nutrients, tabular analysis has been used. Data are presented for four regions, three farm-size groups, two seasons, and seven age-sex categories, and refer to consumption over a 24-hour period. Results in this and the next section are based on 4756 observations (Table 6) relating to the VLS sample households. In the rest of this report reference will be made only to the village and/or region when describing results. Unless otherwise stated, reference is to data from the sample households.

The dominant staple in diets of Aurepalle and Dokur residents in Andhra Pradesh was rice; more so in Dokur where almost half of the arable land had tank and well irrigation facilities. In contrast, residents of the Maharashtra villages relied primarily on coarse grains (Tables 7-10). Seasonal variation in rice consumption was much less in Aurepalle and Dokur than was the case with coarse cereals in both these and the Maharashtra villages. The surplus food-grain seasons in the Andhra Pradesh villages are in the dry season, while the lean seasons are mostly in the monsoon season (Appendix Table 2). In

Sholapur, the surplus seasons are dry, whereas the lean seasons occur in both the wet and dry seasons because of the monsoon fallowing practiced there. The lean seasons in Akola are exclusively in the monsoon season while surplus seasons occur in both wet and dry seasons. Cropping intensity was higher with irrigated paddy in the two Andhra villages, indicating that there are 2-3 harvests in a year and less seasonality in the intake of major cereals. This confirms the observations of Schofield (1974) and of Longhurst and Payne (1979) that seasonal variation in food intake is less in villages with more harvests per year. Storage losses in paddy are also generally less than in coarse grains. That apart, paddy was generally available in markets throughout the year. These factors help explain the relative lack of seasonal variation in rice consumption in the Andhra villages.

Table 6. Number of dietary recall observations recorded in the four regions.

		Region			
Age group	Farm-size group	Aurepalle	Dokur	Sholapur	Akola
1-3	Landless labor and small farm	30	22	20	36
	Medium farm	17	10	37	24
	Large farm	6	21	25	38
4-12	Landless labor and small farm	128	81	190	206
	Medium farm	39	21	127	79
	Large farm	54	67	122	144
13-18	Landless labor and small farm	72	57	88	100
	Medium farm	14	14	52	44
	Large farm	40	43	105	68
Adults	Landless labor and small farm	176	236	313	393
	Medium farm	104	76	246	184
	Large farm	125	135	260	267
	Total	805	783	1585	1583
	Grand total	4756			

The Akola villages consumed significant amounts of wheat, particularly in the surplus seasons. In Sholapur, other cereals such as maize accounted for a significant portion of total cereal consumption, particularly in the lean season. In Aurepalle and the Akola villages, cereals other than rice, wheat, pearl millet, and sorghum were not consumed.

Table 7. Daily mean intake of food items for Aurepalle region (g/caput/day).

Food items	Age group (in years)													
	1-3		4-6		7-12		13-18 Males		13-18 Females		Adult males		Adult females	
	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus
Rice, wheat	116.6	121.5	196.0	185.4	278.0	236.0	386.3	298.5	385.2	308.7	409.2	370.2	376.7	285.3
Pearl millet, sorghum	42.0	110.8	45.7	156.3	58.4	224.5	109.2	295.3	73.7	240.3	104.6	274.6	83.3	299.5
Other cereals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigeonpea, chickpea	3.9	4	6.1	2.1	9.0	5.4	7.6	4.6	18.2	11.6	14.5	9.3	8.2	7.2
Other pulses	2.2	6.9	1.0	4.1	2.3	6.1	8.4	3.8	1.1	7.0	3.1	7.2	2.3	5.1
Leafy vegetables	3.4	1.1	2.9	1.7	1.9	2.8	4.7	4.0	4.9	2.1	3.9	0.6	5.6	2.1
Roots, tubers	3.1	2.7	5.8	3.0	10.0	4.9	15.2	7.0	15.8	6.8	15.9	10.5	11.9	7.4
Other vegetables	14.2	59.9	23.9	70.3	26.7	80.6	16.3	95.3	19.7	77.5	29.2	119.3	25.8	107.8
Groundnuts	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other nuts, oilseeds	0.3	0.5	0.3	1.0	0.2	1.2	0.1	1.3	0	1.5	0.2	2.1	0.2	1.9
Groundnut oil	1.2	0.9	2.9	3.2	2.3	3.5	2.5	1.9	4.1	2.0	3.3	3.7	3.5	2.9
Other oils, fats	0	1.9	0.2	0.1	0.3	1.9	0.5	1.1	0.2	2.4	0.2	1.4	0.3	2.0
Fruits	0	0.1	0	0.1	0	0.1	0	0	0	0	0	0.3	0	0.4
Condiments, spices	4.5	0.8	6.1	0.9	8.4	2.5	11.2	3.1	8.2	4.6	9.7	3.7	9.3	3.9
Fish and fleshy foods	0	0	0.2	0	1.01	0	2.7	0	0.3	0	0.8	2.3	0.3	0.6
Milk, milk products	32.3	62.4	60.6	40.2	105.7	111.4	69.7	166.6	162.0	156.7	135.5	162.1	110.0	108.2
Sugar and jaggery	2.4	2.1	2.0	0.9	4.2	2.3	3.5	0.4	3.2	3.0	3.0	2.4	2.8	1.9
Miscellaneous	0	0.3	0	0.2	0.3	0	0.3	0.7	0	0	0	0.5	0	0.7
Toddy	17.8	0	29.3	0	57.7	5.7	166.2	0	165.0	23.6	374.7	53.2	282.9	74.8
Betel leaves	0	0	0	0	0	0	0	0	0	0	0	0	1.0	1.0

Table 8. Daily mean intake of food items for Dokur region (g/caput/day).

Food items	Age group (in years)													
	1-3		4-6		7-12		13-18 Males		13-18 Females		Adult males		Adult females	
	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus
Rice, wheat	161.6	226.7	310.3	333.5	427.1	450.2	568.3	592.5	487.4	547.0	570.9	494.6	539.6	609.4
Pearl millet, sorghum	10.9	13.3	36.0	91.7	9.5	26.7	18.4	27.7	17.4	39.3	44.1	33.6	33.7	22.1
Other cereals	10.1	2.3	4.4	8.6	31.5	15.7	48.4	18.3	18.8	16.4	15.0	19.1	14.8	20.8
Pigeonpea, chickpea	8.1	7.6	28.4	14.3	22.3	8.3	43.0	14.6	28.8	16.2	35.3	13.3	24.4	11.1
Other pulses	0	0	0	0	0	1.0	0	0.7	0	0	0	0.6	0	0.1
Leafy vegetables	0	0.2	0	1.2	2.8	0.7	4.6	1.8	15.6	3.5	4.2	1.9	5.6	1.4
Roots, tubers	11.5	8.5	15.8	10.0	20.8	12.3	26.2	12.7	23.9	18.8	29.8	20.7	25.4	19.7
Other vegetables	16.0	10.8	24.5	21.3	9.7	23.2	30.2	17.0	8.6	29.3	22.4	33.3	23.1	29.3
Groundnuts	0	0	0	0	0	0.3	0	0	0	0	0	0.4	0	0.3
Other nuts, oilseeds	0	0.5	0	0.4	0	0.9	0	0.7	0	1.7	0	1.4	0	1.5
Groundnut oil	1.8	1.3	2.9	2.5	3.3	2.9	7.6	3.9	4.1	4.2	5.9	4.7	4.2	4.3
Other oils, fats	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fruits	0	1.2	0	0.8	0	0.2	0	0.8	0	0	0	0.3	0	0.5
Condiments, spices	5.4	4.4	9.6	6.3	16.9	8.8	26.5	13.7	17.2	13.5	18.8	13.5	16.8	12.1
Fish and fleshy foods	2.3	2.5	3.9	8.3	11.3	5.7	19.4	20.2	28.9	15.7	23.5	17.4	11.9	13.8
Milk, milk products	20.2	20.9	36.8	39.5	11.6	22.6	31.8	29.5	25.7	52.2	49.9	32.6	18.3	23.6
Sugar and jaggery	2.0	2.6	5.0	4.2	2.9	3.8	3.6	2.3	5.4	5.1	4.1	4.6	2.8	4.4
Miscellaneous	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Toddy	0	0	0	0	0	0	0	0	0	0	56.9	33.4	23.3	20.6
Betel leaves	0	0	0	0	0	0	0	0	0	0.1	0	0	0.7	0.7

Table 9. Daily mean intake of food items for Sholapur region (g/caput/day).

Food items	Age group (in years)													
	1-3		4-6		7-12		13-18 Males		13-18 Females		Adult males		Adult females	
	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus
Rice, wheat	6.8	3.5	11.2	0.7	12.0	6.7	39.0	16.8	23.1	6.4	22.6	14.5	27.0	10.7
Pearl millet, sorghum	115.9	139.1	179.6	289.7	258.2	389.7	357.3	610.4	353.8	482.9	394.8	597.0	338.1	551.5
Other cereals	48.5	0	93.3	0	93.5	0	117.2	0	85.6	0	149.0	0	134.4	0
Pigeonpea, chickpea	10.0	16.2	12.9	22.3	17.2	27.8	31.4	38.0	15.7	28.5	21.9	31.2	22.0	32.8
Other pulses	2.7	0	4.4	0.4	4.8	2.9	6.9	2.3	4.7	0.8	6.0	3.0	6.0	2.4
Leafy vegetables	2.5	0.4	6.3	1.4	4.8	2.6	4.5	3.8	9.2	1.7	8.[illegible]	2.4	6.9	2.1
Roots, tubers	3.4	2.6	8.7	3.6	10.0	6.5	13.8	5.9	10.5	11.1	10.3	8.9	10.1	9.7
Other vegetables	3.8	3.2	6.9	7.4	10.9	9.1	8.9	17.3	15.1	11.0	15.7	15.5	14.0	13.1
Groundnuts	3.3	1.5	9.1	2.3	10.5	5.5	13.1	6.5	18.6	5.3	13.8	6.6	16.8	5.8
Other nuts, oilseeds	0	0	0	0.3	0	0	0.2	0.7	0.2	0	0	0.1	0.4	0.5
Groundnut oil	1.4	1.1	1.7	2.4	2.2	2.8	3.5	4.7	2.5	3.3	3.5	3.6	3.2	4.4
Other oils, fats	0	0	0.1	0	0	0	0	0	0.1	0	0.1	0	0.1	0
Fruits	0	0	0.5	0	0.9	3.9	0.1	3.6	0.5	3.9	1.0	0.5	0.7	2.2
Condiments, spices	4.0	2.5	5.2	3.6	6.5	7.0	7.4	8.2	8.4	7.0	9.3	8.1	8.9	8.6
Fish and fleshy foods	0	0	0	0	0	1.4	0	3.4	0	3.7	0	2.5	0	4.4
Milk, milk products	82.6	105.6	50.1	55.5	37.4	37.3	42.1	33.1	37.6	48.9	34.4	37.0	36.2	35.5
Sugar and jaggery	33.7	30.0	40.6	29.6	41.0	29.0	45.8	35.0	45.4	29.8	50.1	33.5	49.6	37.9
Miscellaneous	0	0	0	1.6	0	0	0	0	0	0	0	0	0	0
Toddy	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Betel leaves	0	0	0	0	0.1	0	0.3	2.9	0.1	0.2	1.9	17.4	0.9	4.8

Table 10. Daily mean intake of food items for Akola region (g/caput/day).

Food items	Age group (in years)													
	1-3		4-6		7-12		13-18 Males		13-18 Females		Adult males		Adult females	
	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus	Lean	Surplus
Rice, wheat	45.8	36.6	19.1	44.1	28.3	56.2	13.6	91.5	45.4	98.6	58.3	121.4	56.3	113.0
Pearl millet, sorghum	127.5	87.7	341.7	224.7	403.5	315.6	681.8	443.4	540.7	396.7	662.0	488.4	573.8	393.1
Other cereals	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pigeonpea, chickpea	14.0	17.4	22.4	35.5	31.3	38.7	37.5	42.8	27.9	47.3	34.5	54.1	32.3	51.1
Other pulses	3.5	2.9	5.9	5.0	8.8	6.4	6.6	9.4	8.3	9.8	8.9	8.9	8.2	8.1
Leafy vegetables	0	0.6	1.4	0.5	0.8	1.0	2.3	1.0	0	1.2	3.3	2.1	2.0	1.1
Roots, tubers	6.7	3.6	13.5	8.7	14.1	14.4	27.6	23.4	17.5	15.5	24.8	22.5	23.9	21.9
Other vegetables	13.9	5.7	14.1	10.8	15.1	13.7	10.8	21.7	15.5	18.7	15.9	22.2	21.5	22.0
Groundnuts	0.5	6.9	4.6	12.6	14.3	16.5	8.3	15.0	8.0	14.4	10.1	12.0	10.2	14.2
Other nuts, oilseeds	0	0	0	0	0	0.1	0	0	0	0	0	0.2	0	0.2
Groundnut oil	1.7	4.5	4.7	6.6	6.2	9.5	6.5	11.0	7.0	10.7	8.0	14.1	7.4	13.0
Other oils, fats	0	0.5	0	1.2	0	0.6	0	0.4	0	0.7	0	0.5	0	0.9
Fruits	2.5	7.7	0.3	8.3	0.1	5.4	0.6	12.6	0.1	8.6	0.8	8.4	1.0	6.2
Condiments, spices	1.8	2.6	4.2	3.8	4.6	4.9	6.0	6.5	5.3	7.2	7.2	8.1	7.1	7.1
Fish and fleshy foods	0	0	1.5	1.1	1.2	2.0	1.0	3.2	2.1	0.6	4.3	4.0	2.4	2.5
Milk, milk products	94.8	122.4	63.8	63.7	47.2	44.6	55.9	52.7	54.1	62.9	54.4	63.3	56.6	63.2
Sugar and jaggery	38.7	37.6	54.7	55.9	49.8	48.2	59.2	61.7	69.7	52.3	70.6	63.2	74.9	64.3
Miscellaneous	3.8	1.1	0	0	1.8	1.9	0	0	0	0	0.8	0.4	0.7	0.9
Toddy	0	0	0	0	0	0	0	0	0	0	0	0.3	0	0.5
Betel leaves	0	0	0	0	0	0.1	0.9	0.7	0.2	0.4	2.0	2.0	1.3	2.2

Daily per caput pulse consumption in the Andhra villages was about half that of the Maharashtra villages.[1] The average cereal:pulse ratios were as follows.

Aurepalle 35 : 1	Sholapur 16 : 1
Dokur 25 : 1	Akola 11 : 1

The ratio recommended by NIN ranges from 3:1 to 6:1, indicating that the diets of people in these villages was not well balanced. Perhaps there is scope for bringing about changes in cropping patterns, particularly in the Andhra Pradesh villages so that more pulse crops are produced. No major differences in the composition of the dietary cereal staple within the villages and across farm-size groups were observed. According to Poleman (1981), at a point along the income scale, the composition of the dietary starchy staple changes. This point, he contends, is indicative of behavior reflecting the absence of perceived nutritional deprivation. The present study indicates that differences in the agroclimatic environment from village to village primarily determine the choice of the starchy staple.[2] We have not measured changes in quality mix that rising incomes naturally bring about.

Consumption of vegetables, although very low, was subject to substantial seasonal variation in all villages. Generally, vegetable consumption was reduced, especially among children, in the surplus food-grain seasons. In a majority of villages, surplus periods were mostly in the dry season. The need for vitamins increases with the rise in intake of food grains, and vitamin deficiencies can result if diets do not contain adequate amounts of "protective foods" rich in vitamins and minerals. These findings suggest that such imbalances may be more frequent in the surplus season even though, as Chambers (1982), Longhurst and Payne (1979), and Schofield (1974) point out, in these surplus (i.e., dry) seasons, total food availability may be better. The National Nutrition Monitoring Bureau (NIN 1981a) has estimated average daily intakes of leafy vegetables to be 26 g per consumption unit in Andhra Pradesh and 10 g per consumption unit in Maharashtra. Figures derived in the present study for these states are a fraction of these.

Consumption of nuts, oils,and fats rarely exceeded 20 g per head per day, and was ofen less than 1 g. Fruits were virtually absent from diets, except in the Akola villages. Condiments and spices were popular among all age groups in all villages. Consumption of fish and fleshy foods was significantly higher in Dokur, no doubt because of its irrigation tanks--a source of fish. Aurepalle villagers showed a consistently higher consumption of milk and milk products, comparable to the National Nutrition Monitoring Bureau's figure for Andhra Pradesh--121 ml per consumption unit (NIN 1981b). Milk was consumed mostly in the form of buttermilk and with tea. Proximity to Hyderabad city has encouraged dairy production in Aurepalle, and this was reflected in its higher consumption of dairy products.

Sugar and jaggery consumption was much greater in Sholapur and Akola compared to Aurepalle and Dokur.[3] This is a reflection of the fact that

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1. The National Nutrition Monitoring Bureau (National Institute of Nutrition 1981a) reported a figure of 72% using state averages.
2. According to Poleman, starchy staple adjustments probably become evident only at quite high levels of income. This may be the reason why we did not observe them in these low-income villages (Singh et al. 1982).
3. Sugar and jaggery consumption in the two Maharashtra villages was somewhat higher than the 32 g per consumption unit per day derived for Maharashtra by the National Nutrition Monitoring Bureau (NIN 1981b). Consumption in the two Andhra villages is about one-quarter of the National Nutrition Monitoring Bureau's figure for Andhra Pradesh: 15 g.

sugarcane occupies a significant portion of the irrigated land in Maharashtra. Toddy was consumed only by the Andhra villagers, and was highest in Aurepalle. Even children consumed significant amounts of toddy in Aurepalle, mostly in its sweet form.

Nutrient Status

It seems clear from the analysis of mean intakes of energy and associated nutrients, as well as from the proportions receiving less than 50% of the RDA for Indians (Gopalan et al. 1976), that there are major deficiencies of energy, vitamins, and minerals in the diets of these villagers.[4] (Appendix Tables 19-50.) Fat consumption is also extremely low.

Average protein intakes exceeded the RDA in all cases except among 13-18 year-olds in the Andhra villages. There was little difference among the farm-size groups. There was a marked seasonal variation in protein intake in Aurepalle as reflected in the t-values shown in the last column of Appendix Table 19. There was some suggestion of this in Akola and Sholapur but none in Dokur. Major protein inadequacies were seen among the 1-3 year-olds regardless of which farm-size category they belonged to. However, the data exclude the contribution from breast milk, which the Indian Council of Medical Research (ICMR 1974) has estimated to be between 2-5 g per day. If this is taken into account and the data adjusted accordingly, there would likely be little evidence of dietary protein deficiency even among 1-3 year-olds.

Mean energy intakes per day fell short of the full RDA for children 1-3 years of age (see Appendix Table 6) in all villages. Even if the contribution of breast milk--between 130 and 280 calories--were added, the mean energy intake would still remain below the 100% RDA. This finding is consistent with results of other studies (Rao et al. 1969). As age increases energy inadequacies tend to decline slightly. In Akola, energy was significantly more adequate in the so-called lean food-grain availability season. In the other regions, there was either no seasonal trend or a slight improvement in the surplus season. The lean season in Akola falls in June-July when landless laborers can find employment with relative ease. This period also sees payments for the cotton harvest beginning to arrive. As cotton is the major cash crop in this region, receipt of proceeds from it possibly had a substantial effect on food consumption. This seasonal effect, together with the generally better overall nutrient status of the Akola villagers, suggests that emphasis on cash cropping had no adverse effect on their well-being in terms of nutrition; Schofield's (1974) review of village nutrition studies suggests that it would.

β-carotene was a limiting nutrient in all regions and across all age- and farm-size groups.[5] Consumption among almost all villagers was less than 50% of the RDA, and there was little statistical evidence of any seasonal variation in the extent of inadequacies except among adult males in Sholapur. In the surplus season of April in this region, adults consume increased quantities of coarse grains and betel leaves, both rich sources of β-carotene (Table 9).

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4. The 50% RDA criterion is used to allow for the fact that individuals can vary intakes of energy and protein by ±30% of average RDA in a self-regulating manner over successive periods and not have vital functions impaired (see earlier discussion on p. 11).
5. β-carotene, a precursor to vitamin A, was measured in this study because it is mainly derived from vegetable sources which are the predominant precursors of vitamin A in Indian diets, rather than from fleshy foods which contain preformed vitamin A. The vitamin A content of fleshy foods and dairy products was converted into units of β-carotene.

Thiamine intake was well below the RDA in Dokur in both the lean and surplus seasons, and in Aurepalle in the lean season. Except among 1-3 year-olds there was little evidence of inadequacy in thiamine intake among the Maharashtra villagers. The predominance of coarse grains and pulses in Maharashtra diets no doubt explains the thiamine adequacy in that region. The marked and statistically significant improvement in thiamine intake in Aurepalle in the surplus food-grain season was apparently due to the greater proportion of coarse grains in respondents' diets in that season (Table 7).

Riboflavin was uniformly lacking in all diets, particularly in those of children. The situation was worst in Dokur. Intake of riboflavin was significantly better in the surplus than in the lean season in Sholapur, due largely to increased consumption of coarse grains and pulses in the surplus season; elsewhere, little seasonality in intake was evident.

Respondents from all age groups in all villages showed major deficiencies in ascorbic acid (vitamin C) intake. In Aurepalle, while increased consumption of chutneys made from cucumber, tamarind, and chillies in the surplus season led to significantly improved ascorbic acid intake, it was not adequate to alleviate the extreme dietary inadequacy.

The RDA for lysine was found to be firmly established only for 10-12 year-old children and adults. Applying the RDA suggested by the World Health Organization (WHO 1973), the only village with any possible lysine inadequacy was Aurepalle in Andhra Pradesh, where the 10-12 year-olds showed some deficiency, especially in the lean season. Reduced lysine intake did not appear to pose a problem for adults in any of the villages. Lysine intakes seemed significantly better in the lean season among families in the Akola region, especially those who were landless or owned small farms. This was, no doubt, due to their increased coarse-grain consumption in lean seasons (Table 10). No marked seasonal patterns were evident in the other regions.

Sulfur amino acids (SAA)[6] were, generally, not deficient in the diets of any region, although a small problem was found to exist among large-farm families in Aurepalle. No seasonal variation in intakes of SAA occurred in either Dokur or in the Sholapur villages, although adults in the Akola villages tended to consume significantly more in the lean season.

The foregoing analysis suggests that the diets in these six villages are mostly deficient in β-carotene, riboflavin, ascorbic acid, and energy.[7] As is increasingly being found by studies on nutrition in India, protein or essential amino acids were, generally, not the limiting nutrients in diets; the diets of Aurepalle residents were a possible exception.[8] Hence, there may be little nutritional value in improving protein quality and/or enhancing protein content in existing diets through either plant breeding or fortification programs. Experiments on animal feeding, such as those by Heard et al. (1977), Jansen and Verburg (1977), and Jansen and Monte (1977), have demonstrated that improving protein quality can help enhance growth, brain development, and efficiency of nitrogen utilization when there is energy deprivation. However, instances of

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6. Recommended daily allowances for 10-12 year-old children were taken from West et al. (1966), and for adults from WHO (1973).
7. Calcium was also found to be limiting in diets of certain socioeconomic groups in some villages, but these results are not reported here.
8. For example see Rao et al. (1969), Indian Council of Medical Research (1974, p. 37), National Institute of Nutrition (1982b), and Operations Research Group, Baroda (1971).

protein and amino acid deficiencies in the six villages were few, even in the presence of significant energy deficiencies. Protein fortification or improvement, under these circumstances, would seem of doubtful value.

Wherever the vitamins (mentioned earlier) are limiting in diets, it is questionable whether augmenting energy intakes alone will significantly improve nutritional well-being. The National Institute of Nutrition (NIN 1982a) points out that the incidence of vitamin B complex deficiency signs is greater in calorie-supplemented groups, probably because requirements of some B complex vitamins depend on calorie consumption. However, further research on these interactions is needed before firm conclusions can be made, as Prasad (1981) indicates.

Relative Nutrient Status

To determine whether nutritional status was correlated among individuals across the four rounds when data were obtained, rank correlation coefficients were calculated. Each individual's energy intake as a percentage of his/her age- and sex-specific RDA was used to rank ordinally the individuals in each of the four rounds. Thereafter, the six pairwise comparisons of the rankings were made using the Spearman rank correlation coefficient to see whether those individuals who ranked the highest in terms of percentage RDA in one round also tended to rank highest in the other rounds.

The coefficients were all very low, most of them ranging between 0.10 and 0.20 and none above 0.50 (Table 11). In Aurepalle and Sholapur few of the rank correlation coefficients were statistically significant, implying thereby that relative energy deficiencies in these villages are not-long lasting. In Dokur and Akola, the two areas which have more assured moisture regimes, with Dokur having extensive irrigation and Akola a relatively dependable rainfall pattern, relative deficiencies tended to be longer lasting than in the other two regions, except in the case of 13-18 year-old males and females. Apparently, the more risky the agroclimatic and socioeconomic setting of a village, the less likely the chances of finding individuals with hardcore energy deficiencies that linger across the seasons. According to these findings, individuals in such villages apparently move up and down the relative nutritional-adequacy scale in a somewhat random fashion.

Table 11. Number of significant rank correlation coefficients of individual energy intakes as a percentage of RDA, using six comparisons by pairs of the rounds during which data were collected.[1]

Age-sex groups (in years)	Region				All regions	Range of correlation coefficients[2]
	Aurepalle	Dokur	Sholapur	Akola		
1-12	Nil	2	Nil	4	6	0-0.33
13-18 Males	Nil	Nil	Nil	Nil	2	0.03-0.48
13-18 Females	Nil	1	1	Nil	1	0-1.00[3]
Adult males	Nil	1	Nil	1	4	0.01-0.31
Adult females	2	5	1	2	5	0.01-0.50
All	3	5	Nil	5	6	0-1.00[3]
(N)	(146)	(140)	(329)	(278)	(893)	

1. The significance level for the rank correlation coefficients was chosen as 5%.
2. Corrected to two decimal places including positive coefficients only.
3. Since this was based on only three observations it should be discounted.

When data on individuals from all regions were pooled and the rank correlation coefficients calculated, the values were mostly significant except again in the case of the 13-18 year-olds. Apparently teenagers in these villages have more transitory energy balances than either younger children or adults. When age-sex groupings were ignored, all six coefficients were statistically significant, with a range of 0.16 to 0.24, which is still quite low. The greater degrees of significance of the coefficients when the data from the four regions were pooled, suggest that the characteristics of villages are major determinants of energy balances of its residents. This finding is further supported by results of regression analyses reported later in this research bulletin.

Measuring Protein Content of Major Food Grains

During several rounds of the diet survey, samples of major food grains consumed by households were obtained and brought to ICRISAT Center for protein analysis. The objective was to ascertain whether the nutritive values of Indian foods given in Gopalan et al. (1976) are an accurate reflection of the nutrient contents of the food grains actually consumed in the villages. Protein content of the samples was measured using the Technicon Auto Analyzer. Resources did not permit analysis of any other nutrient. In all, 817 food-grain samples were analyzed for their protein content(Table 12).

The protein content of sorghum samples was found to be consistently less than the NIN value of 10.4 g by about two percentage points (or 19% less) for local varieties, and by 3.7 percentage points (35% less) for hybrids. This was also the case with finger millet (ragi) and pearl millet, where the difference was 22% and 12% respectively. These are important food grains only in Dokur and Aurepalle, while sorghum is a major component of the diet in all villages. The protein content (in %) of village rice, wheat, pigeonpea, and chickpea was significantly higher than the NIN values. Although not shown in Table 12, t-tests of the significance of the difference in protein contents of the grains across the various seasons showed that it did not vary much. Exceptions were rice in Aurepalle and Kanzara, and pigeonpea in all villages except those in the Sholapur region.

Individual protein intakes were recalculated using measured protein contents as shown in Table 12, and these were compared with the original estimates, which were based on the NIN values of Gopalan et al. (1976). There were no statistically significant differences between the means for any farm-size group or age-sex group in Aurepalle (both seasons) or in Dokur in the lean season (Appendix Tables 51-58). In Dokur, in the surplus season, mean protein intakes were generally higher using the measured values, and the differences were statistically significant in 33% of the cases. This result is understandable as rice is the staple cereal in this village, especially in the surplus season, and coarse-grain consumption is low. Adjusting the protein content of rice upwards and that of coarse grains in the opposite direction obviously tends to improve overall protein intakes.

In both the Maharashtra regions, the forementioned downward adjustments resulted in reduced protein intakes due to the predominance of sorghum in the villagers' diets. In both Sholapur and Akola, the mean measured protein intakes were statistically less significant than the NIN's standardized protein intakes in 57% of the cases. The differences were more pronounced among the older age groups because of their greater overall consumption. For the same reason, in the surplus season in Sholapur and in the lean season in Akola, the effect of using measured protein intakes was the greatest.

Table 12. Protein content of food-grain samples collected during the diet survey (g/100 g of sample).

Sample	Parameters/ statistic	Aurepalle	Dokur	Shirapur	Kalman	Kanzara	Kinkheda	NIN value
Sorghum (local)	Mean	8.56	8.43	8.30	8.49	8.35	8.38	10.4
	SD	1.00	0.99	0.74	0.54	1.25	0.95	
	N	42	22	69	64	48	80	
	t-value[1]	-11.92**	-9.33**	-23.57**	-28.30**	-11.36**	-19.02**	
Sorghum (hybrid)	Mean	-	-	-	-	6.59	7.16	10.4
	SD	-	-	-	-	1.07	1.30	
	N	-	-	-	-	14	5	
	t-value	-	-	-	-	-13.32**	-5.57**	
Rice	Mean	7.90	8.19	-	-	7.32	7.27	6.8
	SD	0.68	0.74	-	-	0.91	1.14	
	N	94	111	-	-	17	9	
	t-value	15.68**	19.79**	-	-	2.36*	1.24	
Wheat	Mean	-	-	-	-	13.63	13.68	11.8
	SD	-	-	-	-	1.35	1.25	
	N	-	-	-	-	32	10	
	t-value	-	-	-	-	7.67**	4.76**	
Finger millet (Ragi)	Mean	-	6.39	-	-	-	-	7.3
	SD	-	0.44	-	-	-	-	
	N	-	27	-	-	-	-	
	t-value	-	-10.75**	-	-	-	-	
Pearl millet	Mean	9.08	-	-	-	-	-	11.6
	SD	1.33	-	-	-	-	-	
	N	19	-	-	-	-	-	
	t-value	-8.26**	-	-	-	-	-	
Pigeonpea dhal	Mean	24.13	23.23	22.53	22.82	23.48	23.43	22.3
	SD	0.51	0.82	0.97	0.57	1.12	1.51	
	N	11	25	32	13	29	29	
	t-value	11.90**	5.67**	1.34	3.29**	5.67**	4.03**	
Chickpea dhal	Mean	-	22.21	-	-	-	22.20	20.8
	SD	-	1.21	-	-	-	0.85	
	N	-	8	-	-	-	7	
	t-value	-	3.30*	-	-	-	4.36**	

1. The t-value is of the significance of the difference between the mean of the measured values in the villages and the NIN value given by Gopalan et al. (1976) as shown in the last column of the table.
* Significant at 5% level.
** Significant at 1% level.

The seasonal distributions of protein intake were calculated using measured values in the place of NIN values (Appendix Tables 59-62). The adjustment had the greatest effect in Akola where there were either fewer people with more than a 100% of RDA, or more people with less than 50% of the RDA when measured protein content was inserted. This was especially so in the lean season and for the medium-sized farm families. In Sholapur, all age-sex groups in landless and

small-farm families had an inferior protein status after the adjustment in the lean season, but only preschool children and adults were worse off in the surplus season. The 13-18 year-olds seem to have an improved protein intake after the adjustment in the surplus season. The 1-6 year-olds were adversely affected in both seasons in medium-farm families, and adults were either unaffected or were worse off. In large-farm families, the 7-18 year-olds and the adults had inferior protein intakes following the adjustment in the surplus season, but in the lean season it was mostly the 1-6 year-olds who were so affected.

In Dokur, it was generally the 1-6 year-olds whose protein intake distributions changed for the worse; the other age groups were either not affected or showed a better distribution. This was true of all farm-size groups. In Aurepalle, in the lean season, medium- and large-farm family intake distributions were either better or unaffected, as was the case with the landless, small-farm, and large-farm families in the surplus season. The 1-3 year-olds of landless and small-farm families had lower intakes in the lean season after the adjustment but, for the other age-sex groups, the position improved. The 1-6 year-olds from the medium-farm group were slightly worse off in the surplus season. There was little effect on the others.

Determinants of Nutrient Intake

The inferences that can be drawn from tabulations of nutrient-intake levels and the proportions of the RDA met are limited. This is because when one compares the averages of two contrasting farm-size groups--as was done in an earlier section--it is not possible to determine whether the variate represented by the farm-size classification is a causal factor or simply a correlate. It may also not be possible to attribute the size of any measured difference, even if it were statistically significant, to the variate. We may know that a real difference exists between the two groups, but we cannot positively state that grouping was the only factor involved. Other factors, which it was not possible to control adequately, may have influenced the differentials observed. In a sense, the earlier tabular analyses are like a "snapshot" of the present situation. What is required is a "movie" to show how the present scenario came to be by allowing many factors to interact and influence behavior at the same time. It is with respect to the latter requirement that multiple regression was employed to determine what agroclimatic and socioeconomic factors explain the differentials observed in the nutrient intake of 1-12 year-old children in the six villages. As children are generally considered to be nutritionally more at risk than adults, it was decided to restrict the analysis to them. The results for 10 important nutrients are shown in Table 13. Twenty explanatory variables were used in each regression equation. Their description and statistics relating to them are given in Table 14. In all there were 938 observations on the children.

The most striking feature that Table 13 reveals is the failure of annual net household income to significantly explain the variability in consumption of any nutrient other than calcium. The lack of income elasticity for protein and energy among children in these villages appears to run counter to the findings of the Operations Research Group, Baroda (ORG 1971), Radhakrishna and Shah (1981), the National Institute of Nutrition (NIN 1982a and 1982b), and the Administrative Staff College of India (1982), to cite just a sample of the many studies that have found such a relationship.

The lack of a significant income effect on vitamin intakes is also rather unexpected. Mruthyunjaya et al. (1981) found that expenditure elasticities of potatoes, onions, tomatoes, and egg plant (brinjals) in rural Karnataka ranged from 0.34 to 1.76. Some of these vegetables are high in β-carotene and

Table 13. Determinants of nutrient intake of children 1-12 years in six southern Indian villages, 1976-78.[1]

Explanatory variables	Dependent variables									
	Protein (g)	Energy (kcal)	Calcium (mg)	Iron (mg)	β-Carotene (μg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)	Lysine (g)
'Surplus' season (dummy)	0.2910	0.0029	-3.8600	1.1407	-52.2320	0.0378	0.0785	0.3636	0.6846	0.0066
	(0.25)[2]	(0.08)	(-0.35)	(1.70)	(-1.27)	(0.95)	(2.64)**	(1.00)	(1.07)	(0.14)
Age (years)	5.0445	0.1953	7.6211	2.2718	23.8149	0.1525	0.0817	1.4676	1.3087	0.1725
	(6.04)**	(7.28)**	(0.96)	(4.68)**	(0.80)	(5.2[illegible])**	(3.79)**	(5.57)**	(2.82)**	(5.03)**
Male (dummy)	0.4670	0.0075	-4.4772	0.4426	71.8883	0.0257	0.0260	0.0470	-0.5799	0.0137
	(0.43)	(0.21)	(-0.43)	(0.69)	(1.84)	(0.67)	(0.92)	(0.14)	(-0.95)	(0.30)
Family size (number)	-0.5941	-0.0204	-16.9618	-0.1694	10.7006	-0.0131	-0.0207	-0.0914	-0.1837	-0.0442
	(-2.69)**	(-2.88)**	(-8.05)**	(-1.32)	(1.36)	(-1.71)	(-3.62)**	(-1.31)	(-1.50)	(-4.86)**
Educated mother (dummy)	2.5019	0.0780	42.6201	0.7813	103.3555	0.0823	0.0134	0.1637	0.7785	0.0626
	(1.43)	(1.39)	(2.56)*	(0.77)	(1.66)	(1.36)	(0.30)	(0.30)	(0.80)	(0.87)
Caste rank (% of villages in lower category)	0.0023	0.0004	-0.0185	-0.0164	-1.1136	-0.0001	0.0007	0.0039	0.0217	0.0009
	(0.10)	(0.55)	(-0.08)	(-1.23)	(-1.36)	(-0.09)	(1.22)	(0.54)	(1.70)	(0.91)
Dokur village (dummy)	5.1291	0.3169	-7.1204	1.7972	-42.4548	-0.2053	-0.4184	1.4220	-4.6953	0.2006
	(2.54)*	(4.88)**	(-0.37)	(1.53)	(-0.59)	(-2.93)**	(-8.03)**	(2.23)*	(-4.18)**	(2.42)*
Shirapur village (dummy)	12.4038	0.2155	51.8385	10.5459	377.1129	0.6551	-0.2338	4.6754	-5.4810	0.2231
	(6.19)**	(3.34)**	(2.71)**	(9.04)**	(5.27)**	(9.41)**	(-4.52)**	(7.39)**	(-4.92)**	(2.71)**
Kalman village (dummy)	16.0910	0.2954	61.9094	9.4076	242.3250	0.8064	-0.1867	5.1493	-6.7538	0.3006
	(8.61)**	(4.92)**	(3.47)**	(8.65)**	(3.63)**	(12.42)**	(-3.87)**	(8.73)**	(-6.50)**	(3.91)**
Kanzara village (dummy)	19.2900	0.4338	94.2868	17.4077	263.0228	0.8760	-0.1547	7.1394	-4.6522	0.3956
	(8.89)**	(6.22)**	(4.55)**	(13.78)**	(3.39)**	(11.62)**	(-2.76)**	(10.42)**	(-3.86)**	(4.43)**
Kinkheda village (dummy)	22.5080	0.5696	87.7053	17.4021	279.0342	0.9251	-0.1060	7.3418	-6.9342	0.5999
	(10.34)**	(8.14)**	(4.22)**	(13.74)**	(3.59)**	(12.24)**	(-1.89)	(10.68)**	(-5.73)**	(6.71)**
Whether nutritional morbidity signs evident (dummy)	3.0409	0.0742	1.8448	1.9294	94.5763	0.1019	-0.0074	1.4237	0.3243	0.0719
	(2.53)*	(1.92)	(0.16)	(2.75)**	(2.20)*	(2.44)*	(-0.24)	(3.75)**	(0.48)	(1.45)
Whether nonnutritional morbidity signs evident (dummy)	-0.1638	0.0168	12.4607	0.0871	-15.7078	0.0297	0.0378	-0.1186	0.5025	-0.0265
	(-0.12)	(0.40)	(0.99)	(0.11)	(-0.33)	(0.65)	(1.11)	(-0.28)	(0.69)	(-0.49)
If medium-farm household (dummy)	4.2561	0.1091	5.2623	0.8689	-16.5320	0.1397	0.1183	1.2604	1.0387	0.1952
	(2.70)**	(2.15)*	(0.42)	(0.95)	(-0.29)	(2.55)*	(2.91)**	(2.53)*	(1.19)	(3.01)**

1. There were 938 observations in each regression.

2. Figures in parentheses are t-values.

* Significant at 5% level.

** Significant at 1% level.

Continued.

Table 13 continued.

Explanatory variables	Dependent variables									
	Protein (g)	Energy (kcal)	Calcium (mg)	Iron (mg)	β-Carotene (μg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)	Lysine (g)
If large-farm household (dummy)	4.1850 (2.57)*	0.1032 (1.97)*	47.8560 (3.08)**	1.1247 (1.18)	215.1459 (3.70)**	0.109[illegible] (1.93)	0.1711 (4.07)**	0.8248 (1.60)	3.2120 (3.54)**	0.2529 (3.77)**
Annual net household income (Rs. '0,000)	-2.7502 (-0.92)	-0.0591 (-0.62)	149.4500 (5.24)**	-2.0429 (-1.17)	-49.4537 (-0.46)	-0.1069 (-1.03)	0.0007 (0.01)	-0.5851 (-0.62)	1.3753 (0.83)	0.0128 (0.10)
Ability to do work (dummy)	-2.3856 (-2.67)**	-0.0813 (-2.83)**	-20.0177 (-2.35)*	-1.0539 (-2.05)*	-153.2007 (-4.80)**	-0.0762 (-2.46)*	-0.0954 (-4.14)**	-0.5159 (-1.83)	-1.5792 (-3.18)**	-0.1151 (-3.13)**
Birth order (number)	-0.2458 (-0.63)	-0.0074 (-0.60)	-1.0215 (-0.28)	-0.0687 (-0.30)	-7.6376 (-0.55)	-0.0042 (-0.31)	0.0044 (0.44)	-0.0630 (-0.51)	-0.0537 (-0.25)	-0.0054 (-0.34)
Participation rate of mother (ratio)	-5.1945 (-2.29)*	-0.1595 (-2.18)*	-49.4077 (-2.28)*	-2.1706 (-1.64)	98.5332 (1.22)	-0.0657 (-0.83)	-0.1046 (-1.78)	-0.4022 (-0.56)	4.0228 (3.19)**	-0.3546 (-3.80)**
Age^2 (years)	-0.1962 (-3.31)**	-0.0081 (-4.24)**	-0.4652 (-0.82)	-0.0742 (-2.15)*	-2.3017 (-1.09)	-0.0054 (-2.64)**	-0.0042 (-2.76)**	-0.0527 (-2.82)**	-0.0629 (-1.91)	-0.0079 (-3.24)**
Intercept	20.7642	0.8182	333.473	8.4794	718.75	0.3436	0.8441	2.3546	12.208	1.2519
$\bar{R}^2$	0.3580	0.3254	0.1950	0.4113	0.1079	0.4620	0.1938	0.3435	0.1405	0.2539
Standard error of estimate	16.3478	0.5256	155.974	9.5143	583.511	0.5677	0.4219	5.1614	9.0882	0.6719

ascorbic acid. Why a similar income or expenditure effect was not detected in these six villages is not clear. There may be several possible explanations for these novel findings on income effects.

Table 14. Variables used in the regression analysis on children 1-12 years in six southern Indian villages, 1976-78.

Abbreviation	Description	Unit	Mean	Standard deviation
PROTEIN	Protein intake per caput	g	43.32	20.40
ENERGY	Energy intake per caput	kcal ('000)	1.54	0.64
CALCIUM	Calcium intake per caput	mg	241.12	173.84
IRON	Iron intake per caput	mg	23.16	12.40
CAROTENE	β-carotene intake per caput	mg	424.49	617.78
THIAMINE	Thiamine intake per caput	mg	1.28	0.77
RIBOFLAV	Riboflavin intake per caput	mg	0.57	0.47
NIACIN	Niacin intake per caput	mg	11.89	6.37
VITC	Ascorbic acid intake per caput	mg	9.03	9.80
LYSINE	Lysine intake per caput	g	1.51	0.78
SEASON	Season dummy, "1" if surplus and "0" if lean season	dummy	0.48	0.50
AGE	Age	years	7.30	3.06
WEIGHT	Weight	kg	18.26	6.07
HEIGHT	Height	cm	111.10	18.13
ARMCIRCU	Arm circumference	cm	15.09	2.02
SEX	Sex dummy, "1" if male and "0" if female	dummy	0.57	0.50
FMLYSIZE	Number of members in a family	number	8.37	3.27
EDUCDUM	Education dummy of mother, "1" if educated, "0" otherwise	dummy	0.20	0.40
CASTRANK	% of the village population falling in a lower caste group than the household being observed	%	53.07	29.29

Continued.

Table 14 continued.

Abbreviation	Description	Unit	Mean	Standard deviation
VILBD	Dokur village dummy, "1" if Dokur, "0" otherwise	dummy	0.14	0.34
VILCD	Shirapur village dummy, "1" if Shirapur, "0" otherwise	dummy	0.19	0.40
VILDD	Kalman village dummy, "1" if Kalman, "0" otherwise	dummy	0.23	0.42
VILED	Kanzara village dummy, "1" if Kanzara, "0" otherwise	dummy	0.14	0.34
VILFD	Kinkheda village dummy, "1" if Kinkheda, "0" otherwise	dummy	0.13	0.34
NUTMORB	Nutritional morbidity dummy, "1" if symptoms are present, "0" otherwise	dummy	0.35	0.48
NONUTMOR	Nonnutritional morbidity dummy, "1" if symptoms are present,"0" otherwise	dummy	0.26	0.44
SEG2D	Farm-size group 2 dummy, "1" if medium-farm household, "0" otherwise	dummy	0.24	0.43
SEG3D	Farm-size group 3 dummy, "1" if large-farm household, "0" otherwise	dummy	0.33	0.47
NETINC	Annual gross household income less the costs of production, costs of maintenance of livestock and machinery, costs of raw materials, costs of family human and owned bullock labor, and interest paid on borrowed capital	rupees ('0,000)	0.38	0.30
BIRTHORD	Order of birth, 1-8 indicates order from oldest to youngest child	number	2.71	1.48
DISABLD	Disability dummy, "1" if able, "0" if disabled	dummy	0.47	0.50
PARMUM	Average participation rate of mother during peak and slack seasons	ratio	0.30	0.32
Age^2		years	62.56	43.69

First, we are dealing with children, whereas most studies that found a positive relationship between income and protein-calorie consumption had calculated consumption either on a per caput basis or on the basis of a consumption unit. Rao (1980) notes that income effects on food consumption are generally less in the case of children than adults. Second, most other studies had failed to make adjustments for the effects of other agroclimatic, demographic, and socioeconomic variables on nutrient consumption before attempting to explain residual variation as a function of income. The multiple regression approach we have used (Table 13) separates these contributions to the explanation of variation in nutrient intakes. Third, the measure of income used in this study was carefully compiled by resident investigators who lived in the

Erratum: ICRISAT Research Bulletin no. 7: The determinants of individual diets and nutritional status in six villages of southern India.

On page 34, Table 14, replace the line of item DISABLD with:

DISABLTY	Degrees of disability (see page 17 for code description)	index	4.38	0.83

This amendment requires the replacement of three words (shown in bold) in the last sentence of the second paragraph on page 38, as follows:
"The significant negative relationship between being **unable** to undertake physical work and the intake of nutrients is **quite** plausible."

villages for a number of years and who had excellent rapport with the respondents. These investigators collected data on income through monthly interviews throughout the period of the nutrition, health, and time-allocation survey and checked by periodical visits to farmers' fields to assess crop yields, input use, etc. The income measure also reflects net household income.[9] Most other nutrition studies have used gross income generally estimated through a series of questions put to respondents once during the survey.

According to Radhakrishna and Shah (1981), the expenditure elasticities for calorie consumption per caput in rural India, using National Sample Survey data, is around 1.0 for people in the lowest-income households (< Rs. 36 per caput per month in 1976-77 prices) and falls to 0.44 for those in the highest-income groups (> Rs. 150 per caput per month). The present finding that income has no effect on children's calorie consumption suggests either that it is the adults who consume any additional calories as family income rises, or that there is no tendency for calorie consumption to rise as net incomes increase in these villages. However, the data on calorie consumption (Appendix tables) do not seem to indicate that children have a markedly inferior intake as a percentage of RDA compared to youths and adults. Nor does this seem to be influenced by the size of the farm, which is partially a proxy for income. Hence, changes in the intrafamily distribution of food calories may not explain the lack of an income effect on children's calorie consumption. However, more research is required on this before a firm conclusion can be reached.[10]

A number of studies have found that overall household income is not as significant a factor as mother's income in determining the status of child nutrition (Safilios-Rothschild 1980). As we have used total household net income in the regression equations, the possible influence of the mother's contribution has not been assessed.

The finding of a highly positive and statistically significant effect of net household income on children's calcium consumption is not wholly unexpected. Milk, milk products, and green leafy vegetables are good sources of calcium, while all cereals except rice contain this element (Gopalan et al. 1976). From an analysis of the food intake data presented in Tables 7-10 of this study, most of the calcium in children's diets was found to be derived from milk and milk products, coarse grains, rice and to a lesser extent from sweet toddy in Andhra Pradesh villages. In Maharashtra villages, milk, milk products, and pulses were the main sources. The influence of income on calcium intake was reflected through variations in consumption of these items. An increase in net household income of one standard deviation (78%) from the mean level of Rs. 3810 per year to Rs. 6780 would result in an increase of 50 mg (21%) in calcium consumption among children from the mean level of 241 mg (Table 14). Hence, household income appears to be a potent tool for overcoming calcium deficiencies since an increase in income would translate into increased consumption of readily available calcium-rich foods.

Mothers' education had a significant role in improving both calcium and β-carotene intakes. Although the coefficient of this variable was positive in

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9. Annual gross household income less the cost of crop production, cost of maintenance of livestock and machinery, cost of raw materials, cost of family labor and owned bullocks, and interest paid on borrowed capital.
10. Perhaps the range of incomes found in these villages is much less than in the data used by Radhakrishna and Murty and other researchers. Singh et al. (1982) found a mean annual net household income of Rs. 2842 with a standard deviation of only 2578 in these six villages from 1975-76 to 1977-78. This could account for the absence of an income effect.

all other regressions as well, it lacked significance. Hence it appears that the formally educated mothers--only 20% in these villages (Table 14)--did recognize that milk and other foods, which are rich sources of calcium and β-carotene, were important for the nutritional well-being of their children. As the earlier analysis showed, virtually all children suffered from substantial vitamin A dietary deficiencies in these villages, regardless of their farm-size classification (Appendix Tables 21, 29, 37, and 45). The policy conclusion is clear: improvement in the educational status of women can significantly improve the status of vitamin A consumption in their children. Deficiency of vitamin A is probably the most serious nutritional deficiency in India. Children whose mothers spend a lot of their time in the daily hired labor market tend to consume significantly less protein, energy, calcium, and lysine than those children whose mothers remain at home. Surprisingly, ascorbic acid consumption among children whose mothers participate in the daily labor market was significantly greater than among those whose mothers do not. Often, young children accompany their mothers to the fields when they work. On such occasions, they may pick and eat wild greens, tamarind, and chillies--all rich in ascorbic acid--from the village fields and commons, where they are generally freely available. This may be the reason for the positive relationship found between mothers' participation in the hired labor market and children's consumption of this nutrient.

The variables that consistently explain most of the variation in nutrient intake are the village dummies.[11] These primarily reflect differences in their agroclimatic and socioeconomic characteristics.[12] The coefficients on these village dummies reflect differences between each village and the village of Aurepalle in Mahbubnagar district of Andhra Pradesh.[13] The children in Aurepalle village have significantly lower intakes of protein, energy, calcium, iron, β-carotene, thiamine, niacin, and lysine than those in virtually all other villages. Aurepalle is in a drought-prone area, has little irrigation, its soils are heavily-eroded Alfisols with low moisture-holding capacity, and it has the lowest average level of income as well as the highest degree of absolute and relative poverty (Singh et al. 1982). From this it appears that inherent differences in resource endowments between villages and regions may have largely determined the nutritional status of children. Variations in household incomes within and among villages did not appear to matter much, except in the case of calcium. Children in the four Maharashtra villages: Shirapur and Kalman (Sholapur district) and Kanzara and Kinkheda (Akola district) showed substantially greater levels of calcium intake than the two villages in Mahbubnagar: Aurepalle and Dokur. Aurepalle and Dokur villagers consumed more rice in their diets than the Maharashtra villagers, who rely heavily on coarse cereals (Tables 7-10). This helps explain why Andhra Pradesh and Maharashtra differ in terms of protein, calcium, iron, β-carotene, thiamine, and niacin intakes. Coarse grains generally contain more of these nutrients than rice, and besides, the nutrients are not usually lost in the milling process as happens with rice.[14]

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11. A dummy variable is a binary (0,1) specification of the effect of a particular factor on the dependent variable. When an observation refers to a particular village, for example, the dummy variable for that village takes the value of 1, and "0" otherwise.
12. For details see Tables 2, 3, Jodha et al. (1977), Jodha (1978), and Appendix Table 1.
13. Deletion of one village dummy is necessary for econometric reasons to avoid singularity in the matrix inversion process required to fit ordinary least squares regression equations to the data.
14. Dokur children showed the lowest thiamine consumption. This may be due to the relatively higher proportions of rice consumed compared to Aurepalle, as well as the lack of nuts and oilseeds in their diets (Table 8).

Children of Aurepalle consumed more riboflavin and ascorbic acid than those of the other five villages. The low riboflavin intake among Dokur children is explained by the predominance of rice--a particularly poor source of the vitamin (Gopalan et al. 1976)--in the cereal component of their diets relative to Aurepalle and the Maharashtra villages. In addition, among Dokur children the intake of milk and milk products--a major source of this vitamin--is low. Aurepalle children generally consume much more riboflavin-rich milk and milk products such as buttermilk (Table 7). This explains their superior intake of riboflavin. The higher intakes of ascorbic acid in Aurepalle seem to be due to greater consumption of vegetables such as cucumber, chillies, and tamarind. These vegetables are high in ascorbic acid and are often eaten raw in the form of chutneys which preserve the vitamin. Among food items often consumed in Aurepalle and which are reasonably high in ascorbic acid are okra (bhendi), gourds, beans, egg plant (brinjals), cluster beans, spinach (palak), gogu, amaranth (thotacura), tomatoes and potatoes. Unfortunately, these are generally consumed after cooking resulting thereby in considerable loss of ascorbic acid.

The larger the size of the family in these villages, the lower is the intake of nutrients except β-carotene. However, the effect is significant only in the case of protein, energy, calcium, riboflavin, ascorbic acid, and lysine.[15] Studies reported by Rao (1980) and the World Health Organization (WHO 1976) indicate that the prevalence of severe forms of malnutrition among children is greater in large families. The results of this study confirm that this negative effect is strong on the intake of the above six nutrients and is evident regardless of other characteristics of the region, village, or households concerned. When parents in these villages have more children, other things being equal, apparently this results in an inferior nutritional intake of each child. In other words, the quantity and (nutritional component of) quality of children are substitutes in the context of household decisions, as postulated by Becker and Lewis (1974) and de Tray (1974). There did not seem to be discrimination against children lower in the birth order, judging from the lack of significance on the coefficients for this variable.

One might expect that children with nutritional deficiency signs would be consuming a less nutritious diet. There, however, appears to be a strong positive relationship between the presence of clinical nutritional deficiency signs for vitamins A and B complex in these children and the intakes of protein, energy, iron, β-carotene, thiamine and niacin--derived mainly from staple foods.[16] The National Institute of Nutrition (NIN 1982a) found that a slightly larger proportion (65%) of individuals with nutritional deficiency signs were consuming adequate amounts of calories compared with those with no signs (61%). Mean intakes of proteins and calories among households with at least one member showing one or more nutritional deficiency signs were also found to be significantly greater.

This positive relationship between nutritional morbidity and nutrient intake is because increased intake of protein and calories without a concomitant increase in vitamins, particularly riboflavin, generally results in increased clinical manifestations. The relationships are, in fact, of a simultaneous or interactive nature, where nutritional deficiency signs also depend to a significant extent on the relative intakes of nutrients, as well as the reverse

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15. The positive relationship between family size and β-carotene intake of children, though not significant, suggests that such families eat more coarse grain, vegetables, milk, and milk products. These were the major sources of β-carotene in children's diets.
16. This was not true in the cases of calcium, riboflavin, ascorbic acid, and lysine.

causality postulated in the nutrient intake regressions. Barlow (undated) suggests that one would require a series of 20 simultaneous equations to adequately specify the relationships between health, nutrition, income, fertility, and education, all of which are jointly determined variables in a household decision-making framework. However, defining and estimating such a model was beyond the scope of the present study.

For B complex vitamins, deficiency signs are generally greater in individuals with higher levels of energy intake because requirements for some B complex vitamins are dependent on energy intake, although recent work by Bamji et al. (1979), Sarma et al. (1981), and Bamji et al. (1982) suggests that this is not always true. In this study, the simple correlation coefficient between energy and riboflavin intake of the children was low (0.31) and the incidence of B complex deficiency signs was high (4 to 41%) (Bidinger 1983). Also, children with higher β-carotene intakes may have been consuming diets inadequate in fat content; fat is needed to facilitate conversion of β-carotene into vitamin A (as well as its absorption). Thus, one finds a positive relationship between nutritional deficiency signs and β-carotene intake.

Unlike the case with nutritional morbidity signs, no relationship was found between nonnutritional morbidity signs and nutrient intakes. This was also true of sex: there were no significant differences between boys and girls in the intake of these 10 nutrients. Caste also had no effect on nutrient intake. The latter two findings are similar to those of the Tamil Nadu Nutrition Project (Administrative Staff College of India 1982). The significant negative relationship between being able to undertake physical work and the intake of nutrients is difficult to rationalize.

Age had no influence on calcium and β-carotene intakes, but it had a strong and highly significant positive influence on the consumption of the other eight nutrients, a finding similar to that of the Tamil Nadu Nutrition Project (Administrative Staff College of India 1982). There was a strong curvilinear relationship between age and consumption of these eight nutrients. Consumption increases until a peak is reached, after which it declines at a particular age. It may be recalled that the mother's education also had a substantial effect on intakes of calcium and β-carotene. One might deduce from this that the effect of mother's education is very real, and leads to augmentation of the child's intake of these two nutrients from a very early age and that the intakes from then on do not increase with age, as they should. Perhaps the general education of the mother creates the proper awareness and appreciation of the need for items like milk and vegetables in children's diets. However, specific nutritional education programs may be required to ensure that children's consumption of calcium and β-carotene increases as they grow older, through increased consumption of milk, vegetables, and other rich sources of these nutrients. Somehow it appears that children are able to increase their consumption of other nutrients as they age. This is more likely to be simply a result of their increased appetites rather than recognition of an increased dietary requirement of these nutrients.

Children from medium- and large-farm households had, generally, higher intakes of protein, energy, riboflavin, and lysine, compared with those from landless and small-farm households. Landholding size or farm size did not significantly influence consumption of iron: children from both landless and large-farm families showed the same levels of iron consumption. Pearl millet, finger millet, green leafy vegetables, and jaggery were the primary sources of iron. Children from large-farm households consumed significantly more calcium, β-carotene, and ascorbic acid than those from landless and small-farm households. Intake of these three nutrients was not significantly greater among children from medium-farm households compared with those from landless, small-farm, and large-farm families. However, children from medium-farm

households did consume significantly more thiamine and niacin than children from the other groups.

The influence of larger landholdings on vitamin consumption suggests that some home-produced protective foods are either not demanded by landless and small-farm families, and/or are not available to them in village markets. Programs that bring the home- or kitchen-garden concept to landless and small-farm households, with the object of making them grow foods high in vitamin and mineral content, could prove beneficial. Land reforms could have the effect of further reducing the intakes of vital nutrients, judging from the positive relationship between farm-size and nutrient consumption.

Because net household income had little effect on nutrient intake (as discussed earlier), it was thought that the collinearity between this variable and the farm-size group dummies was responsible. To examine this possibility all regressions were rerun, dropping the farm-size group dummies.[17] The significant positive income coefficient in the calcium equation remained so when these dummies were deleted. For all other nutrients except lysine, the income coefficients remained statistically nonsignificant, suggesting that collinearity with the farm-size group dummies was not the reason for the absence of an income effect.[18] Lysine was an exception. The income coefficient for lysine intake became highly significant when the farm-size dummies were dropped, suggesting some collinearity. From these results it seems that access to land and the type of income and/or produce derived from land, are conducive to improved intake of nutrients (except iron) among children, regardless of the level of total household income.

We did not find a marked seasonal effect in nutrient intake of the children in these villages, except for riboflavin, the intake of which improved in the so-called "surplus" food-grain season when cereal consumption rises. Schofield (1974) found substantial seasonal variation in calorie intake in a review of 25 African nutrition studies, with consumption being higher in the dry than in the wet seasons. As she notes, there are few Indian studies that include an analysis of seasonality which would enable comparison with our finding of little seasonality in child nutrition. Chambers (1982) contends that in many tropical environments the wet season is the period when malnutrition, morbidity, and mortality are at their peak. In the same season the opportunity cost of time lost due to these problems is also at a peak. This may well be true of adults in these villages, but not of children.

Anthropometric Indices of Nutritional Status

Physical growth is considered one of the major outcomes of the interaction between nutrition and the environment. Measurements of weight, height, arm circumference, and triceps skinfold thickness are commonly recognized as important indices of nutritional status, that is, of protein-energy malnutrition. Height is primarily a reflection of cumulative or past nutritional status, whereas the other measures refer more to current or transitory nutritional status (Seoane and Latham 1971).

Data are generally presented as percentiles of the population falling into appropriate ranges, if at least 200 observations occur in each age-sex group.

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17. These regressions had a specification different from those in Table 13, and excluded $(\text{age})^2$, birth order, and the mother's participation rate.
18. However, in a number of cases the signs of the income coefficients changed from negative to positive when the farm-size group dummies were dropped.

As this was not the case in this study, data are presented in terms of means, standard deviations, and percentages of individuals falling into different percentage-of-standard categories. Here, 100% of the standard is defined as the median for the reference population. In the case of weight-for-age, the classification suggested by Gomez et al. (1955) was adopted for categorizing degrees of malnutrition, and Indian standards were used. These categories were as follows.

% of weight-for-age standard	Category/degree
≥90	Normal
75-89	Mild/first
60-74	Moderate/second
<60	Severe/third

Waterlow's (1976) classification was used for height-for-age and weight-for-height. These were as follows.

% of standard	Category
≥90	Normal
80-89	Mild
70-79	Moderate
<70	Severe

Weight-for-Age of Preschool Children

Mean percentage weight-for-age of 1-6 year-old preschool children ranged from 78% in Dokur village (Mahbubnagar) and Kinkheda village (Akola) to 84% in Shirapur village of Sholapur. Apparently, there was not much variation in the mean status from region to region--a finding similar to the one by the ICMR (1974) study of preschool children in India. Severe cases of malnutrition among preschoolers tended to increase slightly in the surplus season in all regions except Dokur (Table 15). The incidence levels ranged from 1.6 to 7.1% in the lean season, and from 1.8 to 5.2% in the surplus season. This may be because adults devote more attention to agricultural field activities in the surplus season resulting in some neglect of young children. Chambers (1982) cites a number of studies that report this effect. Poleman (1981) cites six surveys in India involving more than 32 000 children where the median incidence of severe malnutrition measured on the Gomez scale was 2.6% with a range of 1.1 to 20%. The Indian Council of Medical Research (ICMR 1974) found the incidence of kwashiorkor (protein deficiency) in India to be 1%, and marasmus (severe wasting) 2%. This study confirms these figures.

The percentage of children suffering from moderate malnutrition ranged from 20 to 43 in the different regions. Compared to smaller farm-size groups, there was less seasonal variation in the proportion of preschool children with moderate and severe malnutrition among the large-farm households. The variation was sharpest in the lean period. This suggests that the children of less affluent households are more prone to seasonal malnutrition than those from more affluent households; this is in line with one of Chambers's (1982) major conclusions. To what extent factors other than food availability, such as the prevalence of morbid conditions of infection and infestation, availability of prompt treatment, cultural constraints on food distribution within family, and maternal attributes of resourcefulness and education, are responsible for these differences is difficult to assess from the available data. The incidence of protein-energy malnutrition (PEM), as measured by the number of children with

mild or worse levels of severity on the Gomez scale, was not significantly different between the landless/small-farm families and the medium-/large-farm families in any of the four regions, as measured by a chi-square test.

Table 15. Weight-for-age distribution (in %) of preschool children, 1-6 years old, in six southern Indian villages, 1976-78.

Region	Nutritional status levels[1]	Season: Lean	Season: Surplus
Aurepalle	Normal	22.81	20.69
	Mild	36.84	48.28
	Moderate	36.84	25.86
	Severe	3.51	5.17
Dokur	Normal	14.29	19.28
	Mild	35.71	50.60
	Moderate	42.86	26.51
	Severe	7.14	3.61
Sholapur	Normal	32.56	35.09
	Mild	45.74	42.11
	Moderate	20.15	21.05
	Severe	1.55	1.75
Akola	Normal	27.27	27.59
	Mild	38.64	41.38
	Moderate	31.82	26.44
	Severe	2.27	4.60

1. Gomez classification (Gomez et al. 1955).

Weights of Adults

Mean weight of adult males was around 48 kg and of adult females about 41 kg (Tables 16 and 17). These are slightly below the average weight of 50 kg for the rural male, and 42 kg for the rural female (NIN 1982c). In Sholapur, adults tended to be heavier than those in the other regions. The reason for this was not clear.

There were no significant differences in the weights of adults between seasons, suggesting thereby that food intakes were perhaps adjusted to match demand variations--associated with peak and slack seasons--for strenuous agricultural work. This finding was at variance with Chambers' (1982) seasonality thesis. Generally, the surplus seasons were periods requiring more expenditure of energy in these villages.

Heights, Arm Circumferences, and Skinfold Thicknesses of Adults

As expected, men were taller than women and had thicker arms, but, compared to women, men had smaller skinfold thicknesses (Table 18). In general, members of the more affluent households showed higher values for all the three measures. Since there was little regional variation in these statistics, only one table containing the pooled data is featured in this paper. Heights and skinfold thicknesses did not differ significantly between the lean and surplus seasons.

Table 16. Weights of adult males (in kg) in six southern Indian villages, 1976-78.

		Farm-size group											
		Landless and small farmers			Medium farmers			Large farmers			All		
Region	Season	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Aurepalle	Lean	35	44.52	5.68	20	49.05	4.00	25	54.22	9.84	80	48.68	8.03
	Surplus	37	44.07	5.11	22	48.49	5.43	29	53.77	9.67	88	48.37	8.10
	t-value for seasonal effect[1]	0.354			0.377			0.169			0.249		
Dokur	Lean	22	47.12	9.36	8	44.25	6.45	18	49.08	4.41	48	47.38	7.43
	Surplus	65	47.60	7.64	20	43.88	4.19	42	50.55	4.09	127	47.99	6.54
	t-value for seasonal effect	0.240			0.180			1.246			0.530		
Sholapur	Lean	124	49.98	7.02	87	50.98	6.88	115	48.82	6.08	326	49.84	6.70
	Surplus	44	50.09	6.35	30	51.16	7.27	41	48.33	6.06	115	49.74	6.54
	t-value for seasonal effect	0.092			0.122			0.443			0.138		
Akola	Lean	55	46.10	5.46	23	45.89	4.80	31	48.11	6.62	109	46.63	5.72
	Surplus	107	46.82	5.37	51	46.10	5.10	59	48.54	5.94	217	47.12	5.52
	t-value for seasonal effect	0.804			0.167			0.314			0.747		

1. None of the t-values was significant at the 5% level.

Table 17. Weights of adult females (in kg) in six southern Indian villages, 1976-78.

		Farm-size group											
		Landless and small farmers			Medium farmers			Large farmers			All		
Region	Season	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Aurepalle	Lean	30	40.22	3.63	18	40.16	5.71	9	45.99	5.10	57	41.11	5.00
	Surplus	25	39.87	4.16	23	40.42	6.01	9	45.48	6.86	57	40.98	5.68
	t-value for seasonal effect[1]	0.333			0.140			0.179			0.130		
Dokur	Lean	21	38.82	6.77	9	39.51	4.62	13	38.17	6.24	43	38.77	6.10
	Surplus	77	39.81	7.33	25	39.12	6.09	36	39.26	6.15	138	39.54	6.79
	t-value for seasonal effect	0.557			0.174			0.546			0.665		
Sholapur	Lean	114	43.34	4.78	79	42.16	7.03	89	42.48	5.66	282	42.74	5.76
	Surplus	41	42.50	4.85	27	41.56	7.49	32	41.77	6.19	100	42.01	6.03
	t-value for seasonal effect	0.961			0.377			0.594			1.076		
Akola	Lean	47	39.51	5.96	21	40.54	4.45	28	39.95	3.99	96	39.86	5.10
	Surplus	96	39.94	5.82	40	40.69	4.23	53	40.41	3.90	189	40.23	5.01
	t-value for seasonal effect	0.412			0.129			0.501			0.586		

1. None of the t-values was significant at the 5% level.

Table 18. Heights, arm circumferences, and skinfold thicknesses of adults in six southern Indian villages, 1976-78.

Farm-size group	Measurements	Adult males						Adult females					
		Lean season			Surplus season			Lean season			Surplus season		
		N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	SD
Landless laborers and small farmers	Height (cm)	235	160.89	6.05	305	160.30	6.44	209	147.98	5.45	282	147.08	10.47
	t-value[1]	1.084						1.134					
	Arm circumference (cm)	236	23.39	2.47	308	23.00	2.11	212	22.45	2.02	285	21.91	2.07
	t-value	1.983*						2.906**					
	Skinfold thickness (mm)	236	5.30	1.93	253	5.20	1.89	212	8.05	2.90	236	7.78	3.07
	t-value	0.579						0.954					
Medium farmers	Height (cm)	136	162.46	6.97	146	161.08	6.19	125	149.27	4.88	135	148.18	4.87
	t-value	1.760						1.801					
	Arm circumference (cm)	139	23.77	2.18	147	23.21	1.97	127	22.29	2.45	136	22.11	2.22
	t-value	2.281**						0.625					
	Skinfold thickness (mm)	139	6.01	3.15	123	5.63	2.43	127	7.37	2.91	115	7.19	3.04
	t-value	1.083						0.470					
Large farmers	Height (cm)	184	162.61	6.85	198	163.12	6.30	136	149.54	5.34	157	149.50	5.39
	t-value	0.758						0.064					
	Arm circumference (cm)	190	23.82	2.21	200	23.91	1.93	139	22.18	2.63	158	22.03	2.46
	t-value	0.429						0.508					
	Skinfold thickness (mm)	190	5.55	2.00	170	5.88	2.17	139	7.68	3.37	130	7.73	3.51
	t-value	1.501						0.119					
All	Height (cm)	555	161.84	6.60	649	161.34	6.45	470	148.77	5.31	574	148.00	8.26
	t-value	1.326						1.747					
	Arm circumference (cm)	565	23.63	2.32	655	23.32	2.06	478	22.33	2.32	579	21.99	2.21
	t-value	2.472**						2.434**					
	Skinfold thickness (mm)	565	5.56	2.32	546	5.51	2.13	478	7.76	3.05	481	7.63	3.19
	t-value	0.374						0.645					

1. t-value for seasonal effect. * Significant at 5% level. ** Significant at 1% level.

However, arm circumferences seemed to be significantly smaller--in the statistical sense--in the surplus seasons, although the measured differences (in cm) were less than 2%. This confirms that surplus seasons are periods when tasks are more demanding of physical effort such as harvesting, threshing, and carrying of produce, although, with the exception of the Akola villages, adult energy intakes were significantly greater in the surplus than in the lean seasons. These anthropometric measures indicate that much of the additional intake may be dissipated in increased energy expenditure.

Weight-for-Height

Weight-for-height was calculated for all age-sex groups using international standards (Table 19 and Appendix Table 10).

The proportion of adults with less than 70% of the standards (7.3 to 19.7%) was, in general, higher than in the younger age groups (0 to 6.4%). This probably reflects an increase in food availability across generations. In all age groups, the percentage of individuals falling below 70% of the weight-for-height was higher in the surplus season. These proportions were comparable to those cited by Seckler (1979), who estimates that truly malnourished individuals in India, as measured by weight-for-height--not weight-for-age as is commonly done--number between 10 and 20%, and not between 40 and 50% as hitherto believed.[19] Small stature may be a reflection of both genetic make-up as well as of past chronic malnutrition. There may be little functional impairment in those with reduced stature but with normal weight-for-height, since few individuals utilize their maximum physical potential (Srikantia 1977). People can be small and yet healthy. And, safe drinking water, sanitary living conditions, and personal hygiene can be more important in ensuring good health than a greater weight-for-age (Mahajani 1981). One must acknowledge, however, that these "short adults" are the ones who have survived; countless others no doubt died during the earlier periods of chronic malnutrition. According to Calloway and Wood (1978) there is also considerable evidence to indicate that cognitive and physical development of the survivors of early malnutrition is impaired due to growth retardation. One must be cautious, however, in making inferences from such anthropometric indices.

Determinants of Weight and Height of Children

Conceptually, the nutritional status of individuals is dependent on two groups of factors. The first consists of food intake and the presence or absence of morbidity (infective conditions that impose stress on nutrient intakes). These may be considered direct determinants. The second group of factors that influence food intake and morbidity include purchasing power, nutrient content of the foods consumed, and a host of sociobiological factors such as age, sex, caste, educational status, and family size. These can be termed as indirect determinants of nutritional status (Figure 2). To identify the actual importance of these variables on weight and height of children aged 1-12 years, multiple regression analysis was done (Tables 20 and 21).

The quantity of protein in the diet did not significantly affect the weight of children when the two anthropometric variables, height and arm circumference, were included as regressors (models 1 and 3, Table 20). This is not unexpected

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19. Many nutrition scientists, however, regard the views of Sukhatme (1981), Sukhatme and Margen (1978), and Seckler (1979 and 1980) on the large scope for human adaptation to relatively low levels of nutrient intake as controversial.

Table 19. Weight-for-height distributions, using international standards, in six southern Indian villages, 1976-78.

Farm-size group	Age-sex groups (in years)	Lean season					Surplus season				
		<=70%	<=80%	<=90%	Above 90%	Total	<=70%	<=80%	<=90%	Above 90%	Total
Landless laborers and small farmers	1-6	1	18	43	38	95	3	14	42	42	125
	7-12	0	14	47	39	178	1	18	41	41	153
	13-18 Males	0	2	32	66	53	6	6	27	60	63
	13-18 Females	2	7	25	66	56	2	5	26	67	43
	> 18 Males	17	43	29	11	235	19	46	27	8	251
	> 18 Females	8	27	39	25	209	11	35	35	18	237
Medium farmers	1-6	3	9	35	53	75	3	11	36	50	66
	7-12	2	8	54	35	83	6	8	54	32	65
	13-18 Males	0	26	22	52	27	0	10	10	81	21
	13-18 Females	0	3	30	67	33	0	4	37	59	27
	> 18 Males	11	47	32	10	136	20	49	25	7	122
	> 18 Females	10	25	38	27	125	11	32	37	20	114
Large farmers	1-6	3	14	36	48	80	5	9	42	44	86
	7-12	0	13	40	46	114	1	20	43	36	98
	13-18 Males	2	15	32	52	66	6	10	33	52	52
	13-18 Females	2	4	12	82	51	3	6	21	70	33
	> 18 Males	13	46	29	12	184	14	44	30	12	169
	> 18 Females	7	31	40	22	136	13	32	37	18	129

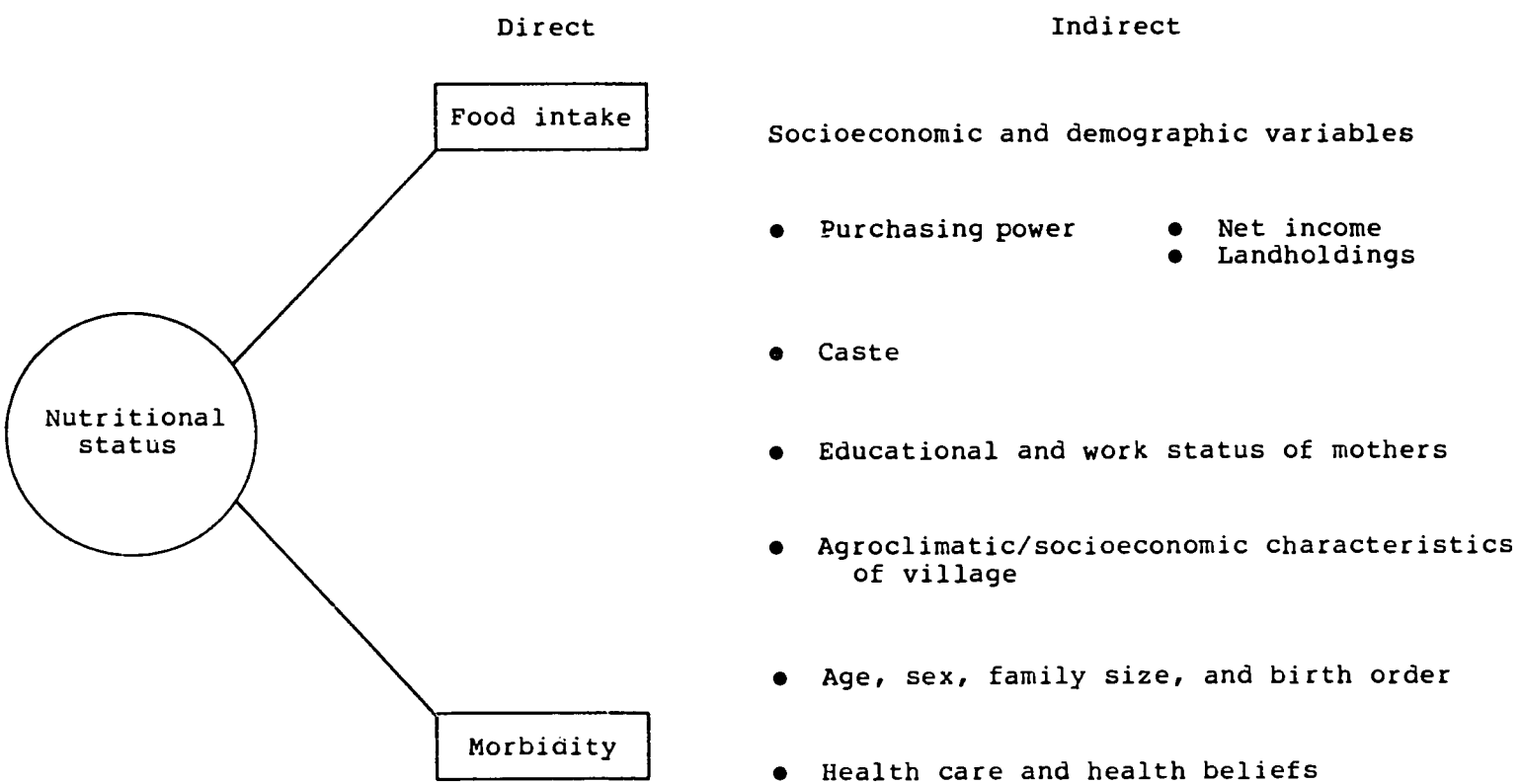

Figure 2. Determinants of nutritional status of children 1-12 years.

as anthropometric variables may in part be proxies for food intakes. The regressions that include them show that there is a highly significant positive relationship between all these age-dependent anthropometric measurements. There was, not surprisingly, a significant and positive relationship between energy consumption and weight.

When height and arm circumference were dropped from the equation (models 2 and 4, Table 20) the significance of protein, energy, family size, and age in explaining weight substantially increased. The age variable begins to explain the variability in weight previously explained by height and arm circumference. The coefficients on age and $(age)^2$ imply that an increase of 1 year in the age of children from the mean level of 7.3 years increases their weight by about 1.3 kg, and this gain in weight occurs at an increasing rate up to the age of 12, at least. Children in larger families weighed less by about 120 g for every additional family member. Children of Kanzara village were lighter by a little over 1 kg than those in other villages, after adjusting for the effects of other variables. Intake of protein and energy does influence a child's weight. None of the other variables, including income, had any significant effect on the determination of a child's weight. Children of mothers who participate more in the labor market tended to be lighter. But this effect was not statistically significant, unlike the case with nutrient-intake regressions (Table 13) where many coefficients on this variable were significant. The t-values on the income variable in models 2 and 4 were nearly double those in the regression equations in Table 13 which explain protein and energy consumption of 1-12 year-old children. Although not significant, higher t-values suggest that income is a more powerful determinant of medium-term anthropometric status than of shorter-term nutritional status indicated by dietary surveys.

Table 20. Determinants of weight (kg) of children 1-12 years in six southern Indian villages, 1976-78.

Explanatory variables	Model 1	Model 2	Model 3	Model 4
Protein intake per caput (g)	0.0073 (1.72)	0.0177 (2.77)**		
Energy intake per caput (kcal)			0.3462 (2.64)**	0.7502 (3.80)**
"Surplus" season (dummy)	-0.0947 (-0.64)	-0.0227 (-0.10)	-0.0936 (-0.64)	-0.0203 (-0.09)
Age (yrs)	-0.6518 (-5.09)**	1.2317 (7.48)**	-0.6763 (-5.27)**	1.1742 (7.09)**
Height (cm)	0.2270 (21.21)**		0.2262 (21.17)**	
Arm circumference (cm)	0.7866 (14.47)**		0.7842 (14.45)**	
Male (dummy)	0.0094 (0.07)	-0.2718 (-1.28)	0.0102 (0.07)	-0.2676 (-1.27)

Continued.

Table 20 continued.

Explanatory variables	Model 1	2	3	4
Family size (number)	0.0568 (1.97)*	-0.1177 (2.74)**	0.0590 (2.05)*	-0.1129 (-2.64)**
Educated mother (dummy)	0.0407 (0.18)	0.4220 (1.25)	0.0333 (0.15)	0.4079 (1.21)
Caste rank (% of village in a lower category)	0.0050 (1.71)	-0.0056 (-1.25)	0.0049 (1.67)	-0.0058 (-1.31)
Dokur village (dummy)	-0.3408 (-1.32)	-0.6946 (-1.78)	-0.4122 (-1.59)	-0.8381 (-2.13)*
Shirapur village (dummy)	0.5548 (2.16)*	0.1204 (0.31)	0.5742 (2.27)*	0.1863 (0.49)
Kalman village (dummy)	0.4912 (2.06)*	0.4251 (1.18)	0.5121 (2.21)*	0.4982 (1.42)
Kanzara village (dummy)	0.6739 (2.37)*	-1.0728 (-2.54)*	0.6651 (2.39)*	-1.0462 (-2.54)*
Kinkheda village (dummy)	1.2550 (4.34)**	0.0446 (0.10)	1.2232 (4.33)**	0.0238 (0.06)
Whether nutritional morbidity signs evident (dummy)	0.1415 (0.92)	0.2167 (0.93)	0.1393 (0.91)	0.2166 (0.93)
Other nonnutritional morbidity signs evident (dummy)	0.1190 (0.71)	0.1168 (0.46)	0.1122 (0.67)	0.1016 (0.40)
If medium-farm household (dummy)	0.2494 (1.23)	0.2816 (0.92)	0.2440 (1.21)	0.2769 (0.91)
If large-farm household (dummy)	-0.4579 (-2.18)*	-0.0397 (-0.13)	-0.4606 (-2.21)*	-0.0413 (-0.13)
Annual net household income (Rs '0,000)	0.6756 (1.77)	0.9900 (1.71)	0.6763 (1.77)	0.9844 (1.77)
Birth order (number)	0.0255 (0.51)	0.0053 (0.07)	0.0262 (0.53)	0.0065 (0.09)
Participation rate of mother (ratio)	0.2343 (0.80)	-0.7414 (-1.68)	0.2476 (0.85)	-0.7149 (-1.63)
Age^2	0.0523 (6.89)**	0.0278 (2.45)*	0.0535 (7.04)**	0.0301 (2.66)**
Intercept	-19.181	7.9215	-19.1738	7.7615
$\bar{R}^2$	0.88	0.73	0.88	0.73
Standard error of the estimate	2.0895	3.1655	2.0849	3.1540

* Significant at 5% level. ** Significant at 1% level.

Table 21. Determinants of height (cm) of children 1-12 years in six southern Indian villages, 1976-78.

Explanatory variables	Model 1	Model 2	Model 3	Model 4
Protein intake per caput (g)	-0.0005 (-0.05)	-0.0237 (1.87)		
Energy intake per caput (kcal)			-0.0722 (-0.22)	1.1005 (2.43)*
"Surplus" season (dummy)	0.3556 (0.96)	0.3220 (0.63)	0.3558 (0.96)	0.3261 (0.64)
Age (yrs)	5.0111 (17.68)**	6.9606 (18.44)**	5.0211 (17.61)**	6.8835 (18.10)**
Weight (kg)	1.4522 (21.21)**		1.4534 (21.17)**	
Arm circumference (cm)	0.4167 (2.75)**		0.4166 (2.74)**	
Male (dummy)	-0.0119 (-0.03)	-0.4958 (-1.02)	-0.0116 (-0.03)	-0.4893 (-1.01)
Family size (number)	-0.2263 (-3.11)**	-0.4372 (-4.44)**	-0.2273 (-3.13)**	-0.4309 (-4.38)**
Educated mother (dummy)	-0.1841 (-0.33)	0.5631 (0.73)	-0.1803 (-0.32)	(0.5459 (0.71)
Caste rank (% of village in a lower category)	-0.0100 (-1.34)	-0.0211 (-2.08)*	-0.0100 (-1.34)	-0.0215 (-2.12)*
Dokur village (dummy)	-0.3435 (-0.53)	-1.3743 (-1.54)	-0.3233 (-0.49)	-1.5780 (-1.75)
Shirapur village (dummy)	-0.2858 (-0.44)	-0.3045 (-0.34)	-0.2790 (-0.43)	-0.1914 (-0.22)
Kalman village (dummy)	-1.2440 (-2.06)*	-0.5906 (-0.71)	-1.2342 (-2.10)*	-0.4620 (-0.57)
Kanzara village (dummy)	-4.3618 (-6.16)**	-6.1102 (-6.32)**	-4.3420 (-6.26)**	-6.0452 (-6.39)**
Kinkheda village (dummy)	-3.4036 (-4.66)**	-3.5529 (-3.57)**	-3.3766 (-4.72)**	-3.5523 (-3.65)**
Whether nutritional morbidity signs evident (dummy)	0.3545 (0.91)	0.6329 (1.19)	0.3575 (0.92)	0.6368 (1.20)
Other nonnutritional morbidity signs evident (dummy)	-0.1961 (-0.46)	-0.0248 (-0.04)	-0.1950 (-0.46)	-0.0474 (-0.08)

Continued.

Table 21 continued.

Explanatory variables	Model 1	2	3	4
If medium-farm household (dummy)	0.3017 (0.59)	0.6495 (0.93)	0.3065 (0.60)	0.6485 (0.93)
If large-farm household (dummy)	0.4581 (0.86)	0.5552 (0.77)	0.4630 (0.87)	0.5586 (0.77)
Annual net household income (Rs '0,000)	-0.4564 (-0.47)	1.0246 (0.77)	-0.4602 (-0.48)	1.0126 (0.76)
Birth order (number)	-0.2812 (-2.24)*	-0.2537 (-1.47)	-0.2816 (-2.24)*	-0.2523 (-1.47)
Participation rate of mother (ratio)	-2.0187 (-2.74)**	-3.2245 (-3.19)**	-2.0262 (-2.75)**	-3.1929 (-3.17)**
Age^2	-0.1618 (-8.53)**	-0.1201 (-4.63)**	-0.1623 (-8.52)**	-0.1169 (-4.50)**
Intercept	56.8427	73.8258	56.8607	73.6054
$\bar{R}^2$	0.91	0.84	0.92	0.84
Standard error of the estimate	5.2847	7.2522	5.2846	7.2428

* Significant at 5% level. ** Significant at 1% level.

In both models 2 and 4 (Table 20), the medium- and large-farm dummies were not significant, and in the latter, the sign was negative. This was in contrast to the nutrient-intake regressions (Table 13) where all coefficients on these two variables were positive and 13 of the 20 were significant. Apparently, children from the larger farms consumed more food richer in essential nutrients, but this was not reflected in their weight and only to a limited extent in their height.

Regression equations were also fitted using calcium, iron, β-carotene, thiamine, riboflavin, niacin, ascorbic acid, and lysine in place of protein and energy. The signs and significance levels of most coefficients were much the same as in Table 20.

Similar regressions on the determinants of the heights of 1-12 year-old children showed that current protein and energy consumption had a less significant effect on height than on weight (Table 21). As expected, height increased but at a decreasing rate as the child grew older.

The negative effect of larger family sizes was statistically more pronounced on height than on weight. This suggests that family size primarily affects the early growth of the child, and while this retardation is permanent, it does not impair the child's ability to enhance its weight. The same is apparently true of children from the higher-caste families, who are significantly shorter than others but not lighter. Contrary to the determinants of weight, large-farm households have taller children, but the effect is not significant. The implication here is that large-farm children are better off earlier in life when their basic height (or permanent anthropometric status) is

established. Transitory anthropometric status, as measured by weight, does not appear to be affected and, if anything, large-farm children are lighter than children from landless, small- and medium-farm families.

Current net household income has much less explanatory power in the height equations than in weight equations. This is a reflection of the fact that height is primarily a feature predetermined by genetic and early-childhood experience, whereas weight is more transitory. Children higher in the birth order (i.e., the youngest) are shorter than those who are lower in the order, but of the same age and with similar socioeconomic characteristics. No such effect was evident in the case of a child's weight, again reinforcing that the influence of birth order manifests itself early in a child's life.

A number of regressions were also fitted to the data on the 1-6 year-old children in the subsample of households used in the time-allocation study (reported later), to determine if the time spent by other family members could help explain weight-for-age and weight-for-height.[20] In all there were 74 observations and 21 explanatory variables in the regressions. The explanatory variables were protein or energy intake, season, sex, family size, education of mother, caste rank, village dummies, morbidity dummy, net household income, birth order, size of landholding dummies, average time spent per day by family members in agricultural activities, average time spent by family members per day on child care activities, and leisure time of the mother.

In general, the explanatory power of the above specification was greater ($\bar{R}^2$ equals 0.32) in the weight-for-age equation than in the weight-for-height equation ($\bar{R}^2$ equals 0.05). In the weight-for-age equation sex, birth order, and the Kinkheda village dummy were the only variables that were statistically significant. The size of the coefficients suggests that these male children have a weight-for-age which is 10 percentage points lower than that of females, after making adjustments for the effects of other variables. Female children would not seem to be discriminated against in these six villages in terms of this measure of nutritional status, as is commonly believed. This supports the Administrative Staff College of India's (1982) finding in Tamil Nadu that there was no significant difference in nutrient consumption among young boys and girls.

Children one step lower in the birth order have, generally, a 3 percentage point reduction in their weight-for-age according to these regression results. This confirms the effect of birth order on nutrient intakes (as we had found earlier) but not its effect on weight. The weight-for-age results are in line with conventional wisdom (WHO 1976). Children of Kinkheda were found to have a weight-for-age some 21 percentage points lower than those of Aurepalle children. Why this was so is not clear.

We could not detect any significant effect of differences in average household time-allocation patterns (measured by participant observation three times during the study period) on the weight-for-age of 1-6 year-old children. Blau (1981), in a study in Nicaragua, also did not find a significant relationship between the mother's hours of work and either child mortality or child nutritional status as measured by standardized height.

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20. Waterlow (1976) describes those with a deficit in weight-for-age as stunted, which is a reflection of past nutritional history. Those with a deficit in weight-for-height are described as wasted due to an inferior current nutritional status. Seoane and Latham (1971) state that the latter measure is the most relevant for assessment of current undernutrition.

There were only two statistically significant variables in the weight-for-height regression: energy consumption and the Kanzara village dummy. The magnitude of the energy effect was, however, extremely small--an increase in energy intake of 1000 kcals would only lead to an increase of 6 percentage points in the weight-for-height index.

In summary, the results of these latter regressions were inconclusive, but they do indicate that there are many more influences on the nutritional well-being of preschool children, as measured by these anthropometric indices, than we were able to specify in our equations.

Results of Time-Allocation Analysis

The results of the time-allocation analysis are presented in terms of the average time spent by men, women, and children on the eight main activities (mentioned earlier), since there appeared to be no substantial variations in time allocation across the four rounds. In all, observations available on 285 individuals were recorded in each round (Appendix Table 63).[21]

It was found that leisure occupied much of the time of family members in all regions; next came agricultural activities, ranging from 1 hour to 11 hours; domestic activities ranging from less than a few minutes to almost seven hours (Table 22) followed. Community activities took up the least time: only a few minutes.

Men, women, and children from the labor and small-farmer group all spent more time on agricultural activities compared with those from medium- and large-farmer groups (Table 23). A possible explanation for this could be that, apart from working on their own limited landholdings, they entered the daily labor market more frequently. Ghodake, Ryan, and Sarin (1981) found that males and females from labor households participated more in the daily labor market than those from cultivator households. Those from labor and small-farm households also tended to enter the daily labor market at similar times during the year.

There was little difference between the time spent on agricultural activities by men and women from medium- and large-farm households. But this was not the case with children: children from medium-farm households spent the least time on agricultural activities. Among regions, the time expended on agricultural activities by men, women, and children of Dokur was the greatest, followed by Sholapur, Akola, and Aurepalle.

Across the four regions, men spent more time than women on agricultural activities, and children the least.

As expected, women in all regions spent more time on domestic activities than men and children. Women from medium-farm families devoted more time to domestic activities than those from labor and small-farm families. This may be because women from medium-farm families spent less time on agricultural activities than the latter. The difference in the time expended by men and

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21. While investigators gathered household time-allocation data by participant observation for a complete day, in practice some of the data were collected retrospectively. This was particularly the case with late evening, early morning, and midday activities when investigators could not be present in the households. As villagers are noted for their noncognizance of time, such activities may be subject to significant errors of measurement.

children in the three farm-size groups does not follow a definite pattern but, in general, men, women, and children from Akola spent more time on domestic activities than those from the other regions.

Table 22. Range of time spent (in hours and minutes) on various activities in six southern Indian villages, 1976-78.

Activity	Range
1. Leisure	11.25 - 18.00
2. Agriculture	1.00 - 11.00
3. Domestic	0.05 - 6.45
4. Schooling	1.00 - 5.30
5. Personal care	0.40 - 2.10
6. Child care	Less than a minute - 0.55
7. Religious and social	Less than a minute - 0.40
8. Community	Few minutes (negligible)

Leisure, including sleeping time, took up 11.5 to 18 hours in a day. Children were found to have more leisure than adults in Maharashtra villages; and men and women about the same in all regions. This may, however, be a spurious result because the investigators did not accompany the men out of the house and, generally, marked all time away from home as an agricultural activity. Females from large-farm families, and children from labor and small-farm households had, generally, more leisure time than their counterparts in the other categories. Children from landless and small-farm families had more leisure compared with other children because their school attendance was poorer.

Adults from Aurepalle and Dokur had more leisure time than those from Sholapur and Akola. Children from the Maharashtra villages, on the other hand, had more leisure and spent more time on domestic activities and less on agricultural activities compared with children from the two Andhra Pradesh villages.

The time spent on personal care did not differ much among landholding groups in every region. Women, however, spent slightly more time on this activity compared to men and children. Men, women, and children from Maharashtra villages spent the most time on personal care, and those from Dokur the least.

In every region, time expended on child care was quite small irrespective of landholdings. This may be because child care is a joint activity and the fact that it was often disregarded on account of being the lesser of two joint tasks. When the time spent on child care was calculated only for those families with children 1-6 years of age (Table 24), the time-allocation picture was a little better than when all families were considered in the analysis above (Table 23). As in the case of personal care, women spent slightly more time on child care than did men and children.

Table 23. Time allocated (h/day) for various activities in six southern Indian villages in four regions.

Category	Farm-size groups	Region			
		Aurepalle	Dokur	Sholapur	Akola
			Agricultural		
Men	Landless laborers and small farmers	7.04	11.02	9.23	8.58
	Medium farmers	3.69	8.23	8.04	7.84
	Large farmers	5.83	8.58	8.35	6.17
Women	Landless laborers and small farmers	5.20	4.94	4.17	3.62
	Medium farmers	1.67	5.49	3.92	2.88
	Large farmers	1.62	2.14	3.38	1.52
Children	Landless laborers and small farmers	4.03	5.45	1.92	3.37
	Medium farmers	1.04	-	0.47	-
	Large farmers	2.28	3.29	2.51	0.59
			Domestic		
Men	Landless laborers and small farmers	0.73	0.19	0.55	0.61
	Medium farmers	0.42	0.32	0.62	0.93
	Large farmers	0.63	0.19	0.48	1.44
Women	Landless laborers and small farmers	2.74	3.93	5.28	5.15
	Medium farmers	6.00	4.57	4.44	6.76
	Large farmers	3.87	4.41	4.46	5.59
Children	Landless laborers and small farmers	0.40	-	0.83	0.94
	Medium farmers	0.53	-	0.48	0.37
	Large farmers	0.10	0.10	0.53	1.87
			Leisure		
Men	Landless laborers and small farmers	14.64	11.69	12.15	12.05
	Medium farmers	17.94	14.24	13.22	13.06
	Large farmers	15.67	14.27	13.09	13.48
Women	Landless laborers and small farmers	13.82	13.54	12.20	12.63
	Medium farmers	14.51	12.52	12.87	11.42
	Large farmers	15.84	15.76	12.93	13.27
Children	Landless laborers and small farmers	16.36	17.45	18.07	16.55
	Medium farmers	15.93	-	16.83	17.46
	Large farmers	14.75	17.10	16.34	16.24
			Personal care		
Men	Landless laborers and small farmers	0.87	0.69	1.67	2.10
	Medium farmers	1.27	0.66	1.75	1.98
	Large farmers	1.05	0.80	1.89	2.05

Continued.

Table 23 continued.

Category	Farm-size groups	Region			
		Aurepalle	Dokur	Sholapur	Akola
Women	Landless laborers and small farmers	1.21	0.97	1.69	1.94
	Medium farmers	1.02	0.88	1.84	1.83
	Large farmers	1.23	0.96	1.81	2.08
Children	Landless laborers and small farmers	0.95	0.72	1.85	1.76
	Medium farmers	1.23	-	1.95	2.22
	Large farmers	1.10	0.97	1.76	1.83
		Child care			
Men	Landless laborers and small farmers	0.34	-	0.003	0.12
	Medium farmers	0.17	0.13	0.01	0.12
	Large farmers	0.61	-	0.17	0.12
Women	Landless laborers and small farmers	0.95	0.05	0.36	0.58
	Medium farmers	0.25	0.43	0.64	0.67
	Large farmers	0.79	0.30	0.47	0.81
Children	Landless laborers and small farmers	0.18	0.15	0.15	0.34
	Medium farmers	0.35	-	-	0.17
	Large farmers	0.07	-	0.06	0.46
		Schooling			
Children	Landless laborers and small farmers	1.98	-	1.11	0.48
	Medium farmers	4.88	-	4.16	3.72
	Large farmers	5.54	2.44	2.57	2.45
		Religious and social			
Men	Landless laborers and small farmers	-	-	-	0.04
	Medium farmers	-	-	-	0.05
	Large farmers	-	-	-	0.36
Women	Landless laborers and small farmers	-	-	0.09	0.01
	Medium farmers	-	-	0.10	0.05
	Large farmers	-	-	0.65	0.40
Children	Landless laborers and small farmers	-	-	-	-
	Medium farmers	-	-	-	0.05
	Large farmers	-	-	0.01	-

Women from landless and small-farm families in Dokur spent, on an average, only three minutes per day on child care. This is much less compared to other villages, and may be because they participate more in hired-labor activities throughout the year than other women. While this is not reflected in the daily analysis presented in Table 23, it becomes evident when the whole year is analyzed (Ghodake et al. 1981).

School attendance was lowest among children from labor and small-farm households. This may be because they spent more time on agricultural activities and/or accompanied their parents to the fields. Even though these children have more leisure time than children from medium- and large-farm households, it is

not spent on schooling, which is a discouraging finding. Another reason may be the cost of notebooks, textbooks, etc. Time spent in school by Dokur children was the least, averaging less than 1 hour; Aurepalle children spent the most: approximtely 4 hours.

Time spent on community activities in the villages was negligible; only men from medium-farm households in Aurepalle, and from large-farm households in the Akola region engaged in them.[22]

Table 24. Comparison of average time spent (h/day) by men, women, and children on child-care activities by all families, and by families with young children in six southern Indian villages in four regions.

	Region			
Type of family	Aurepalle	Dokur	Sholapur	Akola
Average time spent per person in all families	0.47	0.12	0.20	0.40
Average time spent per person in families with young children	1.82	0.56	1.00	1.94

Maharashtra villages were conspicuous by the time--albeit limited--expended by their members on religious and social activities. In contrast, no resident of the Andhra Pradesh villages was observed to spend time exclusively on these activities. But that may be because these activities are performed at night and may have been classified by the investigators as leisure. Women spent comparatively more time than men and children on religious and social activities. Men from large-farm households spent more time on these activities than others, particularly in Akola.

The small amounts of time spent on personal and child care and the availability of adequate leisure time may indicate that child care, personal care, and hygiene are not given the importance they deserve, which is a discouraging finding. Improved nutrition may not only be a question of food but of food in relation to the total environment. If severe malnutrition is not so much due to food deficiencies as because of inadequate water, sanitation, and infection--as contended by some nutritionists and medical doctors (Margen 1981)--then the time spent at home on personal and child care can be a key element in strategies that address this problem.

Conclusions

The diets of people living in these six SAT villages of Maharashtra and Andhra Pradesh were mostly deficient in energy, calcium, β-carotene, B complex vitamins, and ascorbic acid. Proteins and essential amino acids were not generally limiting, except in particular circumstances, as is increasingly being found by nutrition studies. In view of the acute vitamin and mineral deficiencies in these villages, programs to increase the production of vegetables, dairy products, and fruits that contain significant quantities of these nutrients would seem appropriate. Increased production would tend to lower their relative prices and thereby enhance the real incomes of the

22. Community activities often took place at night when the investigators were not present in the households. Hence, these findings may understate the true picture.

villagers. As income elasticities of demand for such "protective foods" seem high, a significant increase in consumption of deficient vitamins and minerals could result. Nutrition education programs could further assist this process. The energy deficit could be largely overcome by increasing the availability of food grains, especially cereals. The findings do not support Lipton's (1975) thesis that increased production of fruits, vegetables, and milk will be detrimental to the poor in developing countries.

Villagers in Maharashtra were found to consume more sorghum and millet than those in Andhra Pradesh, who rely more on rice. The Maharashtra villagers therefore showed better vitamin and mineral intakes. This supports earlier findings that ICRISAT can make a major contribution to the improvement of nutritional status in India by concentrating on increasing the yields and yield stability of its mandate crops to facilitate increased intakes. Substantial efforts to improve protein content and protein quality would not seem necessary, especially if they involve some sacrifice in attaining yield and stability increases.

Data from this study show that sorghum and millet contributed 12% of the calcium, 27% of the β-carotene, and 21% of the riboflavin in diets of 1-12 year-old children in the two Andhra Pradesh villages; and 24%, 26%, and 71% in the four Maharashtra villages. Belavady (1977) has shown that improved Indian cultivars of sorghum have considerable genetic variability in their vitamin and mineral content. Hence, both the scope for research to manipulate vitamin and mineral contents, and the likelihood of a significant effect on diets of the malnourished would seem to exist. Further basic research on this question is desirable before screening for vitamins and minerals is initiated in breeding programs. Some improvement in nutrient status may be possible with such an approach, but it is unlikely to remove the vitamin and mineral deficiencies in diets. Again, the most effective strategy would be to increase production and consumption of foods that are major sources of vitamins and minerals presently deficient in diets.

Individual nutrient intakes of 1-12 year-old children were not influenced by the level of net household income after making allowances for other variables. Calcium, derived mainly from milk and dairy products, was an exception. This result differs from that of most previous studies probably because of the concept of income used. We used the net income concept, while others used either expenditure or gross income as their explanatory variable. If the present results are indicative of the relationship in the rest of the Indian semi-arid tropics, it appears that relying solely on income growth from economic development to alleviate nutritional deficiencies may not be sufficient, even though it may be necessary.

Absolute and relative nutritional status of individuals in this study, as measured by both anthropometric statistics and dietary intakes, was mostly dependent on the agroclimatic and socioeconomic characteristics of the villages and regions in which they are located. For example, residents of villages growing a cash crop such as cotton as the major enterprise had, generally, the best nutritional status. Villages where rice and other food grains dominated the cropping patterns usually had inferior diets. Nutrition programs in SAT regions should probably focus on whole villages and not be overly concerned with particular socioeconomic groups within them, with the exception of individual households with the following characteristics.

- Those with larger families, other things being equal, as nutritional intakes of children were found to be generally lower in these families, except for vitamin A.

- Landless and small-farm households, other things being equal, as nutrient

intakes of children were worse in these households.

- Households where mothers have no formal education, as it was found that intakes of vitamin A and calcium were higher among children of educated mothers. But since consumption of these nutrients does not seem to increase as children become older, special programs for all households may be desirable to ensure that vitamin A and calcium intakes increase as children grow older.

Contrary to the finding by a number of studies, reviewed by Schofield (1974), Longhurst and Payne (1979), and Chambers (1982), our research did not reveal any significant seasonal variation in anthropometric indices or in nutrient intakes, except for B complex vitamins, whose consumption generally increased during periods when food grains are available in surplus. These periods were mostly in the dry se sons in these six villages.

The view put forth by the authors cited above that the wet season is when malnutrition and morbidity are at their peak is an oversimplification so far as these villages are concerned. Even though food-grain availability may be greater in the surplus (dry) seasons, the availability of "protective" foods such as leafy vegetables is much more restricted than in the wet season. As lack of vitamins and minerals causes a major dietary gap in these SAT villages, directing nutrition programs to the wet season would not address the entire problem. More research is required on vitamin and mineral nutrition in terms of enhancing their availability, especially in the dry season. It is in the latter area that further development of common property resources (CPR) such as village forests and fallow lands could play a key role. Jodha (1982) found that CPR contribute significantly to the income and nutrition of lower-income groups in the SAT villages he studied. If sources of vitamins and minerals could be developed, making them freely available primarily in the dry season, and if these crops could be grown on CPR, it could help alleviate a major nutritional problem. Tree crops probably hold out the best prospect. In the wet season, annual crops on private fields can, no doubt, provide the answer. The advantage of providing foods high in vitamins and minerals from CPR is that it is the poor people who would primarily benefit. Further research is required to quantify more precisely the seasonal patterns of availability of nutrients derived from CPR in SAT villages. When this has been done, research and policy strategies aimed at filling in the nutritional gaps can be devised.

The inferences derived by Chambers (1982) and Longhurst and Payne (1979) that improved technologies should not exaggerate labor peaks in the wet season lest energy balances are adversely affected may not hold. To advocate, as Longhurst and Payne (1979) do, appropriate mechanization, chemical weed control, and use of high-yielding varieties that are less time constrained in the wet seasons when energy balance is apparently negative, is to ignore two basic factors. Firstly, creation of labor peaks is one of the few avenues whereby laborers can expect to increase their wage rates and employment opportunities. With expenditure elasticities of demand for calories around 1.0 for low-income groups in rural India (Radhakrishna and Shah 1981), creation of wet-season labor peaks could result in a net improvement in nutritional status. However, this is an empirical question which only further research can answer. Landless and small-farm families, who rely mostly on wage labor for their sustenance, would benefit the most from creation of labor peaks. Labor-saving technologies can only make their economic position worse. Secondly, in situations where soils are of the kind that have a high moisture-holding capacity such as Vertisols (deep black soils), which are spread over large tracts in SAT India, peak labor activities occur mostly in the dry (mostly surplus food-grain availability) season, as crops are grown in the dry season on residual soil moisture. In such agroclimatic environments and in villages with high irrigation, there is no necessary tradeoff between additional work activity in the peak-labor periods

and energy balance. The problem mainly emerges in areas such as Aurepalle which have Alfisols (red soils) with low moisture-holding capacity and little irrigation, and where crops are grown only in the wet season, corresponding to the period when food-grain availability is low and labor demand high. To a lesser extent the seasonality issue emerges in regions such as Akola which have medium-deep to shallow Vertisols with moderate moisture-holding capacity. Here, as in Dokur, crops are grown during both wet and dry seasons.

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Appendix Tables 1 - 18

Village Characteristics, Survey Methodology, and Analytical Procedures

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Appendix Table 1. General information on the selected villages.

Details	Aurepalle	Dokur	Shirapur (Sholapur)	Kalman	Kanzara	Kinkheda
Location code number	40[1]	42[1]	54[2]	3[2]	42[3]	130[3]
Area in sq. miles	6.28[1]	4.55[1]	5.70[2]	9.90[2]	2.30[3]	2.00[3]
Total number of households	476	313	297	423	169	143
Total population	2711	1783	1615	2368	930	687
Percentage of literacy	15[1]	15.81[1]	17.17[2]	13.3[2]	33.68[3]	28.64[3]
No. of landless labor households	131	41	70	102	55	58
No. of land owners completely leased-out or rented-out	7	22	44	110	5	2
No. of operational holding households	338	250	183	211	109	83
Area operated in hectares	1193.93	655.87	1195.55	1682.6	664.78	478.14
Average size of landholding in hectares	3.53	2.62	6.53	7.97	6.1	5.76
Percentage of irrigable area to total operated area	12.04	32.28	8.23	9.19	4.45	0.93
Distance from nearest town/marketing center (km)	8	5	8	35	8	13
Distance from taluka headquarters/block	21	45	8	35	8	13
Distance from nearest pucca road	8	3	2.4	5	7	0.4
Distance from nearest railway station	70	5.6	6.4	37	4	0.4
Distance from nearest bus stand	0	5	2.4	35	0.2	0.4
Distance from nearest sub-post office	2	0	0	0	0	0
Road connection (all weather, fair weather, no road)	All weather	All weather	Fair weather	All weather	All weather	Fair weather
Frequency of bus services (per day)	4	3	Nil	3	5	10
Education facilities	UP[4]	UP	H[4]	H	UP	P[4]
Medical facilities	Nil	PM[4]	Nil	PHC[4]	Nil	PM
Veterinary facilities	Nil	Nil	Nil	Veterinary Hospital	Nil	Nil
Drinking water facilities	Well	Well	Well	Well	Well	Well
Electrified?	Yes	Yes	Yes	Yes	Yes	Yes
Weekly market	Nil	Devarkadra	Nil	Kalman	Murtizapur	Murtizapur
No. of shops	8	10	3	9	5	3
No. of tea shops	1	7	2	4	1	Nil
No. of cooperatives	2	Nil	1	1	1	1
No. of radios	25	42	16	35	32	11
No. of newspaper facilities	3	2	1	2	1	Nil
No. of electric pumpsets	120-150	28	22	32	26	3
No. of oil engines	11	31	4	21	1	4
No. of grinding mills	2	1	3	3	2	1
Type of soils (with % of area)	Red soil 23% Sandy soil 28% Shallow black 15% Gravelly soil 19% Alkaline/ problem soil 15%	Shallow red 55% Deep red 10% Medium black 30% Deep black 5%	Deep black 50% Medium black 20% Shallow black 30%	Deep black 25% Medium black 50% Shallow black 25%	Shallow black 15% Medium black 75% Deep black 10%	Shallow black 30% Medium black 50% Deep black 10% Shallow red 10%

1. District Census Hand Book, Census 1971, Mahbubnagar District, Directorate of Census Operation, Andhra Pradesh.
2. District Census Hand Book, Census of India 1961, Sholapur, The Maharashtra Census Office, Bombay.
3. District Census Hand Book, Census of India 1961, Akola, The Maharashtra Census Office, Bombay.
4. P = primary school; UP = upper primary school; H = high school; PM = private medical practitioner; PHC = primary health center.

Appendix Table 2. Dates of diet, nutrition, and health surveys.

Village	Round	Dates	Season: Food supply	Season: Climate[1]
Aurepalle	1	29 October - 07 November, 1976	Surplus	Dry
	2	01 April - 13 April, 1977	Lean	Dry
	3	29 June - 11 July, 1977	Lean	Wet
	4	16 November - 25 November, 1977	Surplus	Dry
Dokur	1	03 January - 17 January, 1977	Surplus	Dry
	2	23 April - 30 April, 1977	Surplus	Dry
	3	04 August - 21 August, 1977	Lean	Wet
	4	28 January - 03 February, 1978	Surplus	Dry
Shirapur	1	29 December - 08 January, 1977	Lean	Dry
	2	24 April - 29 April, 1977	Surplus	Dry
	3	18 August - 02 September,1977	Lean	Wet
	4	04 January - 10 January, 1978	Lean	Dry
Kalman	1	09 December - 15 December, 1976	Lean	Dry
	2	06 April - 10 April, 1977	Surplus	Dry
	3	01 August - 15 August, 1977	Lean	Wet
	4	16 December - 25 December, 1977	Lean	Dry
Kanzara	1	30 October - 13 Novemebr, 1976	Surplus	Dry
	2	16 March - 30 March, 1977	Surplus	Dry
	3	25 June - 06 July, 1977	Lean	Wet
	4	19 October - 27 October, 1977	Surplus	Wet
Kinkheda	1	11 October - 15 October, 1976	Surplus	Wet
	2	28 February - 06 March, 1977	Surplus	Dry
	3	09 June - 20 June, 1977	Lean	Wet
	4	07 November - 22 November, 1977	Surplus	Dry

1. The wet season is generally from June to October, and the dry season from November to May.

Appendix Table 3. Facsimile of the household schedule used in the study.

NIN-ICRISAT-HSC Collaborative Study

HOUSEHOLD SCHEDULE

State: District: Taluq: Block: Date: Village:

Family No: Name of head of the family: Community:

Household members and their demographic particulars: Type of House:

S.No.	Name of the member	Relation to head	Sex	Age	Marital status	Literacy	Major occupation	Income per annum	REMARKS
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									
13.									
14.									
15.									

Continued.

Appendix Table 3 continued.

INDIVIDUAL DIETARY INTAKE (ORAL QUESTIONNAIRE)*

Family No. Name of the head of the family (with surname) Date

Village Code: A/B/C/D/E/F State: Maharashtra/A.P.

Particulars	Serial number of the Individual						
	1	2	3	4	5	6	7
Name							
Age in years							
Sex							
Physiological Status**: NPNL/Preg./Lact./BF/BF+S/S							
Height (cms)							
Weight (kgs)							
Arm circumference (cms)							
Fat Fold at Triceps (mms)							
Head Circumference (cms)							
Chest Circumference (cms)							
Clinical signs [NAD (✓)/Present (●)]							

Type of preparation	Foodstuffs	Raw amount g.	Total cooked quantity	Individuals' Intake (Cooked Quantity)						
				1	2	3	4	5	6	7
Early morning										

* Record participation in any feeding programme with details and food consumed outside the home.
** NPNL: Non-Pregnant Non-Lactating; Preg.: Pregnant; Lact.: Lactating; BF: Breast-fed only; S: Supplements only.
● Enter the code number of the sign (from Nutrition Assessment Schedule).
Village Code: A = Aurepalle; B = Dokur; C = Shirapur; D = Kalman; E = Kanzara; F = Kinkheda.
In case of cereals and millets specify whether freshly (within two months) harvested or not, and name the variety.

Continued.

Appendix Table 3 continued.

INDIVIDUAL DIETARY INTAKE (ORAL QUESTIONNAIRE)

				Individuals' Intake (Cooked Quantity)						
				Name of the Individual						
	Type of preparation	Foodstuff	Raw Amount g.	Total cooked quantity	1	2	3	4	5	6	7
Breakfast											
Mid-morning											
Lunch											
Tea & Snacks											
Dinner											

Appendix Table 4. Standard weights and measures used in the study.

Kalman and Shirapur

Cup no.	Volume of cups (ml)
1	2299
2	1380
3	1043
4	780
5	527
6	341
7	220
8	172
9	120
10	87
11	46
12	28
13	17

Local measures used in Shirapur and Kalman

1 Payli = 4 sher
1 Adhli = 2 Sher
1 Sher = 2 Athwa
1 Athwa = 2 Chipta
1 Chipta = 2 Kolwa
1 Kolwa = 2 Nilwa
1 Nilwa = 2 Chilwa

Sorghum flour: 1 Sher = 1130 g

Cup no.	Wt. of Sorghum flour (g)
1	1130
2	700
3	580
4	385
5	270
6	195

Wheat flour: 1 Sher = 1000 g
1 Athwa = 500 g

Continued.

Appendix Table 4 continued.

Cup no.	Weight (g)
Red gram dhal:	
1	1670
2	1015
3	765
4	535
5	375
6	265
7	200
8	125
9	70
Bengal gram dhal:	
9	80
8	140
7	214
6	290
5	412
Bengal gram flour:	
5	250
6	178
7	120
8	75
9	46
Green gram dhal: 1 Kolwa = 107 g	
4	610
5	430
6	300
7	215
8	143
9	80
10	50
Horse gram:	
3	812
4	582.5
5	426.0
6	311
7	215
8	137

Continued.

Appendix Table 4 continued.

	Cup no.	Weight (g)
Bengal gram (whole):		
	9	72
	8	135
	7	200
	6	258
	5	385
Sugar:		
	8	165
	9	96
	10	72
	11	42
	12	25
	13	15
Red chilli powder:		
	9	45
	10	37
	11	22
	12	18
	13	8
	3 standard spoons = 8 g	
	1 standard spoon = 3 g	
Groundnuts: 1 Sher = 1 kg		
	6	228
	7	177
	8	112
	9	67
	10	55
	11	28
	12	18
Garlic:		
	Large = 20 g	
	Medium = 10 g	
	Small = 5 g	
Onion:		
	Large = 60 g	
	Medium = 40 g	
	Small = 20 g	

Continued.

Appendix Table 4 continued.

Cup no.	Wt. of wheat flour (g)
1	1000
2	675
3	506
4	356
5	253
6	183

Maize flour: 1 Sher = 1132 g

Cup no.	Wt. of maize flour (g)
1	1200
2	730
3	565
4	395
5	275
6	195

Vermicelli

4	250
5	190
6	150
7	85
8	60
9	30

Rice

1 Kolwa = 200 g

Cup no.	Wt. of raw rice (g)
7	230
6	322
5	467
4	633
3	927

Red gram dhal - local measures

1 Kolwa	=	217.8 g
1 Chilwa	=	60.0 g
1 Chipta	=	465.0 g
1 Nilwa	=	106.0 g

Continued.

Appendix Table 4 continued.

Milk - local measures

1 Kolwa	=	200 ml
1 Chipta	=	500 ml
1 Nilwa	=	100 ml
1 Chilwa	=	50 ml
1/2 Chilwa	=	25 ml
1 Chatak	=	50 g

Weight of milk:

Cup no.	Wt. in g
6	344
7	213
8	172
9	120
10	89
11	45
12	27
13	17

Weight of oil:

10	63
11	41
12	22
13	14.5

Appendix Table 5. Example of method used to calculate dietary intake.

Type of preparation	Foodstuffs	Raw amount (g)	Total cooked quantity	Individual intake (cooked quantity) 1	2	3	4	5	6
				HA1	HB2	HC3	HC4	dog	
"Tur dhal"	Red gram dhal	8* (125 g)	3* (1043 g)	6* (341 g)	7*	7*	9*	rest	
	Onions	1 large (20 g)							
	Chilli powder	3 spoons (8 g)							
"Jowar bhakry"	Sorghum flour	1-1/4 "sher" (1413 g)	7 "bhakry"	2	2	1	1	1	

*Cup number.

Method of calculation adopted was as follows.

$$\text{Dhal: } \frac{125\text{ g}}{1043\text{ g}} \times 341\text{ g} = 41\text{ g; Onions: } \frac{20\text{ g}}{1043\text{ g}} \times 341 = 7\text{ g; Chilli: } \frac{8\text{ g}}{1043\text{ g}} \times 341\text{ g} = 2.6\text{ g;}$$

$$\text{Sorghum: } \frac{1413\text{ g}}{7} = 202\text{ g each} \times 2 = 404\text{ g.}$$

Thus, "HA1" ate 41 g red gram, 7 g onions, 2.6 g chilli powder, and 404 g sorghum flour.

Appendix Table 6. Daily allowances of nutrients for Indians.[1]

Group	Particulars	Calories	Proteins (g)	Calcium (g)	Iron (mg)	Vitamin A: Retinol (µg)	Vitamin A: or β-carotene (µg)	Thiamine (mg)	Riboflavin (mg)	Nicotinic acid (mg)	Ascorbic acid (mg)	Folic acid (ug)	Vitamin B_{12} (ug)	Vitamin D (IU)
Man	Sedentary work	2400	55	0.4-0.5	20	750	3000	1.2	1.3	16	50	100	1	
	Moderate work	2800						1.4	1.5	19				
	Heavy work	3900						2.0	2.2	26				
Woman	Sedentary work	1900	45	0.4-0.5	30	750	3000	1.0	1.0	13	50	100	1	
	Moderate work	2200						1.1	1.2	15				
	Heavy work	3000						1.5	1.7	20				
	Pregnancy (second half of pregnancy)	+300	+10	1.0	40	750	3000	+0.2	+0.2	+2	50	150-300	1.5	
	Lactation (up to 1 year)	+700	+20		30	1150	4600	+0.4	+0.4	+5	80	150		
Infants	0-6 months	120/kg	2.3-1.8/kg	0.5-0.6	1.0 mg/kg	400					30	25	0.2	200
	7-12 months	100/kg	1.8-1.5/kg			300	1200							
Children	1 year	1200	17	0.4-0.5	15-20	250	1000	0.6	0.7	8	30-50	50-100	0.5-1.0	
	2 years		18											
	3 years		20											
	4-6 years	1500	22			300	1200	0.8	0.8	10				
	7-9 years	1800	33			400	1600	0.9	1.0	12				
	10-12 years	2100	41			600	2400	1.0	1.2	14				
Adolescents	13-15 yr Boys	2500	55	0.6-0.7	25	750	3000	1.3	1.4	17				
	13-15 yr Girls	2200	50		35			1.1	1.2	14				
	16-18 yr Boys	3000	60	0.5-0.6	25	750	3000	1.5	1.7	21				
	16-18 yr Girls	2200	50		35			1.1	1.2	14				

1. Source: Gopalan et al. (1976).

Appendix Table 7. Facsimile of the nutrition assessment schedule used by the National Nutrition Monitoring Bureau.

NATIONAL NUTRITION MONITORING BUREAU
(Indian Council of Medical Research)

NUTRITION ASSESSMENT SCHEDULE

State: District: Taluk: Date: Village:

Serial No. Family No. Block:

Name of the subject: Sex: Male/Female

Name of the Father/Guardian: Occupation:

Income (per annum): Date of birth: Age: Yrs mths.

Source: Parents/record

Breast fed/BF + Supplements/Not BF (BF) Pregnant/Lactating: mths.

ANTHROPOMETRY:
Heights (cms.): Fat fold at triceps (mms.):
Weight (kgs.): Head Circumference* (cms):
Arm Circumference (cms): Chest Circumference* (cms):

CLINICAL EXAMINATION:

Hair:
- Sparse 01.*
- Discoloured 02.*
- Easily plucked 03.*

Moon face 04.*
Parotid enlargement 05. (bilateral, painless)
Oedema 06.
Emaciation 07.
Marasmus 08.
Conjunctival xerosis 09.
Bitot's spots 10.
Corneal xerosis/ Keratomalacia 11.
Corneal opacity 12.
Night blindness 13.
Photophobia 14.
Anaemia 15.
Nasolabial dyssebacea 16.
Angular stomatitis 17.
Cheilosis 18.

Tongue:
- red & raw 19.
- Papillae-atrophic 20.
- Papillae-hypertrophic 21.

Pellagra 22.
Crazy pavement dermatosis 23.

Pigmentation at Knuckles/fingers/toes 24.
Phrynoderma 25.
Koilonychia 26.
Gums-spongy bleeding 27.
Craniotabes 28.
Epiphyseal enlargement 29.
Beading of ribs 30.
Knock-knees/bow legs 31.
Frontal parietal bossing 32.

Teeth:
- -caries 33.
- Mottled enamel 34.

Enlargement of spleen 35.
Enlargement of liver 36.
Soft
Firm
Hard
Thyroid enlargement 37.
Others 38.

* For children below 5 years only.

Appendix Table 8. Facsimile of the schedule showing weight and height standards (for boys) used by the National Institute of Nutrition.

NATIONAL INSTITUTE OF NUTRITION
Hyderabad - 500 007, India

Name: Age: Male/Female

Occupation: Income/month: Rs.

Educational Status: Family Size

Height cm	Weight kg	Arm circ. cm	FFT mm

REMARKS

YOUR RECORD

Height cm	Weight kg	Arm circ. cm	FFT mm

Expected Height- and Weight-for-Age--Boys

Age (yrs)	Height (cm)	Weight (kg)	Age (yrs)	Height (cm)	Weight (kg)
1.0	72.0	9.50	10.0	135.0	30.00
1.5	79.5	10.50	11.0	140.0	32.50
2.0	85.0	11.25	12.0	145.0	35.50
2.5	90.0	12.50	13.0	151.0	39.75
3.0	94.0	13.75	14.0	158.7	45.00
3.5	98.0	14.75	15.0	163.5	49.50
4.0	101.5	15.75	16.0	167.0	53.25
4.5	105.0	17.25	17.0	169.5	56.00
5.0	108.0	18.25	18.0	171.5	57.50
6.0	114.0	20.50	19.0	172.0	58.75
7.0	119.5	23.00	20.0	172.0	59.50
8.0	124.5	25.50	21.0	172.0	60.00
9.0	130.0	27.75			

Source: National Institute of Nutrition, Hyderabad-500 007.

Appendix Table 9. Facsimile of the schedule showing weight and height standards (for girls) used by the National Institute of Nutrition.

NATIONAL INSTITUTE OF NUTRITION
Hyderabad - 500 007, India

Name: Age: Male/Female

Occupation: Income/month: Rs.

Educational Status: Family size:

Height cm	Weight kg	Arm circ. cm	FFT mm

REMARKS

YOUR RECORD

Height cm	Weight kg	Arm circ. cm	FFT mm

Expected Height- and Weight-for-Age--Girls

Age (yrs)	Height (cm)	Weight (kg)	Age (yrs)	Height (cm)	Weight (kg)
1.0	72.8	8.70	6	114.0	19.50
1.5	78.5	9.80	7	119.0	22.00
2.0	83.8	10.50	8	124.0	24.75
2.5	88.5	11.30	9	130.0	27.50
3.0	92.8	12.25	10	136.0	30.50
3.5	97.0	13.30	11	141.5	33.75
4.0	100.3	14.45	12	147.5	38.75
4.5	104.0	15.65	13	152.5	43.25
5.0	108.0	16.90	14	154.5	45.00
			15	156.5	46.25
			16	157.0	47.50
			17	157.0	49.00

Source: National Institute of Nutrition, Hyderabad-500 007.

Appendix Table 10. Measurements, age groups, and standards used to analyze anthropometric data.

Measurement	Age group (in years)	Standards
Arm circumference	1-5	Wolanski, personal communication, 1964. (Jelliffe 1966.)
Arm circumference	6-17	O'Brien et al. 1941. (Jelliffe 1966.)
Arm circumference	18-99	O'Brien and Shelton 1941; Hertzberg et al. 1963. (Jelliffe 1966.)
Triceps skinfold thickness	1-5	Hammond 1955a; Tanner and Whitehouse 1962. (Jelliffe 1966.)
Triceps skinfold thickness	6-17	Hammond 1955a. (Jelliffe 1966.)
Weight-for-Age, Height-for-Age	1-17 (girls) 1-21 (boys)	National Institute of Nutrition, Hyderabad, India.
Weight-for-Height	1-18	Stuart and Stevenson 1959. (Jelliffe 1966.)
Weight-for-Height	19-99	Society of Actuaries 1959; ICNND 1963; Bridgforth, personal communication, 1965. (Jelliffe 1966.)

Appendix Table 11. Classification of household activities for time-allocation analysis.

1. Agricultural

   Collecting fuel
   Feeding/milling/tending animals
   Gathering information for productive purposes
   Handicrafts
   Home gardening
   Work outside on own farm
   Work outside on others' farm
   Work outside not on farms but for self
   Work outside not on farms but for others

2. Domestic

   Processing food including drying
   Cooking and preparing food
   Washing clothes and utensils
   Collecting water
   Marketing in village
   Cleaning in and around house
   Making/repairing clothes
   Serving

3. Leisure

   Leisure/recreation active
   Leisure/recreation non-active

4. Personal care

   Personal care and eating

5. Child care

6. Schooling

7. Community

8. Religious and social

Appendix Table 12. Relative rank of respondents' castes with traditional occupations, Aurepalle village.

Caste rank	Caste	Traditional occupation
1	Brahmin	Priest
2	Kapu	Cultivation
3	Velama	Cultivation
4	Padmasali	Weaving
5	Bogama	Dance and entertainment
6	Katika	Butcher
7	Gowda	Toddy tapping
8	Wadla	Carpentry
9	Chakali	Washing clothes
10	Kurama	Weaving
11	Mala	Agricultural labor
12	Madiga	Shoe-making

Aurepalle caste rank

Caste range	No. of families	Percentage	Range	New caste rank (mean)
1	2	5.0	95.0-100.0	97.50
2	7	17.5	77.5- 95.0	86.25
3	1	2.5	75.0- 77.5	76.25
4	1	2.5	72.5- 75.0	73.75
5	1	2.5	70.0- 72.5	71.25
6	1	2.5	67.5- 70.0	68.75
7	10	25.0	42.5- 67.5	55.00
8	1	2.5	40.0- 42.5	41.25
9	1	2.5	37.5- 40.0	38.75
10	6	15.0	22.5- 37.5	30.00
11	3	7.5	15.0- 22.5	18.75
12	6	15.0	0.0- 15.0	7.50

N = 40.

Appendix Table 13. Relative rank of respondents' castes with traditional occupations, Dokur village.

Caste rank	Caste	Traditional occupation
1	Reddy	Farming
2	Bhatrajulu	Court poets
3	Kammari	Blacksmithy work
4	Jogi	Farming
5	Musti	Farming
6	Telaga	Farming
7	Boya	Farming
8	Golla	Agriculture and sheep raising
9	Mangali	Barber service
10	Yerkali	Basket making and pig raising
11	Madiga	Shoe making

Dokur caste rank

Caste range	No. of families	Percentage	Range	New caste rank (mean)
1	7	17.5	82.5-100.0	91.25
2	2	5.0	77.5- 82.5	80.00
3	1	2.5	75.0- 77.5	76.25
4	1	2.5	72.5- 75.0	73.75
5	6	15.0	57.5- 72.5	65.00
6	6	15.0	42.5- 57.5	50.00
7	5	12.5	30.0- 42.5	36.25
8	4	10.0	20.0- 30.0	25.00
9	1	2.5	17.5- 20.0	18.75
10	1	2.5	15.0- 17.5	16.25
11	6	15.0	0.0- 15.0	7.50

N = 40.

Appendix Table 14. Relative rank of respondents' castes with traditional occupations, Shirapur village.

Caste rank	Caste	Traditional occupation
1	Maratha	Farming
2	Koshti	Weaving and farming
3	Wani	Trading
4	Mali	Agricultural labor
5	Shepherd	Agriculture and sheep raising
6	Muslims	Farming and Agricultural labor
7	Mahar	Agricultural labor
8	Huler	Agricultural labor

Shirapur caste rank

Caste range	No. of families	Percentage	Range	New caste rank (mean)
1	22	55.0	45.0-100.0	72.50
2	2	5.0	40.0- 45.0	42.50
3	1	2.5	37.5- 40.0	38.75
4	1	2.5	35.0- 37.5	36.25
5	9	22.5	12.5- 35.0	23.75
6	1	2.5	10.0- 12.5	10.50
7	4	10.0	0.0- 10.0	5.00

N = 40.

Appendix Table 15. Relative rank of respondents' castes with traditional occupations, Kalman village.

Caste rank	Caste	Traditional occupation
1	Maratha	Farming
2	Koshti	Farming and weaving
3	Wani	Trading
4	Mali	Agriculture
5	Goldsmith	Goldsmithy
6	Kumbhar	Agricultural labor and pot making
7	Shepherd	Agriculture and sheep raising
8	Waddar	Agricultural labor and stone raising
9	Mahar	Agricultural labor

Kalman caste rank

Caste range	No. of families	Percentage	Range	New caste rank (mean)
1	19	48.7	51.3-100.0	75.65
2	2	5.1	46.2- 51.3	48.75
3	2	5.1	41.1- 46.2	43.65
4	3	7.7	33.4- 41.1	37.25
5	1	2.6	30.8- 33.4	32.10
6	1	2.6	28.2- 30.8	29.50
7	8	20.5	7.7- 28.2	17.95
8	1	2.6	5.1- 7.7	6.40
9	2	5.1	0.0- 5.1	2.25

N = 39.

Appendix Table 16. Relative rank of respondents' castes with traditional occupations, Kanzara village.

Caste rank	Caste	Traditional occupation
1	Maratha	Farming
2	Kunbi	Farming
3	Gosavi	Living on alms or charitable relief and farming
4	Mali	Agriculture
5	Muslim	Farming
6	Sonar	Jewelry making
7	Potter	Pot making
8	Barber	Barber
9	Washerman	Washing clothes
10	Kaikadi	Basket making
11	Mahar	Agricultural labor
12	Mang	Musician and agricultural labor

Kanzara caste rank

Caste range	No. of families	Percentage	Range	New caste rank (mean)
1	7	17.5	82.5-100.0	91.25
2	1	2.5	80.0- 82.5	81.25
3	3	7.5	72.5- 80.0	76.25
4	14	35.0	37.5- 72.5	55.00
5	1	2.5	35.0- 37.5	36.25
6	1	2.5	32.5- 35.0	33.75
7	1	2.5	30.0- 32.5	31.25
8	2	5.0	25.0- 35.0	27.50
9	1	2.5	22.5- 25.0	23.75
10	1	2.5	20.0- 22.5	21.25
11	7	17.5	2.5- 20.0	11.25
12	1	2.5	0.0- 2.5	1.25

N = 40.

Appendix Table 17. Relative rank of respondents' castes with traditional occupations, Kinkheda village.

Caste rank	Caste	Traditional occupation
1	Kunbi (Tirale)	Farming
2	Kunbi (Ghatod)	Farming
3	Kalal	Distillers
4	Carpenter	Carpentry and agricultural labor
5	Shepherd	Farming and sheep raising
6	Gawari	Farming and cattle grazing
7	Muslim	Farming
8	Tirmoli	Farming and agricultural labor
9	Beldar	Construction of mud wall and farming
10	Mahar	Agricultural labor and farming

Kinkheda caste rank

Caste range	No. of families	Percentage	Range	New caste rank (mean)
1	2	5.0	95.0-100.0	97.50
2	11	27.5	67.5- 95.0	81.25
3	2	5.0	62.5- 67.5	65.00
4	2	5.0	57.5- 62.5	60.00
5	7	17.5	40.0- 57.5	48.75
6	8	20.0	20.0- 40.0	30.00
7	2	5.0	15.0- 20.0	17.50
8	2	5.0	10.0- 15.0	12.50
9	3	7.5	2.5- 7.5	6.50
10	1	2.5	0.0- 2.5	1.25

N = 40.

Appendix Table 18. Definitions used in the VLS income analysis.

A. Gross household income = gross farm income + gross nonfarm income	
1. Gross farm income	Income from crops, livestock, and from renting out family-owned resources (except family labor).
a. Crop income	The gross value of both main and byproducts of crops, including fodder grown on owned and leased-in land.
b. Livestock income	Includes the value of milk and animal products, such as eggs, meat, mutton, wool, cow dung, etc., and income from sale of animals and poultry birds.
c. Rental income	Embraces income received from hiring out bullocks, draft animals, machines and implements, and leasing out land.
2. Nonfarm income	Includes income from regular salaries and daily wages of family members; contract business; handicrafts, trades, artisanship, and others; and transfer incomes such as gifts, gambling, remittances, interest received from moneylending, and house rents.
B. Expenses	
1. Farm expenses	Crop cultivation + livestock maintenance + maintenance cost of production capital.
a. Direct costs (Out-of-pocket expenses)	
i. Crop expenses	1. Value of seed (home produced + purchased). 2. Value of fertilizers and organic manures. 3. Value of pesticides/insecticides. 4. Hired human labor. 5. Hired bullock labor. 6. Fuel and lubricant charges for operating farm machinery (used on own farm). 7. Payments for hiring implements and machinery. 8. Irrigation charges. 9. Miscellaneous expenses.

Continued.

Table 18 continued.

ii. Livestock maintenance	1. Cost of fodder and feed (both home-produced and purchased). 2. Cost of concentrates (both home-produced and purchased). 3. Hired human labor for feeding, grazing, and other husbandry activities. 4. Charges for grazing land, and others. 5. Other miscellaneous expenses such as veterinary changes, ropes, and others.
iii. Maintenance cost of production capital	1. Repairs and machines (payments to carpenters, blacksmiths, and others). 2. Fuel and lubricants for maintenance. 3. Litigation charges relating to land and other family-owned resources used for agricultural purposes.
b. Imputed costs	1. Value of family labor used for crop production and maintenance of livestock and production capital. 2. Value of owned bullock labor time used in crop production. 3. Value of rents paid for leased-in land.
c. Overhead costs	1. Depreciation. 2. Land revenues and other taxes.
2. Nonfarm expenses	1. Taxes, rents, and fees for trade and handicrafts. 2. Transport charges. 3. Cost of materials and interest on loans. 4. House rents for trading activities. 5. Maintenance and repairs of houses. 6. House taxes, gifts, and remittances. 7. Miscellaneous expenses relating to trades and handicrafts.
C. Net household income	Gross household income - expenses C = (A-B)

Appendix Tables 19 - 50

Individual Intakes of Nutrients

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Appendix Table 19. Intake of protein (in g) and percentage of recommended daily allowance (RDA) met in Aurepalle region.

		Lean season					Surplus season					
				% of sample consuming					% of sample consuming			
Farm-size group	Age group (in years)	Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	14.6	10.4	38.5	30.8	13	20.5	10.6	11.8	47.1	17	1.52
	4-6	19.6	9.1	14.8	22.2	27	29.9	14.2	4.3	60.9	23	3.10**
	7-12	27.7	9.8	12.5	10.0	40	44.2	19.0	5.3	55.3	38	4.86**
	13-18 Males	45.9	13.6	10.0	25.0	20	54.0	19.8	10.0	45.0	20	1.51
	13-18 Females	37.7	11.2	15.4	7.7	13	52.3	18.1	5.3	57.9	19	2.58*
	>18 Males	42.8	15.7	4.9	17.1	41	60.1	23.8	8.9	53.3	45	3.94**
	>18 Females	34.4	10.8	32.6	17.4	46	52.0	23.7	15.9	50.0	44	4.57**
Medium farmers	1-3	18.7	5.8	0.0	42.9	7	22.7	7.8	0.0	70.0	10	1.15
	4-6	25.5	18.4	0.0	33.3	6	36.0	11.7	0.0	88.9	9	1.36
	7-12	46.3	23.6	8.3	66.7	12	54.8	13.6	0.0	91.7	12	1.08
	13-18 Males	35.9	13.9	20.0	0.0	5	58.0	10.2	0.0	20.0	5	2.87*
	13-18 Females	32.3	0.1	0.0	0.0	2	50.1	1.2	0.0	50.0	2	20.91**
	>18 Males	50.7	22.2	15.4	34.6	26	67.5	19.4	0.0	75.0	28	2.97**
	>18 Females	46.3	23.5	12.5	29.2	24	64.7	18.8	0.0	69.2	26	3.07**
Large farmers	1-3	12.3	3.3	0.0	0.0	3	34.6	11.6	0.0	100.0	3	3.20*
	4-6	30.6	11.6	0.0	85.7	7	26.1	9.4	0.0	66.7	3	0.59
	7-12	31.1	11.7	13.0	34.8	23	44.8	16.5	0.0	61.9	21	3.20**
	13-18 Males	48.5	17.8	20.0	50.0	10	66.6	16.1	0.0	70.0	10	2.39*
	13-18 Females	50.4	16.6	10.0	40.0	10	60.8	16.8	0.0	70.0	10	1.39
	>18 Males	50.7	22.1	13.9	38.9	36	65.6	20.9	5.3	71.1	38	2.98**
	>18 Females	48.0	19.2	3.8	50.0	26	62.2	18.0	0.0	84.0	25	2.72**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 20. Intake of energy (in kcal) and percentage of RDA met in Aurepalle region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	613	383	46.2	7.7	13	779	394	29.4	17.6	17	1.16
	4-6	865	359	40.7	11.1	27	1169	569	34.8	30.4	23	2.29*
	7-12	1228	422	20.0	2.5	40	1642	604	15.8	26.3	38	3.53**
	13-18 Males	2137	637	0.0	15.0	20	2064	741	10.0	15.0	20	-0.33
	13-18 Females	1794	512	7.7	7.7	13	2016	608	5.3	42.1	19	1.08
	>18 Males	2169	607	7.3	14.6	41	2369	925	15.6	28.9	45	1.17
	>18 Females	1697	562	23.9	10.9	46	2100	877	15.9	36.4	44	2.61*
Medium farmers	1-3	796	153	14.3	0.0	7	791	346	30.0	10.0	10	-0.04
	4-6	1068	549	33.3	16.7	6	1315	405	11.1	44.4	9	1.01
	7-12	1876	655	8.3	33.3	12	1973	469	0.0	50.0	12	0.42
	13-18 Males	1711	607	20.0	20.0	5	2128	184	0.0	0.0	5	1.47
	13-18 Females	1812	254	0.0	0.0	2	1924	145	0.0	0.0	2	0.54
	>18 Males	2464	854	11.5	26.9	26	2492	674	7.1	35.7	28	0.14
	>18 Females	2227	838	4.2	25.0	24	2322	604	0.0	42.3	26	0.46
Large farmers	1-3	445	77	100.0	0.0	3	1335	364	0.0	66.7	3	4.15**
	4-6	1254	259	0.0	14.3	7	1336	333	0.0	33.3	3	0.43
	7-12	1330	428	17.4	4.3	23	1883	554	0.0	38.1	21	3.73**
	13-18 Males	1833	492	20.0	0.0	10	2578	688	0.0	30.0	10	2.79*
	13-18 Females	1933	5495	10.0	10.0	10	2374	653	10.0	40.0	10	1.63
	>18 Males	2061	684	19.4	13.9	36	2637	817	5.3	42.1	38	3.28**
	>18 Females	1980	614	7.7	42.3	26	2502	680	0.0	56.0	25	2.88**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 21. Intake of β -carotene (in μ g) and percentage of RDA met in Aurepalle region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	218	341	84.6	7.7	13	166	292	94.1	5.9	17	-0.44
	4-6	181	218	96.3	0.0	27	250	349	91.3	4.3	23	0.85
	7-12	161	137	100.0	0.0	40	444	567	92.1	5.3	38	-3.06**
	13-18 Males	348	455	90.0	0.0	20	521	742	90.0	5.0	20	0.89
	13-18 Females	401	495	92.3	0.0	13	410	505	94.7	0.0	19	0.05
	>18 Males	342	424	95.1	0.0	41	405	396	95.6	0.0	45	0.71
	>18 Females	415	581	97.8	2.2	46	394	566	97.7	2.3	44	-0.17
Medium farmers	1-3	216	320	85.7	0.0	7	122	51	100.0	0.0	10	-0.93
	4-6	502	727	66.7	16.7	6	200	167	88.9	0.0	9	-1.22
	7-12	390	649	83.3	0.0	12	334	206	100.0	0.0	12	-0.29
	13-18 Males	81	101	100.0	0.0	5	356	318	100.0	0.0	5	1.84
	13-18 Females	75	106	100.0	0.0	2	197	98	100.0	0.0	2	1.19
	>18 Males	333	497	96.2	0.0	26	395	330	100.0	0.0	28	0.55
	>18 Females	442	659	95.8	0.0	24	466	345	100.0	0.0	26	0.16
Large farmers	1-3	154	153	100.0	0.0	3	339	165	100.0	0.0	3	1.43
	4-6	188	159	100.0	0.0	7	68	99	100.0	0.0	3	-1.19
	7-12	221	146	100.0	0.0	23	254	172	100.0	0.0	21	0.69
	13-18 Males	201	146	100.0	0.0	10	307	149	100.0	0.0	10	1.62
	13-18 Females	269	74	100.0	0.0	10	274	107	100.0	0.0	10	0.11
	>18 Males	252	147	100.0	0.0	36	284	172	100.0	0.0	38	0.86
	>18 Females	364	244	100.0	0.0	26	324	189	100.0	0.0	25	-0.66

** Significant at 1% level.

Appendix Table 22. Intake of thiamine (in mg) and percentage of RDA met in Aurepalle region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	0.3	0.3	61.5	7.7	13	0.5	0.4	29.4	29.4	17	1.51
	4-6	0.4	0.4	59.3	7.4	27	0.8	0.6	13.0	39.1	23	2.81**
	7-12	0.5	0.3	60.0	7.5	40	1.5	0.8	13.2	71.1	38	7.38**
	13-18 Males	0.8	0.6	55.0	20.0	20	1.8	0.9	10.0	75.0	20	4.13**
	13-18 Females	0.8	0.5	46.2	23.1	13	1.6	0.8	15.8	73.7	19	3.20**
	>18 Males	0.9	0.7	58.5	22.0	41	1.8	0.9	15.6	60.0	45	5.14**
	>18 Females	0.6	0.4	65.2	15.2	46	1.6	0.9	20.5	56.8	44	6.86**
Medium farmers	1-3	0.3	0.2	42.9	14.3	7	0.7	0.3	0.0	60.0	10	3.07**
	4-6	0.5	0.6	83.3	16.7	6	1.0	0.5	0.0	44.4	9	1.76
	7-12	1.0	0.8	25.0	33.3	12	1.7	0.6	0.0	100.0	12	2.43*
	13-18 Males	0.6	0.4	40.0	0.0	5	1.6	0.3	0.0	80.0	5	4.47**
	13-18 Females	0.5	0.3	50.0	0.0	2	1.6	0.4	0.0	100.0	2	3.11
	>18 Males	1.0	0.7	38.5	11.5	26	1.8	0.7	0.0	71.4	28	4.20**
	>18 Females	1.0	0.8	41.7	33.3	24	1.9	0.6	0.0	80.0	26	4.52**
Large farmers	1-3	0.2	0.1	66.7	0.0	3	0.7	0.4	0.0	66.7	3	2.10
	4-6	0.8	0.5	28.6	42.9	7	0.7	0.5	0.0	33.3	3	-0.29
	7-12	0.7	0.4	30.4	21.7	23	1.1	0.6	9.5	42.9	21	2.62*
	13-18 Males	1.1	0.7	30.0	60.0	10	2.3	0.6	0.0	100.0	10	4.12**
	13-18 Females	1.1	0.5	20.0	40.0	10	1.7	0.6	0.0	80.0	10	2.43*
	>18 Males	1.2	0.7	33.3	36.1	36	1.8	0.7	2.6	65.8	38	3.69**
	>18 Females	1.1	0.6	19.2	50.0	26	1.8	0.7	4.0	80.0	25	3.84**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 23. Intake of riboflavin (in mg) and percentage of RDA met in Aurepalle region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	0.2	0.1	84.6	0.0	13	0.4	0.4	58.8	23.5	17	1.76
	4-6	0.3	0.5	77.8	11.1	27	0.7	0.8	43.0	13.0	23	2.15*
	7-12	0.6	1.0	87.5	5.0	40	1.1	1.1	28.9	15.8	38	2.10*
	13-18 Males	0.8	0.8	75.0	10.0	20	1.4	1.8	45.0	5.0	20	1.36
	13-18 Females	1.6	2.1	53.8	23.1	13	0.8	0.4	26.3	10.5	19	-1.63
	>18 Males	1.2	1.6	63.4	7.3	41	1.3	1.2	35.6	20.0	45	0.33
	>18 Females	0.9	1.4	63.0	8.7	46	1.1	1.1	36.4	27.3	44	0.75
Medium farmers	1-3	0.3	0.3	71.4	14.3	7	0.4	0.4	60.0	10.0	10	0.56
	4-6	0.5	0.5	50.0	33.3	6	0.7	0.7	33.3	22.2	9	0.60
	7-12	1.0	1.0	41.7	33.3	12	1.4	0.9	8.3	50.0	12	1.03
	13-18 Males	1.3	1.4	60.0	40.0	5	1.4	1.0	20.0	40.0	5	0.13
	13-18 Females	1.1	1.2	50.0	50.0	2	2.0	2.0	0.0	50.0	2	0.55
	>18 Males	1.8	1.7	42.3	34.6	26	1.4	1.1	25.0	21.4	28	-1.03
	>18 Females	1.7	1.8	45.8	33.3	24	1.3	0.9	15.4	23.1	26	-1.01
Large farmers	1-3	0.4	0.4	66.7	33.3	3	1.3	1.1	33.3	66.7	3	1.33
	4-6	1.8	1.7	28.6	14.3	7	1.2	1.6	66.7	33.3	3	0.52
	7-12	1.5	1.3	34.8	43.5	23	1.8	1.5	14.3	47.6	21	0.71
	13-18 Males	1.3	1.2	60.0	40.0	10	3.9	1.4	0.0	100.0	10	4.46**
	13-18 Females	1.6	1.0	20.0	60.0	10	3.6	2.0	0.0	90.0	10	2.83*
	>18 Males	1.9	1.6	38.9	50.0	36	3.3	2.0	5.3	76.3	38	3.31**
	>18 Females	2.0	1.2	23.1	65.4	26	3.3	2.0	4.0	72.0	25	2.83**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 24. Intake of ascorbic acid (in mg) and percentage of RDA met in Aurepalle region.

		Lean season					Surplus season					
				% of sample consuming					% of sample consuming			
Farm-size group	Age group (in years)	Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	5.7	5.2	100.0	0.0	13	11.2	10.8	76.5	5.9	17	1.69
	4-6	9.7	6.6	88.9	0.0	27	13.5	10.4	78.3	4.3	23	1.57
	7-12	9.4	6.5	92.5	0.0	40	23.8	18.8	50.0	10.5	38	4.57**
	13-18 Males	10.7	6.2	95.0	0.0	20	30.3	30.0	40.0	20.0	20	2.86**
	13-18 Females	11.9	5.5	100.0	0.0	13	29.6	26.7	47.4	10.5	19	2.35*
	>18 Males	14.2	8.4	87.8	0.0	41	32.9	23.5	51.1	22.2	45	4.82**
	>18 Females	12.3	11.1	95.7	2.2	46	26.0	21.1	65.9	9.1	44	3.88**
Medium farmers	1-3	7.1	7.9	85.7	0.0	7	10.4	11.4	80.0	0.0	10	0.66
	4-6	6.4	7.6	100.0	0.0	6	15.3	16.4	77.8	22.2	9	1.23
	7-12	9.7	7.9	75.0	0.0	12	23.2	19.4	58.3	16.7	12	2.23*
	13-18 Males	9.4	7.0	80.0	0.0	5	14.6	13.5	80.0	0.0	5	0.77
	13-18 Females	8.8	12.4	100.0	0.0	2	19.0	2.7	50.0	0.0	2	1.14
	>18 Males	11.6	8.5	96.2	0.0	26	21.4	18.0	78.6	7.1	28	2.53*
	>18 Females	10.9	8.3	95.8	0.0	24	28.1	26.3	69.2	11.5	26	3.06**
Large farmers	1-3	1.9	2.5	100.0	0.0	3	8.0	3.6	100.0	0.0	3	2.41
	4-6	10.6	8.3	85.7	0.0	7	21.8	8.4	66.7	0.0	3	1.85
	7-12	13.2	9.4	73.9	0.0	23	24.0	17.7	57.1	14.3	21	2.56*
	13-18 Males	9.6	7.8	90.0	0.0	10	29.7	32.0	60.0	20.0	10	1.93
	13-18 Females	12.6	4.9	90.0	0.0	10	16.6	6.7	90.0	0.0	10	1.52
	>18 Males	13.2	10.4	86.1	0.0	36	27.6	18.6	57.9	13.2	38	4.08**
	>18 Females	13.9	9.8	92.3	0.0	26	28.7	18.8	56.0	16.0	25	3.55**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 25. Intake of lysine (in g) and percentage of RDA met in Aurepalle region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	10-12	1.1	0.4	6.7	13.3	15	1.7	0.8	0.0	50.0	16	1.74
	>18 Males	1.7	0.9	0.0	100.0	32	2.0	1.01	3.0	97.0	33	1.48
	>18 Females	1.4	0.7	0.0	100.0	30	1.7	0.8	0.0	96.0	25	1.83
Medium farmers	10-12	2.4	0.3	0.0	66.7	3	2.3	0.4	0.0	75.0	4	-0.30
	>18 Males	2.4	1.0	0.0	100.0	18	2.4	0.9	0.0	100.0	21	0.27
	>18 Females	1.9	0.8	0.0	100.0	17	2.2	0.7	0.0	100.0	22	1.21
Large farmers	10-12	1.6	0.6	14.3	42.9	7	2.1	0.9	0.0	77.8	9	1.16
	>18 Males	2.9	1.3	0.0	100.0	23	3.6	1.4	0.0	100.0	27	1.76
	>18 Females	2.4	1.0	0.0	100.0	8	3.4	1.4	0.0	100.0	9	1.65

Appendix Table 26. Intake of sulfur amino acids (in g) and percentage of RDA met in Aurepalle region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	10-12	1.1	0.5	0.0	82.6	23	1.8	0.7	4.6	86.4	22	3.21**
	>18 Males	1.5	0.7	0.0	61.9	42	2.2	0.9	2.2	88.9	45	3.86**
	>18 Females	1.3	0.5	0.0	100.0	45	1.9	0.9	0.0	90.9	44	4.06**
Medium farmers	10-12	1.8	1.2	0.0	75.0	4	2.2	0.5	0.0	100.0	4	0.64
	>18 Males	2.0	0.9	0.0	84.6	26	2.5	0.8	0.0	92.9	28	2.02*
	>18 Females	1.8	1.0	0.0	100.0	24	2.3	0.8	0.0	100.0	26	2.06*
Large farmers	10-12	1.3	0.6	7.7	76.9	13	1.9	0.7	0.0	100.0	13	2.27*
	>18 Males	9	0.8	2.8	75.0	36	2.7	1.0	0.0	94.7	38	3.86**
	>18 Females	[illegible].9	0.7	0.0	100.0	26	2.6	0.9	0.0	100.0	25	3.28**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 27. Intake of protein (in g) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	15.8	9.7	42.9	57.1	7	21.5	14.4	20.0	60.0	15	0.95
	4-6	35.2	11.9	0.0	85.7	7	36.9	22.4	4.3	76.3	23	0.12
	7-12	39.3	10.7	0.0	61.5	13	39.4	10.5	0.0	50.0	38	0.03
	13-18 Males	60.7	13.2	0.0	44.4	9	49.6	15.1	9.1	27.3	22	-1.92
	13-18 Females	59.5	24.2	0.0	71.4	7	55.4	23.1	5.3	42.1	19	-0.40
	>18 Males	62.8	20.1	0.0	56.5	23	56.2	20.3	6.6	47.4	76	-1.37
	>18 Females	50.1	17.7	2.9	44.1	34	49.9	17.1	2.9	53.4	103	-0.06
Medium farmers	1-3	21.3	5.2	0.0	50.0	2	18.5	7.8	25.0	62.5	8	-0.47
	4-6	38.4	0.0	0.0	100.0	1	31.2	7.0	0.0	100.0	4	-0.92
	7-12	41.9	11.7	0.0	50.0	4	41.3	17.2	8.3	83.3	12	-0.06
	13-18 Males	53.0	19.0	0.0	50.0	2	58.0	22.8	0.0	37.5	8	0.28
	13-18 Females	39.1	17.8	0.0	50.0	2	69.8	31.6	0.0	50.0	2	1.20
	>18 Males	46.6	16.7	11.1	22.2	9	62.5	27.7	0.0	53.8	26	1.61
	>18 Females	54.9	15.5	0.0	60.0	10	54.4	16.2	0.0	58.1	31	-0.09
Large farmers	1-3	16.6	12.6	40.0	40.0	5	21.6	10.9	18.8	62.5	16	0.87
	4-6	35.0	6.6	0.0	100.0	6	33.1	13.8	8.7	78.3	23	-0.32
	7-12	45.5	8.5	0.0	81.8	11	38.0	13.4	11.1	55.6	27	-1.71
	13-18 Males	64.9	18.9	0.0	55.6	9	58.5	21.3	3.8	34.6	26	-0.79
	13-18 Females	42.6	6.4	0.0	0.0	3	41.4	9.0	0.0	20.0	5	-0.20
	>18 Males	67.4	18.7	0.0	75.0	16	63.8	18.2	[illegible].0	66.1	59	-0.70
	>18 Females	54.2	14.2	0.0	58.3	12	56.9	21.4	6.3	58.3	48	0.41

Appendix Table 28. Intake of energy (in kcal) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	729	416	42.9	0.0	7	946	536	26.7	20.0	15	0.95
	4-6	1429	458	0.0	42.9	7	1563	627	8.7	56.5	23	0.52
	7-12	1794	425	7.7	30.8	13	1905	500	0.0	42.1	38	0.72
	13-18 Males	2620	293	0.0	22.2	9	2362	703	9.1	31.8	22	-1.05
	13-18 Females	2252	473	0.0	57.1	7	2441	583	5.3	68.4	19	0.77
	>18 Males	2596	528	0.0	34.8	23	2633	798	6.6	36.8	76	0.21
	>18 Females	2191	530	2.9	35.3	34	2359	668	2.9	53.4	103	1.34
Medium farmers	1-3	850	331	0.0	0.0	2	856	374	25.0	25.0	8	0.02
	4-6	1691	0	0.0	100.0	1	1425	329	0.0	50.0	4	-0.73
	7-12	1795	352	0.0	25.0	4	1794	521	8.3	58.3	12	-0.003
	13-18 Males	2147	182	0.0	0.0	2	2277	491	0.0	25.0	8	0.36
	13-18 Females	1914	786	0.0	50.0	2	2347	184	0.0	100.0	2	0.76
	>18 Males	2136	677	22.2	11.1	9	2623	553	0.0	38.5	26	2.15*
	>18 Females	2324	435	0.0	60.0	10	2534	588	3.2	61.3	31	1.04
Large farmers	1-3	692	527	40.0	40.0	5	969	523	25.0	31.3	16	1.03
	4-6	1407	213	0.0	33.3	6	1437	526	13.0	52.2	23	0.13
	7-12	1858	429	0.0	27.3	11	1669	571	14.8	33.3	27	-0.98
	13-18 Males	2573	400	0.0	33.3	9	2479	614	3.8	26.9	26	-0.43
	13-18 Females	1978	526	0.0	33.3	3	1901	452	0.0	20.0	5	-0.22
	>18 Males	2616	501	0.0	43.8	16	2804	696	0.0	45.8	59	1.01
	>18 Females	2333	334	0.0	50.0	12	2504	824	6.3	50.0	48	0.70

* Significant at 5% level.

Appendix Table 29. Intake of β-carotene (in μg) and percentage of RDA in Dokur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	>100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	>100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	47	49	100.0	0.0	7	116	171	100.0	0.0	15	1.03
	4-6	157	130	100.0	0.0	7	299	681	91.3	8.7	23	-0.54
	7-12	304	397	92.3	0.0	13	136	355	97.4	0.0	38	1.42
	13-18 Males	554	578	88.9	0.0	9	334	769	90.9	4.5	22	-0.77
	13-18 Females	356	510	100.0	0.0	7	408	945	89.5	5.3	19	0.14
	>18 Males	457	712	91.3	0.0	23	287	702	96.1	2.6	76	-1.02
	>18 Females	501	697	91.2	0.0	34	267	587	97.1	1.0	103	-1.92
Medium farmers	1-3	88	109	100.0	0.0	2	86	73	100.0	0.0	8	-0.03
	4-6	220	0	100.0	0.0	1	147	61	100.0	0.0	4	-1.05
	7-12	109	115	100.0	0.0	4	150	136	100.0	0.0	12	0.54
	13-18 Males	35	3	100.0	0.0	2	157	159	100.0	0.0	8	1.04
	13-18 Females	2249	3076	50.0	50.0	2	207	234	100.0	0.0	2	-0.94
	>18 Males	133	152	100.0	0.0	9	245	409	96.2	0.0	26	0.80
	>18 Females	193	267	100.0	0.0	10	281	523	93.5	0.0	31	0.51
Large farmers	1-3	149	176	100.0	0.0	5	53	75	100.0	0.0	16	-1.79
	4-6	202	177	100.0	0.0	6	111	123	100.0	0.0	23	-1.48
	7-12	146	122	100.0	0.0	11	138	135	100.0	0.0	27	-0.17
	13-18 Males	294	150	100.0	0.0	9	126	119	100.0	0.0	26	-3.44**
	13-18 Females	51	36	100.0	0.0	3	108	46	100.0	0.0	5	1.84
	>18 Males	266	210	100.0	0.0	16	219	330	96.6	0.0	59	-0.54
	>18 Females	183	156	100.0	0.0	12	136	136	100.0	0.0	48	-1.05

** Significant at 1% level.

Appendix Table 30. Intake of thiamine (in mg) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	0.2	0.2	42.9	0.0	7	0.3	0.4	46.7	6.7	15	0.62
	4-6	0.6	0.4	42.9	28.6	7	0.6	0.5	34.8	13.0	23	0.00
	7-12	0.5	0.2	46.2	7.7	13	0.6	0.3	26.3	7.9	38	1.12
	13-18 Males	0.8	0.4	55.6	11.1	9	0.8	0.5	45.5	18.2	22	0.00
	13-18 Females	0.8	0.3	14.3	14.3	7	0.9	0.5	36.8	15.8	19	0.49
	>18 Males	1.0	0.5	26.1	13.0	23	0.9	0.5	36.8	9.2	76	-0.84
	>18 Females	0.7	0.3	41.2	14.7	34	0.8	0.4	35.0	10.7	103	1.34
Medium farmers	1-3	0.3	0.3	50.0	0.0	2	0.2	0.1	100.0	0.0	8	-0.89
	4-6	0.7	0.0	0.0	0.0	1	0.4	0.2	50.0	0.0	4	-1.34
	7-12	0.7	0.4	50.0	50.0	4	0.5	0.3	50.0	8.3	12	-1.07
	13-18 Males	0.5	0.0	100.0	0.0	2	0.7	0.4	62.5	0.0	8	0.68
	13-18 Females	0.8	0.5	50.0	0.0	2	0.9	0.2	0.0	0.0	2	0.26
	>18 Males	0.6	0.4	77.8	11.1	9	0.8	0.4	46.2	7.7	26	1.29
	>18 Females	0.7	0.4	60.0	10.0	10	0.8	0.3	29.0	6.5	31	0.84
Large farmers	1-3	0.2	0.3	60.0	0.0	5	0.3	0.2	50.0	6.3	16	0.87
	4-6	0.5	0.2	16.7	0.0	6	0.5	0.2	34.8	0.0	23	0.00
	7-12	0.7	0.4	36.4	18.2	11	0.6	0.2	29.6	0.0	27	-1.03
	13-18 Males	1.4	0.5	11.1	77.8	9	0.7	0.2	34.6	0.0	26	-6.00**
	13-18 Females	0.5	0.2	66.7	0.0	3	0.6	0.2	40.0	0.0	5	0.69
	>18 Males	1.1	0.5	25.0	43.8	16	1.0	0.4	13.6	6.8	59	-0.84
	>18 Females	0.8	0.4	50.0	25.0	12	0.8	0.3	18.8	10.4	48	0.00

** Significant at 1% level.

Appendix Table 31. Intake of riboflavin (in mg) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for season effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	1-3	0.1	0.1	100.0	0.0	7	0.2	0.2	86.7	0.0	15	1.24
	4-6	0.4	0.1	42.9	0.0	7	0.5	0.8	69.6	8.7	23	0.33
	7-12	0.4	0.1	84.6	0.0	13	0.4	0.1	81.6	0.0	38	0.00
	13-18 Males	0.6	0.2	88.9	0.0	9	0.8	1.2	90.9	4.5	22	0.49
	13-18 Females	0.6	0.2	57.1	0.0	7	0.9	1.3	57.9	5.3	19	0.60
	>18 Males	0.7	0.2	65.2	0.0	23	0.7	0.8	78.9	2.6	76	0.00
	>18 Females	0.5	0.2	70.6	0.0	34	0.6	0.7	70.9	1.9	103	0.82
Medium farmers	1-3	0.2	0.1	100.0	0.0	2	0.2	0.1	100.0	0.0	8	0.00
	4-6	0.3	0.0	100.0	0.0	1	0.4	0.1	25.0	0.0	4	0.89
	7-12	0.4	0.1	75.0	0.0	4	0.4	0.2	58.3	0.0	12	0.00
	13-18 Males	0.5	0.2	100.0	0.0	2	0.5	0.2	87.5	0.0	8	0.00
	13-18 Females	0.7	0.6	50.0	0.0	2	0.6	0.1	50.0	0.0	2	-0.23
	>18 Males	0.4	0.2	77.8	0.0	9	0.6	0.2	84.6	0.0	26	2.59*
	>18 Females	0.5	0.2	60.0	0.0	10	0.6	0.2	58.1	0.0	31	1.38
Large farmers	1-3	0.2	0.2	80.0	0.0	5	0.2	0.1	87.5	0.0	16	0.00
	4-6	0.3	0.2	66.7	0.0	6	0.3	0.2	56.5	4.3	23	0.00
	7-12	0.5	0.2	72.7	0.0	11	0.4	0.2	74.1	0.0	27	-1.40
	13-18 Males	1.1	0.9	55.6	22.2	9	0.6	0.3	80.8	3.8	26	-2.51*
	13-18 Females	0.3	0.1	100.0	0.0	3	0.5	0.1	80.0	0.0	5	2.74*
	>18 Males	1.1	0.9	56.3	25.0	16	0.8	0.5	62.7	6.8	59	-1.76
	>18 Females	0.7	0.6	66.7	8.3	12	0.7	0.5	54.2	6.3	48	0.00

* Significant at 5% level.

Appendix Table 32. Intake of ascorbic acid (in mg) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	5.1	6.7	100.0	0.0	7	8.0	8.1	86.7	0.0	15	0.82
	4-6	8.3	8.1	85.7	0.0	7	10.6	9.3	73.9	0.0	23	0.59
	7-12	9.7	6.8	84.6	0.0	13	13.1	11.8	71.1	5.3	38	0.98
	13-18 Males	14.3	12.6	77.8	11.1	9	16.8	14.3	68.2	4.5	22	0.46
	13-18 Females	10.0	8.3	85.7	0.0	7	17.2	12.7	68.4	5.3	19	1.39
	>18 Males	12.9	10.7	82.6	0.0	23	18.9	17.3	68.4	5.3	76	1.57
	>18 Females	15.5	12.0	85.3	0.0	34	17.3	14.9	82.5	1.9	103	0.64
Medium farmers	1-3	6.3	7.6	100.0	0.0	2	4.5	3.4	100.0	0.0	8	-0.55
	4-6	14.8	14.8	100.0	0.0	1	10.3	7.9	75.0	0.0	4	-0.51
	7-12	8.9	6.1	100.0	0.0	4	7.7	9.3	83.3	0.0	12	-0.24
	13-18 Males	7.1	5.8	100.0	0.0	2	5.7	5.3	100.0	0.0	8	-0.33
	13-13 Females	35.1	33.2	50.0	50.0	2	21.9	11.4	50.0	0.0	2	-0.53
	>18 Males	10.6	7.8	88.9	0.0	9	15.7	15.4	76.9	0.0	26	0.95
	>18 Females	8.7	7.2	100.0	0.0	10	14.8	13.9	80.6	0.0	31	1.32
Large farmers	1-3	8.7	9.4	80.0	0.0	5	4.5	5.4	93.8	0.0	16	-1.27
	4-6	12.8	11.6	66.7	0.0	6	8.5	8.5	87.0	0.0	23	-1.03
	7-12	9.5	8.0	90.9	0.0	11	11.1	10.9	81.5	3.7	27	0.44
	13-18 Males	26.3	26.4	44.4	22.2	9	8.7	7.8	88.5	0.0	26	-3.10**
	13-18 Females	6.4	0.2	100.0	0.0	3	12.4	9.6	80.0	0.0	5	1.05
	>18 Males	24.1	24.1	75.0	12.5	16	15.0	11.9	78.0	0.0	59	-2.12*
	>18 Females	17.0	17.4	75.0	8.3	12	12.5	11.6	83.3	0.0	48	-1.08

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 33. Intake of lysine (in g) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	10-12	1.6	0.6	0.0	20.0	5	1.4	0.4	0.0	50.0	10	-0.72
	>18 Males	2.5	1.1	0.0	100.0	20	2.1	1.1	1.7	98.3	58	-1.54
	>18 Females	2.0	1.1	0.0	100.0	20	1.9	1.0	0.0	100.0	74	-0.27
Medium farmers	10-12	0.0	0.0	0.0	0.0	0	4.9	0	0.0	100.0	1	-
	>18 Males	2.0	0.9	0.0	100.0	7	3.0	2.1	0.0	100.0	18	1.12
	>18 Females	2.5	1.0	0.0	100.0	7	2.2	0.9	0.0	100.0	23	-0.74
Large farmers	10-12	2.0	0.2	0.0	100.0	6	1.5	0.5	0.0	63.6	11	-2.85*
	>18 Males	3.5	1.6	0.0	100.0	15	2.8	1.1	0.0	100.0	42	-1.72
	>18 Females	2.4	1.1	0.0	100.0	10	2.4	1.1	0.0	100.0	35	0.05

* Significant at 5% level.

Appendix Table 34. Intake of sulfur amico acids (in g) and percentage of RDA met in Dokur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	10-12	1.5	0.4	0.0	85.7	7	1.4	0.4	0.0	100.0	20	-0.48
	>18 Males	2.2	0.6	0.0	95.7	23	2.0	0.7	1.3	90.0	80	-1.00
	>18 Females	1.7	0.5	0.0	97.1	34	1.8	0.6	0.0	100.0	98	0.80
Medium farmers	10-12	1.7	0.0	0.0	100.0	1	2.2	0.6	0.0	100.0	4	0.80
	>18 Males	1.7	0.6	0.0	77.8	9	2.2	1.0	0.0	96.4	28	1.53
	>18 Females	1.9	0.5	0.0	100.0	10	2.1	0.6	0.0	100.0	27	0.58
Large farmers	10-12	1.6	0.3	0.0	100.0	8	1.3	0.5	6.3	81.3	16	-1.98
	>18 Males	2.3	0.6	0.0	100.0	16	2.3	0.7	1.6	98.4	61	0.21
	>18 Females	1.9	0.4	0.0	100.0	12	2.1	0.7	2.1	97.9	48	0.81

Appendix Table 35. Intake of protein (in g) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	31.6	25.1	11.8	64.7	17	24.1	19.2	22.2	44.4	9	-0.78
	4-6	39.8	21.4	0.0	82.5	40	36.2	16.7	0.0	70.0	20	-0.66
	7-12	49.4	20.0	0.9	74.8	115	49.2	21.0	0.0	73.8	42	-0.06
	13-18 Males	67.4	31.3	3.7	51.9	27	72.1	38.4	22.2	44.4	9	0.37
	13-18 Females	58.5	24.6	3.9	60.8	51	63.2	27.8	0.0	60.0	15	0.63
	>18 Males	75.2	30.8	0.7	74.1	139	73.5	23.2	0.0	78.0	50	-0.36
	>18 Females	64.2	30.8	2.4	64.3	126	68.6	30.9	2.1	70.8	48	0.84
Medium farmers	1-3	22.5	18.1	21.4	46.4	28	23.0	14.2	15.4	53.8	13	0.09
	4-6	36.6	13.4	3.1	90.6	32	40.5	14.6	7.7	92.3	13	0.86
	7-12	44.6	15.1	4.5	74.6	67	55.0	11.7	0.0	96.3	27	3.21**
	13-18 Males	57.0	14.2	0.0	50.0	18	69.3	19.7	0.0	71.4	7	1.75
	13-18 Females	55.9	13.7	0.0	58.3	24	64.2	8.7	0.0	87.5	8	1.60
	>18 Males	65.8	25.4	4.6	65.7	108	76.5	17.2	0.0	91.7	36	2.35*
	>18 Females	59.1	21.8	3.0	63.6	99	68.7	15.9	0.0	88.2	34	2.36*
Large farmers	1-3	26.0	14.9	8.7	69.6	23	23.7	12.3	14.3	71.4	7	-0.37
	4-6	44.1	17.5	2.9	91.2	34	42.1	6.0	0.0	100.0	10	-0.35
	7-12	53.8	21.8	0.0	76.6	77	56.1	15.6	0.0	100.0	23	0.47
	13-18 Males	75.6	40.6	2.1	61.7	47	87.7	24.5	0.0	87.5	16	1.12
	13-18 Females	63.7	26.8	2.4	65.9	41	59.2	8.6	0.0	92.9	14	-0.61
	>18 Males	80.9	33.1	0.0	76.7	116	81.9	19.3	0.0	89.7	39	0.18
	>18 Females	70.0	32.7	3.7	73.1	108	75.8	22.5	2.6	87.2	39	1.02

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 36. Intake of energy (kcal) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	1-3	1037	768	35.3	35.3	17	795	675	44.4	22.2	9	-0.79
	4-6	1346	621	12.5	35.0	40	1224	601	20.0	25.0	20	-0.72
	7-12	1648	571	4.3	22.6	115	1624	656	7.1	21.4	42	-0.23
	13-18 Males	2114	904	22.2	18.5	27	2424	1362	22.2	44.4	9	0.78
	13-18 Females	1972	712	5.9	35.3	51	2099	899	6.7	20.0	15	0.57
	>18 Males	2457	860	1.4	28.8	139	2454	788	4.0	30.0	50	-0.02
	>18 Females	2110	862	7.1	37.3	126	2320	1051	10.4	43.8	48	1.35
Medium farmers	1-3	762	573	46.4	17.9	28	837	492	30.8	30.8	13	0.41
	4-6	1203	404	9.4	25.0	32	1386	460	7.7	46.2	13	1.33
	7-12	1498	468	9.0	14.9	67	1837	364	0.0	25.9	27	3.38**
	13-18 Males	1934	393	5.6	0.0	18	2402	543	0.0	28.6	7	2.41*
	13-18 Females	1814	414	0.0	16.7	24	2163	338	0.0	37.5	8	2.15*
	>18 Males	2186	733	10.2	13.0	108	2555	483	0.0	30.6	36	2.82**
	>18 Females	1964	629	7.1	30.3	99	2298	485	2.9	64.7	34	2.82**
Large farmers	1-3	937	549	30.4	30.4	23	748	431	28.6	14.3	7	-0.84
	4-6	1472	530	2.9	41.2	34	1357	313	0.0	30.0	10	-0.65
	7-12	1768	635	7.8	39.0	77	1739	474	0.0	21.7	23	-0.20
	13-18 Males	2431	1129	12.8	25.5	47	2792	737	0.0	50.0	16	1.19
	13-18 Females	2212	897	4.9	58.5	41	1901	324	0.0	14.3	14	-1.26
	>18 Males	2692	1032	5.2	42.2	116	2587	588	0.0	35.9	39	-0.61
	>18 Females	2347	988	6.5	47.2	108	2400	644	2.6	59.0	39	0.32

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 37. Intake of β-carotene (in μg) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	>100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	>100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	356	272	76.5	0.0	17	231	86	100.0	0.0	9	-1.33
	4-6	434	262	77.5	0.0	40	326	182	90.0	0.0	20	-1.65
	7-12	520	366	87.0	2.6	115	478	570	95.2	2.4	42	-0.55
	13-18 Males	755	687	88.9	3.7	27	970	1275	[illegible]	11.1	9	0.65
	13-18 Females	662	482	90.2	0.0	51	520	303	[illegible]	0.0	15	-1.08
	>18 Males	853	666	87.1	1.4	139	1462	1124	60.0	8.0	50	4.55**
	>18 Females	670	589	95.2	0.8	126	871	810	87.5	2.1	48	1.80
Medium farmers	1-3	346	276	75.0	7.1	28	284	176	84.6	0.0	13	-0.73
	4-6	459	352	78.1	6.3	32	313	108	100.0	0.0	13	-1.46
	7-12	414	269	95.5	1.5	67	397	101	100.0	0.0	27	-0.31
	13-18 Males	495	278	94.4	0.0	18	426	110	100.0	0.0	7	-0.64
	13-18 Females	497	503	95.8	0.0	24	441	112	100.0	0.0	8	-0.31
	>18 Males	817	1097	89.8	2.8	108	1461	1128	58.3	13.9	36	3.03**
	>18 Females	599	475	94.9	1.0	99	780	625	88.2	2.9	34	1.76
Large farmers	1-3	332	205	78.3	0.0	23	263	87	100.0	0.0	7	-0.85
	4-6	1036	1726	58.8	8.8	34	366	190	90.0	0.0	10	-1.22
	7-12	853	1393	81.8	7.8	77	329	104	100.0	0.0	23	-1.79
	13-18 Males	690	495	91.5	0.0	47	726	684	87.5	0.0	16	0.23
	13-18 Females	1311	2221	85.4	7.3	41	356	68	100.0	0.0	14	-1.60
	>18 Males	1091	1266	83.6	5.2	116	1670	1188	51.3	20.5	39	2.51*
	>18 Females	1041	1800	90.7	2.8	108	751	623	92.3	2.6	39	-0.98

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 38. Intake of thiamine (in mg) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	1-3	1.0	0.8	11.8	58.8	17	0.7	0.7	22.2	44.4	9	-0.95
	4-6	1.3	0.8	0.0	70.0	40	1.2	0.6	5.0	65.0	20	-0.49
	7-12	1.7	0.7	0.0	83.5	115	1.6	0.7	0.0	85.7	42	-0.79
	13-18 Males	2.3	1.1	0.0	88.9	27	2.4	1.3	0.0	77.8	9	0.23
	13-18 Females	2.0	0.9	3.9	86.3	51	2.2	0.9	0.0	86.7	15	0.76
	>18 Males	2.6	1.1	0.0	87.8	139	2.5	0.8	0.0	96.0	50	-0.59
	>18 Females	2.2	1.1	1.6	84.9	126	2.3	1.0	0.0	83.3	48	0.55
Medium farmers	1-3	0.7	0.6	28.6	39.3	28	0.6	0.5	23.1	46.2	13	-0.52
	4-6	1.2	0.4	3.1	81.3	32	1.3	0.5	7.7	84.6	13	0.71
	7-12	1.5	0.6	4.5	88.1	67	1.8	0.4	0.0	100.0	27	2.39*
	13-18 Males	1.9	0.5	0.0	83.3	18	2.3	0.8	0.0	85.7	7	1.51
	13-18 Females	1.9	0.5	0.0	95.8	24	2.1	0.5	0.0	87.5	8	0.98
	>18 Males	2.2	0.9	4.6	85.2	108	2.5	0.7	2.8	94.4	36	1.82
	>18 Females	2.0	0.8	2.0	82.8	99	2.3	0.6	0.0	91.2	34	2.00*
Large farmers	1-3	0.7	0.5	17.4	52.2	23	0.6	0.4	28.6	57.1	7	-0.48
	4-6	1.4	0.6	2.9	82.4	34	1.3	0.2	0.0	100.0	10	-0.52
	7-12	1.8	0.7	0.0	81.8	77	1.8	0.5	0.0	100.0	23	0.00
	13-18 Males	2.5	1.4	0.0	78.7	47	2.8	0.8	0.0	100.0	16	0.81
	13-18 Females	2.1	0.9	2.4	85.4	41	1.9	0.3	0.0	100.0	14	-0.81
	>18 Males	2.7	1.2	0.0	87.1	116	2.6	0.7	0.0	100.0	39	-0.49
	>18 Females	2.3	1.2	0.9	79.6	108	2.4	0.7	0.0	97.4	39	0.49

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 39. Intake of riboflavin (in mg) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	1-3	0.3	0.2	64.7	11.8	17	0.4	0.2	55.6	0.0	9	1.21
	4-6	0.4	0.2	45.0	5.0	40	0.4	0.2	45.0	0.0	20	0.00
	7-12	0.5	0.2	53.9	0.9	115	0.6	0.3	33.3	9.5	42	2.40*
	13-18 Males	0.8	0.5	63.0	11.1	27	0.9	0.6	55.6	11.1	9	0.50
	13-18 Females	0.6	0.3	39.2	3.9	51	0.8	0.4	33.3	13.3	15	2.10*
	>18 Males	0.8	0.4	53.2	3.6	139	0.9	0.3	34.0	2.0	50	1.61
	>18 Females	0.7	0.3	44.4	3.2	126	0.8	0.4	33.3	18.8	48	1.79
Medium farmers	1-3	0.3	0.3	67.9	3.6	28	0.3	0.2	69.2	0.0	13	0.00
	4-6	0.4	0.2	56.3	3.1	32	0.6	0.7	30.8	7.7	13	1.49
	7-12	0.5	0.2	62.7	0.0	67	0.7	0.5	7.4	3.7	27	2.78**
	13-18 Males	0.6	0.2	77.8	0.0	18	0.8	0.3	42.9	0.0	7	1.95
	13-18 Females	0.5	0.2	62.5	0.0	24	1.3	1.0	12.5	25.0	8	3.81**
	>18 Males	0.7	0.4	68.5	4.6	108	1.0	0.4	25.0	2.8	36	3.90**
	>18 Females	0.6	0.3	48.5	3.0	99	0.9	0.4	14.7	2.9	34	4.60**
Large farmers	1-3	0.3	0.2	69.6	0.0	23	0.3	0.1	57.1	0.0	7	0.00
	4-6	0.5	0.2	26.5	5.9	34	0.5	0.1	0.0	0.0	10	0.00
	7-12	0.6	0.3	41.6	3.9	77	0.6	0.2	21.7	4.3	23	0.00
	13-18 Males	0.8	0.4	53.2	6.4	47	1.0	0.3	37.5	0.0	16	1.83
	13-18 Females	0.8	0.4	31.7	9.8	41	0.7	0.2	28.6	0.0	14	-0.89
	>18 Males	0.9	0.4	34.5	3.4	116	1.0	0.3	23.1	0.0	39	1.43
	>18 Females	0.8	0.4	34.3	9.3	108	0.9	0.3	20.5	5.1	39	1.42

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 40. Intake of ascorbic acid (in mg) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasona effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	6.4	7.8	94.1	0.0	17	3.7	2.4	100.0	0.0	9	-1.01
	4-6	5.9	5.5	97.5	0.0	40	3.7	2.8	100.0	0.0	20	-1.68
	7-12	8.1	6.7	93.0	0.0	115	7.3	8.5	95.2	2.4	42	-0.62
	13-18 Males	10.7	7.7	88.9	0.0	27	7.4	7.2	88.9	0.0	9	-1.13
	13-18 Females	8.7	7.5	92.2	2.0	51	7.5	4.7	100.0	0.0	15	-0.59
	>18 Males	12.3	10.2	88.5	0.7	139	9.1	7.4	94.0	0.0	50	-2.03*
	>18 Females	11.4	8.5	91.3	0.0	126	9.3	8.3	93.8	0.0	48	-1.47
Medium farmers	1-3	4.1	3.1	100.0	0.0	28	3.2	2.8	100.0	0.0	13	-0.89
	4-6	6.4	3.7	100.0	0.0	32	5.1	3.9	100.0	0.0	13	-1.05
	7-12	7.2	5.3	94.0	0.0	67	6.3	4.4	100.0	0.0	27	-0.78
	13-18 Males	8.9	7.3	88.9	0.0	18	7.1	5.6	100.0	0.0	7	-0.59
	13-18 Females	8.4	7.6	91.7	0.0	24	8.4	5.1	100.0	0.0	8	0.00
	>18 Males	9.8	7.5	91.7	0.0	108	8.4	5.3	100.0	0.0	36	-1.04
	>18 Females	9.3	7.1	94.9	0.0	99	6.2	4.5	100.0	0.0	34	-2.38*
Large farmers	1-3	3.9	4.9	95.7	0.0	23	2.8	2.1	100.0	0.0	7	-0.57
	4-6	9.6	11.0	85.3	2.9	34	2.2	1.6	100.0	0.0	10	-2.10*
	7-12	9.8	10.6	88.3	2.6	77	5.1	3.7	100.0	0.0	23	-2.08*
	13-18 Males	10.6	9.6	91.5	4.3	47	8.6	5.7	100.0	0.0	16	-0.79
	13-18 Females	16.4	15.2	68.3	14.6	41	4.9	2.9	100.0	0.0	14	-2.80**
	>18 Males	12.3	12.8	88.8	4.3	116	8.6	4.9	100.0	0.0	39	-1.76
	>18 Females	12.6	13.0	88.0	3.7	108	8.8	6.8	94.9	0.0	39	-1.74

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 41. Intake of lysine (in g) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	10-12	1.5	0.5	0.0	50.0	50	1.6	0.9	5.9	58.8	17	0.65
	>18 Males	2.2	0.9	0.0	100.0	115	2.1	0.8	0.0	100.0	42	-0.80
	>18 Females	1.9	0.9	0.0	99.1	108	1.9	1.0	0.0	100.0	38	0.23
Medium farmers	10-12	1.8	0.6	0.0	57.7	26	2.1	0.6	0.0	75.0	8	1.19
	>18 Males	2.3	1.2	0.0	100.0	82	2.4	0.7	0.0	100.0	29	0.17
	>18 Females	2.2	1.1	0.0	100.0	71	2.1	0.6	0.0	100.0	25	-0.09
Large farmers	10-12	2.0	1.1	3.7	59.3	27	2.1	0.8	0.0	80.0	10	0.24
	>18 Males	2.5	1.0	0.0	100.0	101	2.7	0.7	0.0	100.0	34	1.16
	>18 Females	2.3	1.1	0.0	98.8	80	2.5	0.9	0.0	100.0	30	0.68

Appendix Table 42. Intake of sulfur amino acids (in g) and percentage of RDA met in Sholapur region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	10-12	1.4	0.4	0.0	90.7	54	1.5	0.7	0.0	94.7	19	1.18
	>18 Males	2.0	0.8	0.7	93.5	138	2.1	0.7	0.0	96.0	50	0.69
	>18 Females	1.7	0.8	0.8	96.9	127	2.0	0.9	0.0	100.0	48	2.05*
Medium farmers	10-12	1.5	0.5	0.0	93.6	31	1.8	0.4	0.0	100.0	10	1.36
	>18 Males	2.2	1.1	0.0	90.6	106	2.2	0.5	0.0	100.0	36	1.16
	>18 Females	1.9	1.0	0.0	100.0	96	2.0	0.5	0.0	100.0	34	0.23
Large farmers	10-12	1.8	0.8	0.0	97.0	33	1.8	0.6	0.0	100.0	10	0.08
	>18 Males	2.4	1.1	0.0	92.2	116	2.3	0.6	0.0	100.0	37	-0.55
	>18 Females	2.1	1.0	0.0	98.2	109	2.1	0.6	0.0	100.0	37	0.35

* Significant at 5% level.

Appendix Table 43. Intake of protein (in g) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	22.2	14.7	27.3	72.7	11	24.6	14.3	12.0	60.0	25	0.46
	4-6	50.7	19.5	0.0	94.7	19	40.2	16.5	1.7	86.4	59	-2.31*
	7-12	65.6	20.7	0.0	97.4	38	57.1	19.7	1.1	86.7	90	-2.20*
	13-18 Males	90.3	29.7	0.0	94.1	17	80.5	22.5	0.0	88.1	42	-1.38
	13-18 Females	82.5	21.0	0.0	100.0	9	66.3	18.9	0.0	81.3	32	-2.22*
	>18 Males	95.4	23.1	0.0	94.5	55	88.1	27.4	1.9	91.6	155	-1.77
	>18 Females	89.0	19.8	0.0	93.9	49	74.3	24.9	1.5	82.1	134	-3.72**
Medium farmers	1-3	33.8	17.7	0.0	80.0	5	23.4	16.0	21.1	68.4	19	-1.27
	4-6	56.9	25.8	0.0	83.3	6	43.6	19.5	0.0	90.9	22	-1.38
	7-12	59.5	23.3	0.0	100.0	12	51.6	21.9	0.0	79.5	39	-1.08
	13-18 Males	123.6	62.9	0.0	100.0	2	97.9	36.1	0.0	62.5	8	-0.80
	13-18 Females	90.7	25.6	0.0	88.9	9	74.4	26.6	0.0	88.0	25	-1.59
	>18 Males	103.9	24.6	0.0	100.0	23	92.7	29.3	1.4	92.8	69	-1.65
	>18 Females	93.1	27.5	0.0	91.3	23	76.6	26.2	1.4	81.2	69	-2.58*
Large farmers	1-3	32.6	21.1	22.2	77.8	9	26.5	22.7	20.7	37.9	29	-0.72
	4-6	47.0	13.9	0.0	100.0	12	50.5	30.2	0.0	73.3	30	0.38
	7-12	60.3	17.9	0.0	92.9	28	60.2	23.5	4.1	85.1	74	-0.02
	13-18 Males	87.3	23.6	0.0	81.8	11	68.3	28.6	0.0	66.7	21	-1.89
	13-18 Females	77.0	26.3	0.0	90.0	10	75.3	27.4	0.0	76.9	26	-0.17
	>18 Males	96.2	25.2	0.0	94.3	35	80.1	30.8	4.2	78.9	95	-2.77**
	>18 Females	80.0	21.0	0.0	88.2	34	76.8	25.6	2.9	80.6	103	-0.66

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 44. Intake of energy (kcal) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	1-3	805	484	27.3	9.1	11	821	477	40.0	24.0	25	-0.10
	4-6	1752	642	0.0	57.9	19	1361	582	10.2	33.9	59	-2.48*
	7-12	2198	701	0.0	63.2	38	1838	653	7.8	45.6	90	-2.32*
	13-18 Males	3043	869	0.0	58.8	17	2771	755	2.4	52.4	42	-1.20
	13-18 Females	2791	570	0.0	88.9	9	2148	604	6.3	46.9	32	-2.85**
	>18 Males	3228	757	1.8	69.1	55	2886	869	2.6	52.3	155	-2.59**
	>18 Females	3030	757	2.0	81.6	49	2452	832	3.0	52.2	134	-4.26**
Medium farmers	1-3	1164	504	20.0	60.0	5	835	621	36.8	21.1	19	-1.09
	4-6	2042	726	0.0	83.3	6	1518	685	4.5	40.9	22	-1.64
	7-12	1997	702	0.0	33.3	12	1756	662	10.3	38.5	39	-1.09
	13-18 Males	4442	2523	0.0	50.0	2	3076	1042	0.0	62.5	8	-1.31
	13-18 Females	3190	994	0.0	66.7	9	2483	749	0.0	60.0	25	-2.22*
	>18 Males	3527	809	0.0	87.0	23	3071	929	1.4	59.4	69	-2.10*
	>18 Females	3237	975	0.0	73.9	23	2565	809	4.3	65.2	69	-3.28**
Large farmers	1-3	1049	583	22.2	33.3	9	955	805	44.8	34.5	29	-0.32
	4-6	1659	491	0.0	58.3	12	1778	1349	23.3	60.0	30	0.30
	7-12	2014	552	3.6	57.1	28	1970	788	6.8	45.9	74	-0.27
	13-18 Males	2979	705	0.0	54.5	11	2189	792	14.3	19.0	21	-2.78**
	13-18 Females	2622	945	0.0	70.0	10	2424	796	7.7	69.2	26	-0.64
	>18 Males	3286	877	2.9	74.3	35	2724	1004	9.5	47.4	95	-2.93**
	>18 Females	2808	730	0.0	67.6	34	2600	883	2.9	57.3	103	-1.24

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 45. Intake of β-carotene (in μg) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	242	96	100.0	0.0	11	235	133	92.0	0.0	25	-0.14
	4-6	359	128	94.7	0.0	19	286	129	96.6	0.0	59	-2.15*
	7-12	501	397	94.7	2.6	38	428	376	96.7	2.2	90	-0.99
	13-18 Males	750	634	94.1	5.9	17	637	428	97.6	0.0	42	-0.80
	13-18 Females	491	89	100.0	0.0	9	537	573	96.9	3.1	32	0.24
	>18 Males	848	598	92.7	5.5	55	795	692	94.2	2.6	155	-0.51
	>18 Females	770	627	95.9	2.0	49	682	448	97.8	0.0	134	-1.04
Medium farmers	1-3	286	37	100.0	0.0	5	282	303	89.5	5.3	19	-[illegible].03
	4-6	445	158	83.3	0.0	6	387	287	95.5	4.5	22	-0.47
	7-12	412	109	100.0	0.0	12	353	134	100.0	0.0	39	-1.38
	13-18 Males	776	443	100.0	0.0	2	633	215	100.0	0.0	8	-0.71
	13-18 Females	649	156	100.0	0.0	9	546	241	100.0	0.0	25	-1.19
	>18 Males	812	243	100.0	0.0	23	684	343	98.6	0.0	69	-1.66
	>18 Females	722	228	100.0	0.0	23	634	343	98.6	0.0	69	-1.14
Large farmers	1-3	442	312	77.8	11.1	9	405	371	72.4	3.4	29	-0.28
	4-6	471	224	83.3	0.0	12	508	526	80.0	3.3	30	0.24
	7-12	456	236	96.4	0.0	28	626	670	85.1	5.4	74	1.31
	13-18 Males	634	242	100.0	0.0	11	544	388	95.2	0.0	21	-0.70
	13-18 Females	623	251	100.0	0.0	10	612	364	92.3	0.0	26	-0.09
	>18 Males	750	290	100.0	0.0	35	849	784	86.3	2.1	95	0.72
	>18 Females	726	302	100.0	0.0	34	824	531	91.3	0.0	103	1.02

* Significant at 5% level.

Appendix Table 46. Intake of thiamine (in mg) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season Mean	SD	% of sample consuming <50% RDA	>100% RDA	N	Surplus season Mean	SD	% of sample consuming <50% RDA	>100% RDA	N	T-values for seasonal effect
Landless laborers and small farmers	1-3	0.7	0.5	27.3	54.5	11	0.7	0.5	16.0	52.0	25	0.00
	4-6	1.6	0.7	0.0	89.5	19	1.3	0.6	1.7	79.7	59	-1.82
	7-12	2.1	0.7	0.0	94.7	38	1.9	0.7	1.1	91.1	90	-1.48
	13-18 Males	3.0	1.0	0.0	100.0	17	2.7	0.8	0.0	97.6	42	-1.21
	13-18 Females	2.7	0.7	0.0	100.0	9	2.2	0.6	0.0	93.8	32	-2.13*
	>18 Males	3.2	0.8	0.0	96.4	55	2.9	0.9	1.3	95.5	155	-2.18*
	>18 Females	2.9	0.7	0.0	98.0	49	2.5	0.9	1.5	94.0	134	-2.81**
Medium farmers	1-3	1.0	0.6	0.0	60.0	5	0.7	0.6	21.1	52.6	19	-1.00
	4-6	1.8	0.9	0.0	83.3	6	1.4	0.7	0.0	72.7	22	-1.17
	7-12	1.9	0.8	0.0	100.0	12	1.7	0.7	0.0	84.6	39	-0.84
	13-18 Males	4.3	2.3	0.0	50.0	2	3.1	1.0	0.0	100.0	8	-1.23
	13-18 Females	3.0	0.9	0.0	88.9	9	2.5	1.0	0.0	96.0	25	-1.32
	>18 Males	3.5	0.8	0.0	100.0	23	3.1	1.1	1.4	94.2	69	-1.61
	>18 Females	3.1	0.9	0.0	91.3	23	2.5	1.0	1.4	89.9	69	-2.55*
Large farmers	1-3	0.9	0.8	33.3	44.4	9	0.6	0.6	37.9	34.5	29	-1.21
	4-6	1.5	0.6	0.0	100.0	12	1.5	1.0	0.0	66.7	30	0.00
	7-12	1.9	0.6	0.0	92.9	28	1.9	0.8	0.0	83.8	74	0.00
	13-18 Males	2.9	0.8	0.0	100.0	11	2.2	1.0	0.0	85.7	21	-2.01*
	13-18 Females	2.6	1.0	0.0	80.0	10	2.5	1.0	0.0	84.6	26	0.27
	>18 Males	3.3	1.0	0.0	91.4	35	2.6	1.0	3.2	85.3	95	-3.54**
	>18 Females	2.7	0.8	0.0	91.2	34	2.5	0.9	1.9	90.3	103	-1.15

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 47. Intake of riboflavin (in mg) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	1-3	0.3	0.1	81.8	0.0	11	0.3	0.2	56.0	4.0	25	0.00
	4-6	0.6	0.2	15.8	10.5	19	0.5	0.3	40.7	6.8	59	-1.36
	7-12	0.8	0.3	18.4	13.2	38	0.7	0.3	27.8	4.4	90	-1.72
	13-18 Males	1.1	0.4	41.2	5.9	17	1.0	0.4	21.4	4.8	42	-0.87
	13-18 Females	0.9	0.3	0.0	11.1	9	0.8	0.2	18.8	6.3	32	-1.18
	>18 Males	1.2	0.3	5.5	7.3	55	1.1	0.4	16.1	9.0	155	-1.69
	>18 Females	1.1	0.3	6.1	16.3	49	0.9	0.3	19.4	12.7	134	-3.99**
Medium farmers	1-3	0.4	0.2	40.0	0.0	5	0.3	0.3	63.2	5.3	19	-0.70
	4-6	0.7	0.4	16.7	33.3	6	0.5	0.3	22.7	9.1	22	-1.35
	7-12	0.7	0.2	8.3	0.0	12	0.6	0.3	46.2	10.3	39	-1.08
	13-18 Males	1.6	1.0	0.0	50.0	2	1.2	0.4	25.0	12.5	8	-0.98
	13-18 Females	1.1	0.4	0.0	33.3	9	1.3	1.3	12.0	16.0	25	0.45
	>18 Males	1.3	0.3	4.3	21.7	23	1.2	0.6	13.0	17.4	69	-0.77
	>18 Females	1.2	0.4	8.7	39.1	23	1.1	1.0	11.6	15.5	69	-0.47
Large farmers	1-3	0.5	0.3	33.3	22.2	9	0.4	0.4	62.1	24.1	29	-0.69
	4-6	0.6	0.2	0.0	16.7	12	0.7	0.4	16.7	20.0	30	0.82
	7-12	0.7	0.2	14.3	0.0	28	0.7	0.3	24.3	4.1	74	0.00
	13-18 Males	1.1	0.3	18.2	0.0	11	0.9	0.3	28.6	0.0	21	-1.79
	13-18 Females	0.9	0.4	10.0	20.0	10	0.9	0.4	15.4	15.4	26	0.00
	>18 Males	1.2	0.4	11.4	20.0	35	1.1	0.6	33.7	20.0	95	-0.91
	>18 Females	1.0	0.3	11.8	17.6	34	1.0	0.5	17.5	15.5	103	0.00

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 48. Intake of ascorbic acid (in mg) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	1-3	6.0	9.8	90.9	0.0	11	4.0	4.7	96.0	0.0	25	-0.84
	4-6	4.2	2.2	100.0	0.0	19	5.2	4.9	98.3	0.0	59	0.86
	7-12	6.9	6.9	94.7	0.0	38	8.4	10.1	92.2	3.3	90	0.84
	13-18 Males	8.5	6.3	88.2	0.0	17	14.6	19.0	78.6	4.8	42	1.29
	13-18 Females	3.9	2.1	100.0	0.0	9	7.6	6.9	93.8	0.0	32	1.58
	>18 Males	8.8	7.2	96.4	0.0	55	12.3	13.0	91.0	1.9	155	1.89
	>18 Females	9.3	7.5	98.0	0.0	49	12.7	21.3	93.3	2.2	134	1.09
Medium farmers	1-3	3.4	3.0	100.0	0.0	5	3.1	3.4	100.0	0.0	19	-0.18
	4-6	4.9	6.1	100.0	0.0	6	8.3	12.0	90.9	4.5	22	0.66
	7-12	15.6	24.0	83.3	16.7	12	6.4	9.4	97.4	2.6	39	-1.98
	13-18 Males	13.3	13.2	50.0	0.0	2	13.3	12.3	87.5	12.5	8	0.00
	13-18 Females	14.5	21.3	77.8	11.1	9	14.5	14.5	72.0	4.0	25	0.00
	>18 Males	11.8	18.6	95.7	4.3	23	12.8	13.1	87.0	1.4	69	0.28
	>18 Females	15.8	24.6	91.3	8.7	23	12.7	14.1	85.9	1.4	69	-0.75
Large farmers	1-3	8.0	12.3	88.9	11.1	9	7.7	12.8	89.7	6.9	29	-0.06
	4-6	15.2	17.3	75.0	16.7	12	7.4	13.8	96.7	3.3	30	-1.54
	7-12	9.1	14.1	92.9	7.1	28	10.3	8.3	87.8	1.4	74	0.53
	13-18 Males	12.4	15.4	90.9	9.1	11	9.9	8.9	85.7	0.0	21	-0.59
	13-18 Females	14.2	18.7	80.0	20.0	10	12.2	13.3	84.6	3.8	26	-0.36
	>18 Males	19.9	23.0	77.1	11.4	35	16.3	17.9	77.9	7.4	95	-0.94
	>18 Females	24.3	30.8	73.5	14.7	34	14.1	13.7	90.3	4.9	103	-2.67**

** Significant at 1% level.

Appendix Table 49. Intake of lysine (in g) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
				% of sample consuming					% of sample consuming			
		Mean	SD	<50% RDA	>100% RDA	N	Mean	SD	<50% RDA	>100% RDA	N	
Landless laborers and small farmers	10-12	2.3	1.2	0.0	87.5	16	1.7	0.6	3.3	66.7	30	-2.16*
	>18 Males	3.0	0.8	0.0	100.0	53	2.6	1.0	1.0	99.0	97	-2.45*
	>18 Females	2.8	0.7	0.0	100.0	45	2.2	0.8	1.2	98.8	83	-4.58**
Medium farmers	10-12	2.5	0.7	0.0	100.0	6	1.9	1.0	9.1	63.6	11	-1.29
	>18 Males	3.2	0.8	0.0	100.0	21	2.8	0.8	0.0	100.0	45	-2.12*
	>18 Females	2.8	0.7	0.0	100.0	19	2.5	0.8	0.0	100.0	35	-1.74
Large farmers	10-12	2.3	0.5	0.0	100.0	9	2.1	1.0	6.3	75.0	16	-0.57
	>18 Males	2.9	0.8	0.0	100.0	28	2.6	1.1	0.0	95.8	48	-1.10
	>18 Females	2.4	0.6	0.0	100.0	27	2.5	0.9	0.0	97.9	47	0.81

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 50. Intake of sulfur amino acids (in g) and percentage of RDA met in Akola region.

Farm-size group	Age group (in years)	Lean season					Surplus season					T-values for seasonal effect
		Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	Mean	SD	% of sample consuming <50% RDA	% of sample consuming >100% RDA	N	
Landless laborers and small farmers	10-12	1.9	0.7	0.0	100.0	21	1.7	0.6	2.2	95.6	45	-1.70
	>18 Males	2.8	0.7	0.0	98.2	55	2.4	0.8	1.9	97.4	155	-3.09**
	>18 Females	2.6	0.6	0.0	100.0	49	2.0	0.7	0.8	98.5	134	-4.96**
Medium farmers	10-12	2.2	0.7	0.0	100.0	6	1.6	0.7	0.0	80.0	15	-1.87
	>18 Males	3.0	0.7	0.0	100.0	23	2.6	0.8	1.5	98.5	67	-2.62*
	>18 Females	2.7	0.8	0.0	100.0	23	2.2	0.7	0.0	100.0	60	-2.96**
Large farmers	10-12	1.7	0.6	0.0	91.7	12	1.7	0.7	0.0	82.1	28	0.17
	>18 Males	2.6	0.7	0.0	94.3	35	2.0	0.9	3.8	84.8	79	-3.59**
	>18 Females	2.2	0.6	0.0	100.0	34	2.0	0.7	1.2	97.6	82	-1.00

* Significant at 5% level. ** Significant at 1% level.

Appendix Tables 51 - 62

Comparison of Effects of Using Measured Protein Content of Major Food Grains and Standard Protein Content on Protein Intakes

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Appendix Table 51. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the lean season in Aurepalle region.

Farm-size group	Age groups (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	14.6	10.4	13	12.7	5.7	12	0.56
	4-6	19.6	9.1	27	20.2	7.6	27	0.26
	7-12	27.7	9.8	40	30.1	10.6	41	1.06
	13-18 Males	45.9	13.6	20	48.9	14.6	18	0.66
	13-18 Females	37.7	11.2	13	40.0	10.5	10	0.50
	>18 Males	42.8	15.7	41	44.9	13.7	43	0.65
	>18 Females	34.4	10.8	46	37.2	9.9	47	1.30
Medium farmers	1-3	18.7	5.8	7	22.9	9.3	8	1.03
	4-6	25.5	18.4	6	30.6	18.4	6	0.48
	7-12	46.3	23.6	12	50.3	23.7	11	0.41
	13-18 Males	35.9	13.9	5	36.2	13.9	3	0.03
	13-18 Females	32.3	0.1	2	37.2	0.3	2	21.91**
	>18 Males	50.7	22.2	26	56.1	21.6	25	0.88
	>18 Females	46.3	23.5	24	51.3	23.2	22	0.73
Large farmers	1-3	12.3	3.3	3	12.8	3.0	3	0.19
	4-6	30.6	11.6	7	33.1	11.1	7	0.41
	7-12	31.1	11.7	23	33.5	12.1	23	0.68
	13-18 Males	48.5	17.8	10	49.7	16.9	10	0.15
	13-18 Females	50.4	16.6	10	66.4	3.4	4	1.87
	>18 Males	50.7	22.1	36	54.0	22.1	36	0.63
	>18 Females	48.0	19.2	26	51.2	19.5	26	0.60

** Significant at 1% level.

Appendix Table 52. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the surplus season in Aurepalle region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	20.5	10.6	17	20.9	10.4	18	0.11
	4-6	29.9	14.2	23	29.9	13.3	23	0.00
	7-12	44.2	19.0	38	43.6	16.6	39	0.15
	13-18 Males	54.0	19.8	20	54.2	18.3	17	0.03
	13-18 Females	52.3	18.1	19	54.6	17.5	15	0.37
	>18 Males	60.1	23.8	45	60.9	23.6	46	0.16
	>18 Females	52.0	23.7	44	53.3	24.0	46	0.26
Medium farmers	1-3	22.7	7.8	10	29.1	22.8	10	0.84
	4-6	36.0	11.7	9	41.1	20.1	10	0.67
	7-12	54.8	13.6	12	53.4	12.2	11	0.26
	13-18 Males	58.0	10.2	5	53.6	6.0	4	0.76
	13-18 Females	50.1	1.2	2	50.0	2.1	2	0.06
	>18 Males	67.5	19.4	28	65.3	16.9	27	0.45
	>18 Females	64.7	18.8	26	60.0	16.1	24	0.95
Large farmers	1-3	34.6	11.6	3	34.3	10.8	4	0.04
	4-6	26.1	9.4	3	28.7	11.1	3	0.31
	7-12	44.8	16.5	21	47.9	17.1	21	0.60
	13-18 Males	66.6	16.1	10	67.1	20.1	9	0.06
	13-18 Females	60.8	16.8	10	70.1	16.4	5	1.02
	>18 Males	65.6	20.9	38	69.8	22.8	37	0.83
	>18 Females	62.2	18.0	25	66.8	19.5	24	0.86

Appendix Table 53. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents from NIN (Gopalan et al. 1976) during the lean season in Dokur region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	15.8	9.7	7	14.1	8.8	4	0.29
	4-6	35.2	11.9	7	31.1	13.1	5	0.56
	7-12	39.3	10.7	13	39.6	10.9	12	0.07
	13-18 Males	60.7	13.2	9	68.7	12.4	5	1.11
	13-18 Females	59.5	24.2	7	60.6	25.8	6	0.08
	>18 Males	62.8	20.1	23	61.3	19.2	19	0.25
	>18 Females	50.1	17.7	34	49.3	17.9	31	0.18
Medium farmers	1-3	21.3	5.2	2	24.6	2.2	3	1.03
	4-6	38.4	0.0	1	40.8	3.4	3	0.61
	7-12	41.9	11.7	4	38.2	11.2	3	0.42
	13-18 Males	53.0	19.0	2	53.4	11.6	4	0.03
	13-18 Females	39.1	17.8	2	43.4	14.6	3	0.30
	>18 Males	46.6	16.7	9	53.9	18.3	13	0.95
	>18 Females	54.9	15.5	10	52.5	14.7	11	0.36
Large farmers	1-3	16.6	12.6	5	16.6	11.0	6	0.00
	4-6	35.0	6.6	6	35.0	6.5	6	0.00
	7-12	45.5	8.5	11	45.3	9.0	13	0.06
	13-18 Males	64.9	18.9	9	63.1	21.9	5	0.16
	13-18 Females	42.6	6.4	3	39.1	1.8	2	0.72
	>18 Males	67.4	18.7	16	67.5	20.2	16	0.01
	>18 Females	54.2	14.2	12	54.5	14.4	15	0.05

Appendix Table 54. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the surplus season in Dokur region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	21.5	14.4	15	21.3	10.2	14	0.04
	4-6	36.9	22.4	23	36.0	22.3	26	0.14
	7-12	39.4	10.5	38	46.3	13.5	42	2.53*
	13-18 Males	49.6	15.1	22	60.8	16.1	16	2.20*
	13-18 Females	55.4	23.1	19	63.9	24.7	17	1.07
	>18 Males	56.2	20.3	76	66.3	21.9	76	2.95**
	>18 Females	49.9	17.1	103	59.6	21.4	109	3.63**
Medium farmers	1-3	18.5	7.8	8	24.5	18.8	9	0.84
	4-6	31.2	7.0	4	43.5	23.0	4	1.02
	7-12	41.3	17.2	12	48.3	17.5	13	1.01
	13-18 Males	58.0	22.8	8	62.1	23.4	6	0.33
	13-18 Females	69.8	31.6	2	68.9	23.5	3	0.04
	>18 Males	62.5	27.7	26	70.7	28.3	40	1.16
	>18 Females	54.4	16.2	31	65.0	19.9	40	2.41*
Large farmers	1-3	21.6	10.9	16	24.5	11.0	18	0.77
	4-6	33.1	13.8	23	38.0	14.8	24	1.17
	7-12	38.0	13.4	27	43.2	14.9	27	1.35
	13-18 Males	58.6	21.3	26	74.9	25.2	15	2.21*
	13-18 Females	41.4	9.0	5	47.0	9.4	5	0.96
	>18 Males	63.8	18.2	59	72.4	19.3	57	2.47*
	>18 Females	56.9	21.4	48	64.5	23.2	50	1.68

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 55. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the lean season in Sholapur region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	31.6	25.1	17	19.1	10.7	18	1.94
	4-6	39.8	21.4	40	33.0	13.2	38	1.68
	7-12	49.4	20.0	115	43.7	17.9	123	2.32*
	13-18 Males	67.4	31.3	27	60.8	20.9	11	0.64
	13-18 Females	58.5	24.6	51	49.8	23.7	22	1.40
	>18 Males	75.2	30.8	139	62.9	24.4	148	3.76**
	>18 Females	64.2	30.8	126	52.7	24.7	133	3.32**
Medium farmers	1-3	22.5	18.1	28	26.8	24.8	23	0.72
	4-6	36.6	13.4	32	41.0	25.0	28	0.86
	7-12	44.6	15.1	67	39.6	18.9	49	1.58
	13-18 Males	57.0	14.2	18	60.8	8.1	5	0.57
	13-18 Females	55.9	13.7	24	71.8	37.1	4	1.63
	>18 Males	65.8	25.4	108	67.5	35.9	85	0.38
	>18 Females	59.1	21.8	99	59.5	32.0	81	0.10
Large farmers	1-3	26.0	14.9	23	25.1	16.1	26	0.20
	4-6	44.1	17.5	34	36.6	16.4	41	1.91
	7-12	53.8	21.8	77	47.9	21.8	90	1.74
	13-18 Males	75.6	40.6	47	98.0	43.8	16	1.87
	13-18 Females	63.7	26.8	41	63.0	32.2	9	0.07
	>18 Males	80.9	33.1	116	69.9	32.4	133	2.65**
	>18 Females	70.0	32.7	108	63.3	30.3	121	1.61

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 56. Comparison of average protein (g/caput/day) intakes using measured contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the surplus season in Sholapur region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	24.1	19.2	9	20.9	15.7	9	0.39
	4-6	36.2	16.7	20	28.7	13.7	20	1.55
	7-12	49.2	21.0	42	41.7	18.0	42	1.76
	13-18 Males	72.1	38.4	9	72.5	31.9	6	0.02
	13-18 Females	63.2	27.8	15	64.4	29.7	6	0.09
	>18 Males	73.5	23.2	50	61.5	19.2	50	2.82**
	>18 Females	68.6	30.9	48	57.8	25.7	50	1.88
Medium farmers	1-3	23.0	14.2	13	19.6	12.2	14	0.67
	4-6	40.5	14.6	13	35.1	12.1	14	1.05
	7-12	55.0	11.7	27	46.7	9.8	27	2.83**
	13-18 Males	69.3	19.7	7	47.5	5.2	3	1.83
	13-18 Females	64.2	8.7	8	58.6	5.3	2	0.85
	>18 Males	76.5	17.2	36	64.4	14.0	36	3.27**
	>18 Females	68.7	15.9	34	58.0	13.0	34	3.04**
Large farmers	1-3	23.7	12.3	7	21.4	10.7	7	0.37
	4-6	42.1	6.0	10	36.3	5.1	10	2.33**
	7-12	56.1	15.6	23	48.5	14.0	23	1.74
	13-18 Males	87.7	24.5	16	83.0	21.7	7	0.44
	13-18 Females	59.2	8.6	14	48.6	4.3	4	2.35*
	>18 Males	81.9	19.3	39	70.7	16.9	38	2.71**
	>18 Females	75.8	22.5	39	65.3	20.0	37	2.15*

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 57. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the lean season in Akola region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	22.2	14.7	11	21.5	14.3	12	0.12
	4-6	50.7	19.5	19	40.4	17.9	19	1.70
	7-12	65.6	20.7	38	55.4	21.1	40	2.15*
	13-18 Males	90.3	29.7	17	81.5	26.9	9	0.74
	13-18 Females	82.5	21.0	9	63.8	27.4	8	1.59
	>18 Males	95.4	23.1	55	77.9	22.8	61	4.10**
	>18 Females	89.0	19.8	49	69.9	20.3	61	4.96**
Medium farmers	1-3	33.8	17.7	5	22.3	12.5	6	1.26
	4-6	56.9	25.8	6	50.0	17.7	10	0.64
	7-12	59.5	23.3	12	46.8	20.4	16	1.53
	13-18 Males	123.6	62.9	2	70.4	65.5	3	0.90
	13-18 Females	90.7	25.6	9	64.9	37.2	5	1.54
	>18 Males	103.9	24.6	23	76.4	32.3	26	3.32**
	>18 Females	93.1	27.5	23	74.2	30.1	23	2.22*
Large farmers	1-3	32.6	21.1	9	32.5	22.0	8	0.01
	4-6	47.0	13.9	12	35.4	14.4	10	1.92
	7-12	60.3	17.9	28	50.3	17.8	28	2.10*
	13-18 Males	87.3	23.6	11	81.1	11.3	6	0.60
	13-18 Females	77.0	26.3	10	68.0	34.2	7	0.61
	>18 Males	96.2	25.2	35	81.5	26.7	36	2.38*
	>18 Females	80.0	21.0	34	70.5	19.5	32	1.90

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 58. Comparison of average protein intakes (g/caput/day) using measured protein contents of village food-grain samples and standard protein contents (Gopalan et al. 1976) during the surplus season in Akola region.

Farm-size group	Age group (in years)	Using NIN protein values			Using measured ICRISAT protein values			T-values
		Mean	SD	N	Mean	SD	N	
Landless laborers and small farmers	1-3	24.6	14.3	25	23.5	15.2	27	0.27
	4-6	40.2	16.5	59	35.5	15.3	61	1.62
	7-12	57.1	19.7	90	48.7	17.5	93	3.05**
	13-18 Males	80.5	22.5	42	68.6	24.7	22	1.94
	13-18 Females	66.3	18.9	32	65.1	20.4	19	0.21
	>18 Males	88.1	27.4	155	76.7	26.1	162	3.79**
	>18 Females	74.3	24.9	134	63.7	23.8	147	3.65**
Medium farmers	1-3	23.4	16.0	19	19.1	9.9	19	1.00
	4-6	43.6	19.5	22	35.1	14.3	25	1.72
	7-12	51.6	21.9	39	46.4	21.5	43	1.08
	13-18 Males	97.9	36.1	8	82.5	32.7	8	0.89
	13-18 Females	74.4	26.6	25	64.4	21.1	16	1.27
	>18 Males	92.7	29.3	69	79.6	27.2	67	2.70**
	>18 Females	76.6	26.2	69	64.5	24.5	69	2.80**
Large farmers	1-3	26.5	22.7	29	25.5	22.6	28	0.17
	4-6	50.5	30.2	30	50.2	30.9	32	0.04
	7-12	60.2	23.5	74	53.3	22.2	75	1.84
	13-18 Males	68.3	28.6	21	67.9	27.5	12	0.04
	13-18 Females	75.3	27.4	26	70.8	30.2	15	0.49
	>18 Males	80.1	30.8	95	74.2	31.4	103	1.33
	>18 Females	76.8	25.6	103	69.6	28.1	110	1.95

** Significant at 1% level.

Appendix Table 59. Distribution of intake as percentage of RDA for protein in Aurepalle region, using measured protein content of food grains.

Farm-size group	Age group (in years)	Lean season N	Lean season Mean	Lean season SD	Lean season % of sample consuming <50% RDA	Lean season % of sample consuming >100% RDA	Surplus season N	Surplus season Mean	Surplus season SD	Surplus season % of sample consuming <50% RDA	Surplus season % of sample consuming >100% RDA	T-values for seasonal effect
Landless laborers and small farmers	1-3	12	12.7	5.7	41.7	16.7	18	20.9	10.4	11.1	55.6	2.48*
	4-6	27	20.2	7.6	7.4	40.7	23	29.9	13.3	4.3	60.9	3.22**
	7-12	41	30.1	10.6	9.8	14.6	39	43.6	16.6	5.1	59.0	4.36**
	13-18 Males	18	38.9	14.6	0.0	22.2	17	54.2	18.3	5.9	41.2	0.95
	13-18 Females	10	40.0	10.5	0.0	20.0	15	54.6	17.5	0.0	60.0	2.36*
	>18 Males	43	44.9	13.7	4.7	25.6	46	60.9	23.6	6.5	58.7	3.88**
	>18 Females	47	37.2	9.9	10.6	23.4	46	53.3	24.0	15.2	67.4	4.25**
Medium farmers	1-3	8	22.9	9.3	0.0	62.5	10	29.1	22.8	0.0	60.0	0.72
	4-6	6	30.6	18.4	0.0	66.7	10	41.1	20.1	0.0	80.0	1.04
	7-12	11	50.3	23.7	0.0	72.7	11	53.4	12.2	0.0	90.9	0.39
	13-18 Males	3	36.2	13.9	33.3	0.0	4	53.6	6.0	0.0	25.0	2.29
	13-18 Females	2	37.2	0.3	0.0	0.0	2	50.0	2.1	0.0	50.0	8.53*
	>18 Males	25	56.1	21.6	8.0	44.0	27	65.3	16.9	3.7	74.1	1.72
	>18 Females	22	51.3	23.2	9.1	68.2	24	60.0	16.1	0.0	83.3	1.49
Large farmers	1-3	3	12.8	3.0	0.0	0.0	4	34.3	10.8	0.0	100.0	3.28*
	4-6	7	33.1	11.1	0.0	85.7	3	28.7	11.1	0.0	66.7	-0.57
	7-12	23	33.5	12.1	8.7	34.8	21	47.9	17.1	0.0	61.9	3.25**
	13-18 Males	10	49.7	16.9	10.0	40.0	9	67.1	20.1	0.0	77.8	2.05
	13-18 Females	4	66.4	3.4	0.0	100.0	5	70.1	16.4	0.0	80.0	0.44
	>18 Males	36	54.0	22.1	11.1	41.7	37	69.8	22.8	2.7	75.7	3.01**
	>18 Females	26	51.2	19.5	3.8	50.0	24	66.8	19.5	0.0	91.7	2.83**

* Significant at 5% level. ** Significant at 1% level.

Appendix Table 60. Distribution of intake as percentage of RDA for protein in Dokur region, using measured protein content of food grains.

Farm-size group	Age group (in years)	Lean season N	Lean season Mean	Lean season SD	Lean season % of sample consuming <50% RDA	Lean season % of sample consuming >100% RDA	Surplus season N	Surplus season Mean	Surplus season SD	Surplus season % of sample consuming <50% RDA	Surplus season % of sample consuming >100% RDA	T-values for seasonal effect
Landless laborers and small farmers	1-3	4	14.1	8.8	50.0	50.0	14	21.3	10.2	14.3	71.4	1.28
	4-6	5	31.1	13.1	0.0	80.0	26	36.0	22.3	11.5	73.1	0.47
	7-12	12	39.6	10.9	0.0	66.7	42	46.3	13.5	0.0	71.4	1.58
	13-18 Males	5	68.7	12.4	0.0	80.0	16	60.8	16.1	6.3	68.8	-1.00
	13-18 Females	6	60.6	25.8	0.0	66.7	17	63.9	24.7	5.9	88.2	0.28
	>18 Males	19	61.3	19.2	0.0	52.6	76	66.3	21.9	3.9	77.6	0.91
	>18 Females	31	49.3	17.9	3.2	51.6	109	59.6	21.4	0.9	78.0	2.45*
Medium farmers	1-3	3	24.6	2.2	0.0	100.0	9	24.5	18.8	22.2	66.7	-0.01
	4-6	3	40.8	3.4	0.0	100.0	4	43.5	23.0	0.0	100.0	0.20
	7-12	3	38.2	11.2	0.0	33.3	13	48.3	17.5	7.7	92.3	0.94
	13-18 Males	4	53.4	11.6	0.0	25.0	6	62.1	23.4	0.0	50.0	0.68
	13-18 Females	3	43.4	14.6	0.0	66.7	3	68.9	23.5	0.0	100.0	1.60
	>18 Males	13	53.9	18.3	7.7	46.2	40	70.7	28.3	5.0	70.0	2.00*
	>18 Females	11	52.5	14.7	0.0	54.5	40	65.0	19.9	2.5	82.5	1.94
Large farmers	1-3	6	16.6	11.0	33.3	33.3	18	24.5	11.0	11.1	72.2	1.52
	4-6	6	35.0	6.5	0.0	100.0	24	38.0	14.8	0.0	83.3	0.48
	7-12	13	45.3	9.0	0.0	76.9	27	43.2	14.9	7.4	63.0	-0.47
	13-18 Males	5	63.1	21.9	0.0	40.0	15	74.9	25.2	0.0	73.3	0.93
	13-18 Females	2	39.1	1.8	0.0	0.0	5	47.0	9.4	0.0	60.0	1.12
	>18 Males	16	67.5	20.2	0.0	75.0	57	72.4	19.3	0.0	84.2	0.89
	>18 Females	15	54.5	14.4	0.0	73.3	50	64.5	23.2	4.0	86.0	1.58

* Significant at 5% level.

Appendix Table 61. Distribution of intake as percentage of RDA for protein in Sholapur region, using measured protein content of food grains.

Farm-size group	Age group (in years)	Lean season N	Lean season Mean	Lean season SD	Lean season % of sample consuming <50% RDA	Lean season % of sample consuming >100% RDA	Surplus season N	Surplus season Mean	Surplus season SD	Surplus season % of sample consuming <50% RDA	Surplus season % of sample consuming >100% RDA	T-values for seasonal effect
Landless laborers and small farmers	1-3	18	19.1	10.7	22.2	50.0	9	20.9	15.7	22.2	33.3	0.35
	4-6	38	33.0	13.2	0.0	76.3	20	28.7	13.7	0.0	60.0	-1.16
	7-12	123	43.7	17.9	3.3	58.5	42	41.7	18.0	4.8	57.1	-0.62
	13-18 Males	11	60.8	20.9	9.1	54.5	6	72.5	31.9	16.7	66.7	0.92
	13-18 Females	22	49.8	23.7	13.6	50.0	6	64.4	29.7	0.0	66.7	1.27
	>18 Males	148	62.9	24.4	2.0	51.4	50	61.5	19.2	4.0	56.0	-0.37
	>18 Females	133	52.7	24.7	6.8	59.4	50	57.8	25.7	8.0	62.0	1.23
Medium farmers	1-3	23	26.8	24.8	17.4	47.8	14	19.6	12.2	21.4	42.9	-1.01
	4-6	28	41.0	25.0	3.6	85.7	14	35.1	12.1	7.1	92.9	-0.83
	7-12	49	39.6	18.9	8.2	55.1	27	46.7	9.8	0.0	92.6	1.82
	13-18 Males	5	60.8	8.1	0.0	60.0	3	47.5	5.2	0.0	0.0	-2.51*
	13-18 Females	4	71.8	37.1	0.0	75.0	2	58.6	5.3	0.0	100.0	-0.47
	>18 Males	85	67.5	35.9	5.9	58.8	36	64.4	14.0	0.0	75.0	-0.50
	>18 Females	81	59.5	32.0	7.4	66.7	34	58.0	13.0	0.0	88.2	-0.26
Large farmers	1-3	26	25.1	16.1	19.2	65.4	7	21.4	10.7	14.3	71.4	-0.57
	4-6	41	36.6	16.4	4.9	85.4	10	36.3	5.1	0.0	100.0	-0.06
	7-12	90	47.9	21.8	2.2	63.3	23	48.5	14.0	0.0	87.0	0.13
	13-18 Males	16	98.0	43.8	0.0	81.3	7	83.0	21.7	0.0	71.4	-0.85
	13-18 Females	9	63.0	32.2	0.0	55.6	4	48.6	4.3	0.0	25.0	-0.87
	>18 Males	133	69.9	32.4	1.5	66.2	38	70.7	16.9	0.0	73.7	0.15
	>18 Females	121	63.3	30.3	0.0	66.9	37	65.3	20.0	2.7	83.8	0.38

* Significant at 5% level.

Appendix Table 62. Distribution of intake as percentage of RDA for protein in Akola region, using measured protein content of food grains.

Farm-size group	Age group (in years)	Lean season N	Lean season Mean	Lean season SD	Lean season % of sample consuming <50% RDA	Lean season % of sample consuming >100% RDA	Surplus season N	Surplus season Mean	Surplus season SD	Surplus season % of sample consuming <50% RDA	Surplus season % of sample consuming >100% RDA	T-values for seasonal effect
Landless laborers and small farmers	1-3	12	21.5	14.3	25.0	66.7	27	23.5	15.2	11.1	55.6	0.39
	4-6	19	40.4	17.9	5.3	89.5	61	35.5	15.3	3.3	82.0	-1.17
	7-12	40	55.4	21.1	5.0	85.0	93	48.7	17.5	2.2	74.2	-1.90
	13-18 Males	9	81.5	26.9	0.0	66.7	22	68.6	24.7	0.0	50.0	-1.29
	13-18 Females	8	63.8	27.4	12.5	87.5	19	65.1	20.4	0.0	73.7	0.14
	>18 Males	61	77.9	22.8	3.3	86.9	162	76.7	26.1	1.9	82.7	-0.32
	>18 Females	61	69.9	20.3	1.6	86.9	147	63.7	23.8	2.7	79.6	-1.78
Medium farmers	1-3	6	22.3	12.5	16.7	50.0	19	19.1	9.9	21.1	57.9	-0.65
	4-6	10	50.0	17.7	0.0	90.0	25	35.1	14.3	0.0	88.0	-2.60*
	7-12	16	46.8	20.4	6.3	68.8	43	46.4	21.5	2.3	69.8	-0.06
	13-18 Males	3	70.4	65.5	33.3	66.7	8	82.5	32.7	0.0	62.5	0.42
	13-18 Females	5	64.9	37.2	20.0	80.0	16	64.4	21.1	0.0	62.5	-0.04
	>18 Males	26	76.4	32.3	11.5	80.8	67	79.6	27.2	0.0	82.1	0.48
	>18 Females	23	74.2	30.1	8.7	91.3	69	64.5	24.5	2.9	87.0	-1.55
Large farmers	1-3	8	32.5	22.0	25.0	75.0	28	25.5	22.6	21.4	35.7	-0.78
	4-6	10	35.4	14.4	10.0	90.0	32	50.2	30.9	0.0	75.0	1.46
	7-12	28	50.3	17.8	3.6	82.1	75	53.3	22.2	5.3	76.0	0.64
	13-18 Males	6	81.1	11.3	0.0	100.0	12	67.9	27.5	8.3	66.7	-1.12
	13-18 Females	7	68.0	34.2	14.3	85.7	15	70.8	30.2	0.0	80.0	0.19
	>18 Males	36	81.5	26.7	2.8	88.9	103	74.2	31.4	5.8	70.9	-1.25
	>18 Females	32	70.5	19.5	0.0	84.4	110	69.6	28.1	4.5	84.5	-0.17

* Significant at 5% level.

Appendix Table 63

Household Time Allocation

Appendix Table 63. Total number of observations on household time-allocation over three rounds.[1]

Category	Socioeconomic group	Aurepalle region	Dokur region	Sholapur region	Akola region
Men	Landless laborers and small farmers	22	13	49	48
	Medium farmers	13	17	27	20
	Large farmers	16	9	41	30
	Subtotal	51	39	117	98
Women	Landless laborers and small farmers	26	22	47	48
	Medium farmers	10	11	27	25
	Large farmers	16	14	32	36
	Subtotal	52	47	106	109
Children	Landless laborers and small farmers	13	5	45	35
	Medium farmers	20	3	33	10
	Large farmers	11	18	25	17
	Subtotal	44	26	103	62
	Total	147	112	326	269

1. The observation unit was persons.