POLICY PAPER 17

Agricultural-based Interventions for Sustainable Nutritional Security

P Adhiguru
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AGRICULTURAL ECONOMICS
AND POLICY RESEARCH
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INDIA

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ACRONYMS AND ABBREVIATIONS

ABS	Average Budget Share
ACC	Administrative Committee on Coordination
AMT	Anna Marumalartchi Thittam
ANC	Anti-natal Clinic
AWW	*Anganwadi* Workers
BDO	Block Development Officer
BLP	Block Level Planning
FAO	Food and Agriculture Organization
GLVs	Green Leafy Vegetables
GoI	Government of India
IAY	Indira Awaas Yojana
ICDP	Integrated Cereal Development Program
ICDS	Integrated Child Development Service
ICRW	Integrated Center for Research on Women
IDD	Iodine Deficiency Disorders
IFPRI	International Food Policy Research Institute
IRDP	Integrated Rural Development Program
JGSY	Jawhar Grama Sabha Yojana
KVK	Krishi Vigyan Kendra
MBS	Marginal Budget Share
MSSRF	M S Swaminathan Research Foundation
NAAS	National Academy of Agricultural Sciences
NATP	National Agricultural Technology Project
NGOs	Non-Government Organizations
NNMB	National Nutrition Monitoring Bureau
NPDP	National Pulse Development Program
PCM	Protein Calorie Malnutrition
PDS	Public Distribution System
PEM	Protein Energy Malnutrition
PNC	Post-natal Clinic
RDA	Recommended Dietary Allowance
SAARC	South Asian Association for Regional Cooperation
SAU	State Agricultural University
SCN	Sub Committee on Nutrition
SGY	Swarna Jayanthi Yojana Scheme
SHG	Self Help Group
TANWA	Tamil Nadu Women in Agriculture
TINP	Tamil Nadu Integrated Nutrition Project
VHN	Village Health Nurse
WFP	World Food Program
WHO	World Health Organization

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FOREWORD

In spite of various nutrition intervention programs being operational in India, it still accounts for 40 per cent of the world's malnourished children and about 60 per cent of Indian women are anemic. It has been realized that agricultural interventions are more beneficial and sustainable in addressing malnutrition among the rural poor than the direct nutritional intervention programs.

Incorporating nutritional objectives in agriculture will be a win-win situation with the poverty alleviation, income growth, nutritional security and ultimately achieving goals of India's agricultural development. In this context, this study has thrown light on the issue of agricultural production systems viz. rice, vegetable, and sugarcane influence on nutritional security of rural households in those systems. The study also gives a view about scope for inter-institutional linkages among developmental departments to promote nutritional security.

The study depicts the potential of vegetable systems to supply healthy food especially rich in vitamins and micronutrients to the weaker sections of the society and expose the weaknesses of non-vegetable production systems. Agricultural- based kind wages and woman income management in the households seems to be favorable for enhanced household nutritional security. Location specific agriculture-based interventions would be necessary to safe guard regional nutritional security balance. The existing weaknesses in institutional linkages amongst development departments suggest immediate reorientation in their approach. The study underlines the need for redefining of agricultural extension to address nutritional security concerns.

We hope that this study linking agriculture and nutrition shall further strengthen the institutional linkages among concerned department as well as guides future policies and planning in the India's sustainable food and nutritional security.

Mruthyunjaya
Director

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Authors

EXECUTIVE SUMMARY

Agricultural interventions are more sustainable in addressing malnutrition among the rural poor than the direct nutritional intervention programs, which may not be cost-effective in the long run. To examine this issue, a study was taken up covering rural households in the rice, vegetable and sugarcane production areas (systems). The rural households comprised small and marginal farmers and agricultural laborers in Dharmapuri district in Tamil Nadu. The scope for inter-institutional linkages among developmental departments to promote nutritional security was also explored.

One village representing each production system was selected for collecting primary data. Sixty households per production system have been selected. Data on socio-economic factors of household members and their dietary intake were collected. The secondary data were collected by interacting with various development departments from village level to state level. The survey was conducted during the year 2000-01.

The study has indicated that, among the food groups, the deficit (shortage of RDA in %) is more pronounced in the case of fruits and green leafy vegetables for both males and females, and was least in pulses and cereals. Among the these production systems, the extent of deficit was comparatively lower in the vegetable production system. Gender wise, the adult females have higher deficit than adult males.

The maternal beliefs about some food items being bad to children, have adversely affected the nutrients intake. For instance, the intake of '*Agathi*' (*Sesbania grandiflora*) was lower though it is highly rich in calcium. The intake of pulses, green leafy vegetables and vegetables by children has been found to be comparatively higher in the vegetable production system. There was also significant deficiency in respect of consumption of fruits, milk, fats and oils in children of all age groups, particularly, in the food-grain-based and cash-crop based production systems.

The deficit in the consumption of vitamin A, iron and vitamin C has been found to be significantly low in the vegetable system as compared to in food and cash crop-based production systems for both men and women. The influence of production systems on nutrient intake among children has revealed in the same pattern as that of adults

These results depict the potential of vegetable system to supply healthy food to the weaker sections of society and expose the weaknesses of non-vegetable production system. Therefore, location-specific horticultural interventions are necessary to ensure nutritional security in different production systems.

The intra-household allocation analysis has revealed that female individuals have higher deficit of vitamin A and iron than the average household deficit due to unawareness about the physiological requirements. However, no conscious gender discrimination in food intake has been noticed.

Regression analysis has shown that, Public Distribution System (PDS) does serve the cause of nutritional security, especially in the rice system with intake of wheat supplying more protein. Region-specific PDS would help balanced dietary intake. The presence of children in a household influences protein and energy intake. Hence, the number of children per household should be considered as one of the indicators for identification of 'at-risk' households. Nutrition knowledge has positively influenced the per capita protein and energy intake in the sugarcane system. It has been found that cash flow without sufficient nutritional knowledge would not automatically lead to a balanced food intake. Hence, nutrition education is more crucial in non-vegetable producing farming systems.

The frequency of consumption of leafy and other vegetables and indigenous crops has been higher in the vegetable system. Kind wages positively influence nutrient intake of the agricultural laborers in the vegetable system. Share of food expenditure has been found comparatively lower in the vegetable production system. In the rice and sugarcane systems, the expenditure share of rice has been found higher, whereas, the share of fruits and vegetables is comparatively lower. In the vegetable system, the food expenditure share has been found well distributed. Well thought of agricultural, and nutrition and educational intervention, programs and market interventions can minimize this disparity across production systems.

In the non-vegetable growing farming systems, the incremental income has been observed to promote purchase of milk and milk products by the households. Interestingly, in the vegetable system, the income increase leads to change in food intake from finger millet to rice due to perception that former is inferior. So, agriculture and nutrition departments can take up joint campaign for promoting consumption of millets. Among non-food

expenditure, health expenditure has been observed to be the highest in the sugarcane system as compared to other systems. Therefore, special agricultural interventions for greater access to fruits and vegetables are essential.

In the rice system, in households with higher income and large land holding size, there has been reduction in the consumption of rice, but increase in the consumption of vegetables and oils. Hence, marginal farmers and agricultural laborers can be assisted for establishing nutrition gardens and cultivation of vegetables in smaller plots of their own land. It has been found that formal education influences the consumption of finger millet. Therefore, nutrition education is as important as formal education. “Number of children” has emerged as an important factor influencing intra household food intake. Homestead gardens have greatly contributed to an increased intake of fruits and vegetables. Earning members positively influenced the intake of pulses suggesting that the increased income flow or direct access to pulses as kind wages contribute to more protein intake.

In this study, programs of various development departments have been examined to assess the linkages in promoting nutritional security. There is some co-operation between Health Department and Integrated Child Development Service (ICDS) in identifying the ‘at-risk’ households. They provide mainly direct feeding and pharmaceutical assistance. Their linkage with agriculture and allied departments has been found to be negligible. Health and nutrition agencies can share the data on nutritional status and the list of ‘at-risk’ households with other development departments. The agricultural regional research stations of State Agricultural Universities, Indian Council of Agricultural Research, *Krishi Vigyan Kendras* (KVKs) etc., can play a greater role in developing regional nutritional security plans and strategies in co-ordination with district level line departments. Joint action can be taken up in the area of nutrition gardening, identification of indigenous micronutrient-rich fruits and vegetables, developing varieties high in micronutrients, especially iron and vitamin A, and designing innovative cropping patterns etc.

Small and marginal farmers and agricultural laborers have greatly been benefited from the dairy and poultry enterprises as an alternative source of income. Hence, Animal Husbandry Department needs to strengthen the co-ordination with other line departments in implementing schemes that promote integrated farming systems.

Panchayati Unions and Village *Panchayats*, which are implementing top-to-down schemes, should be innovative in coordinating with other development agencies in redesigning and implementing the schemes based on local needs for achieving nutritional security of the poor households.

State Agricultural Universities, Home Science colleges, nutrition agencies, and *KVKs* can take up joint training programs for nutrition and extension officials/workers in the management of nutritional gardens. The role of extension functionaries needs to be reoriented because, at present, it is mostly concerned with the distribution of subsidized inputs. Therefore, training programs can be organized to sensitize them regarding nutritional issues of vulnerable sections of the society and the nutritive value of crops.

At present people are passive receivers of governmental nutritional programmes. Therefore, the development departments jointly can help in forming Self-Help Groups (SHGs) from out of the 'at-risk' households. Training programs can also be organized for these SHGs in the areas of financial management, knowledge sharing, establishing grain bank, etc.

Horticulture Departments can promote village co-operatives with social marketing concept for sale of fruits and vegetables especially in the non-vegetable farming areas. Such a strategy would improve nutritional knowledge as well as nutrient intake.

The discussions with the nutrition department reveal that the quality and the quantity of supplementary feeding is one of the main concerns in implementing the schemes like ICDS. The development departments and Food Science and Nutrition Departments of State Agricultural Universities can jointly assist in the formation of community level agro-based small scale processing units which can produce dehydrated leaf powder of nutrient rich spinach, drumstick, *agathi*, spirulina, etc.

Interdepartmental co-ordination committees may be constituted at various levels for periodic monitoring and evaluation and to evolve dynamic policy alternatives from time to time. Coordinated efforts among development departments may be difficult but are must. A strong political will and blessings of the top management is essential to implement these policies and strategies to ultimately reach the goal of sustainable nutritional security.

1. INTRODUCTION

1.1. The Background

India has made significant progress in food production, disease control, and economic and social development since independence. Notwithstanding the progress made, it still accounts for 40 per cent of the world's malnourished children and about 60 per cent of Indian women are anemic (World Bank, 1998). Infections and lifestyle factors probably often combine with inadequate or imbalances in food intake resulting in conditions that lead to malnutrition.

The Government of India has formulated appropriate policies and launched major programs to address the problem of malnutrition. India's National Nutritional Policy (GOI, 1993) stresses upon the importance of direct nutrition interventions for vulnerable groups, including the expansion of Integrated Child Development Service (ICDS), nutrition and health education programs for adolescent girls, better care of pregnant women, and control of micronutrient deficiencies. However, these nutritional intervention programs involve huge expenditures. To address this issue, World Bank assistance to India over the past 18 years, has amounted to $753 million, equivalent to more than one- quarter of its assistance to nutrition world-wide. Within India, the World Bank assistance to the Central Government for ICDS has doubled, from about 15 to 30 per cent between 1991 and 1998. For the year 1997-98, the Central Government expenditure on ICDS was to the tune of Rs.608.85 crore, covering about 2.39 crore beneficiaries. On an average, the cost incurred by the Central Government in providing nutritional intervention per beneficiary amounts to Rs.254.80 per annum. In addition, the state governments bear the cost of supplementary nutrition component.

However, these policies and programs had shown only a limited impact on nutrition among the poor, because of the problems involved in effective targeting, coverage and implementation (World Bank, 1998). The World Bank report also states that, in general, the quality of ICDS services is poor. Although these services are much in demand, they are generally poorly coordinated and delivered. The World Bank has suggested freezing of further expansion until quality and impact are considerably improved. Thus, there is a real difficulty in expanding the direct food feeding intervention programs with particular reference to quality. According to the World Bank, long-term institutional and structural changes in the relevant sectors can play a major role in improving nutritional security in India. Sustaining short-term measures

would not be cost-effective in the long run. Agriculture development over the years has been able to provide food security, in general. In spite of this development, that the malnutrition continues to be major problem particularly among vulnerable sections of population. Therefore, incorporating nutritional objectives in the agricultural policy and programs must be a strategy to solve the nutritional problems of the food-insecured households.

The workshop of South Asian Association for Regional Co-operation (SAARC) on food-based interventions has emphasized strong initiatives to implement the food-based nutrition improvement programs. It has suggested developing the intervention as an integral part of national development plans, with holistic approach (Hussain 1998). Therefore, it is imperative to incorporate nutritional objectives in our agricultural policies/ programs.

Under these circumstances, agricultural programs must include long-term measures in promoting nutritional security. National Nutrition Policy (1993) had echoed that Agricultural Policy had been hitherto concerned exclusively with production, exclusively ignoring nutrition. During the process of evolution of 'green revolution' technologies, we missed the desired focus on nutrition particularly for the poor.

India faces the formidable task of feeding a population of a billion plus. It has over two-thirds of its national workforce directly or indirectly dependent on agriculture. Increased food grain production through adoption of the green revolution technologies has been the cornerstone of India's agricultural success. Effective development programs for milk, oilseeds, poultry, fish and horticultural produce have followed the suit. Food grain production has risen from 51 million tons in 1950-51 to 208.5 million tons in 2001-02. India's Ninth Five-Year Plan estimated that about 230 million tons would be needed by 2020 (NATP Main Document 1998). One of the reasons for continued high malnutrition, could be the production pattern itself. The Green Revolution has largely remained a cereal revolution, with bias towards wheat and rice. Coarse grains and pulses, which supply the poor man's staple and protein requirements, have not been given adequate attention. Impressive increase in cereal production led by wheat and rice with declining trend in the percentage share of coarse grains and pulses is witnessed during past few decades. Per capita net availability of foodgrains moved narrowly between 150 and 175 kg per year. The present per capita net availability of food grains is lower by about 24 per cent, as compared to the recommended minimum per capita dietary norms by Indian Council of Medical Research (Selvarajan and Ravishankar 1996). Thus, if one looks at it from nutritional security angle, there is a need for promoting a balanced food production.

For instance, the production levels of pulses and green leafy vegetables need to be improved. The intake of green leafy vegetables in poor households is low, and one of the important reasons for is that they are not always within their reach, physically and economically. In India, once the third largest producer of horticultural products in the world, the per capita daily availability of fruits and vegetables (60g and 75g, respectively) is short of this minimum requirement (estimated at 85 and 280g, respectively (Gopalan 1996, NNMB 1997). There is thus an urgent need for concerted efforts towards augmentation of production of vegetables and fruits in India.

Although nutritional goals are often implicit, the explicit goals of externally induced changes in the agricultural sector are more likely to be enhanced production, higher income and more foreign exchange earnings. This focus raises three questions of relevance for nutrition. First, would better nutritional effects result from changes in the agricultural policy, if nutritional goals were made explicit? Second, are explicit nutritional goals compatible with the goals more commonly pursued? And third, what is the trade off between the two sets of goals? In other words, need we worry today about the opportunities lost for not planning good nutrition because nutrition goals were not made explicit at the time of designing and implementing changes in the agricultural sector? Or can the usual goals of agricultural change be expected to fulfil nutritional objectives? (Mebrahtu, Pelletier and Pinstrup-Andersen 1995).

There is, thus a need for close examination of the role of agricultural intervention in nutritional security. The macro-level analysis of food production and its per capita availability would not indicate the household food security and nutritional security, particularly for the households at risk. The macro-policies on cropping pattern and food production focus much on increasing the food production the national levels. There is a possibility that cash crops may provide economic benefit to the farmers and may bring foreign exchange in the country also. But, the small and marginal farmers are not likely to spend this additional income on food items. Moreover, the landless laborers when work in food crops, they have a chance of getting some farm produce to take home for consumption. But in the case of production of cash crops this may not happen. The studies have revealed that the commercialization of agriculture has lowered the household food and nutritional security of the poor (Valverde 1977, Taussig 1978b, George 1977).

Another important point is that even if a balanced food production is achieved at macro level, it may not support at micro level the household food and nutritional security. Therefore, the goal of agricultural development should not be limited achieving national food security but should extend to household food and nutritional security especially of the food-insecured households.

The agricultural development agencies also need to consider health and nutrition intervention programs for promoting nutritional objectives along with their programs. The nutritional intake and malnutrition are complex phenomena involving multi-sectoral interests and socio-economic factors. To formulate sound agricultural policies which could fulfil national and household nutritional security, better empirical evidences and deeper analyses are required. There may be differences in the nutrient intake across production systems, depending upon the types of crops grown. In extreme cases of 'at-risk' households, appropriate interventions are required for providing nutritional security. There have been only a few studies on exploring the potential of agricultural-based interventions for better nutrient intake by the rural households in the Indian context. Further, if the agricultural production system is to be improved to address the nutritional issues of the specific areas, at micro-level, sound linkages will have to be established amongst the agencies involved in tackling the problem of malnutrition.

The present study was therefore, taken up to find the nutrient intake pattern of the rural households under different agricultural production systems. The households dependent solely on agriculture, of small and, marginal farmers and of agricultural landless laborers, which are all more at risk regarding malnutrition, have been studied in details. The possible linkages between programs of the departments of agriculture, health and nutrition interventions have been studied. It would help in identifying areas for exchange of information and experience on nutritional management in the country. Based on the status of nutrition, nature and strength of linkages among the concerned departments, the agriculture-based nutritional interventions can be planned and implemented. The findings of the study would be useful in devising policy for sustainable nutritional security.

1.2. Objectives

The specific objectives of the study were:

1. To find the nutrient intake pattern and its determinants of rural households under different agricultural production systems, and

2. To assess the possibilities of fostering institutional linkages among agriculture, health, and nutritional-intervention programs and with a view to designing programs for achieving sustainable nutritional security.

1.3. Out line of the report

The report is organized into eight chapters. Following the introduction part, the second chapter provides review of past studies carried out in household nutrition. Chapter 3 deals about methodology explaining sampling and analytical frameworks followed in this study. Inter and intra household food and nutrients consumption pattern has been presented in Chapter 4. Chapter 5 describes about factors influencing consumption. Information on institutional linkages among agriculture, health and nutrition departments has been presented in Chapter 7. The last chapter presents major conclusions and policy implications.

2. REVIEW OF PAST STUDIES

2.1. Malnutrition status

Poverty and hunger go hand in hand, affecting particularly the children in the developing world. The number of underweight children in under-five years age group is rising in the developing countries; it has gone up from 164 million in 1980 to 184 million in 1990, with about 200 million by the turn of the century. Almost half of the children in South Asia are projected to be significantly underweight by 2000. Micronutrient deficiencies are also widespread in this area. About 14 million pre-schooling children have eye problem due to deficiency of vitamin A. Between a quarter and a half of a million children go blind each year for lack of Vitamin A, and two-thirds of these die within months of going blind. Iron-deficiency leading to anemia, which diminishes learning capacity and lowers physical health-also affects about a billion people in the world, particularly children and women of child bearing age (Pinstrup-Andersen *et al.* 1997). There are various factors influencing nutritional security.

The major nutritional deficiencies in the developing world are: protein-energy malnutrition (PEM), iron-deficiency anemia, iodine-deficiency disorders (IDD), and vitamin A deficiency (ACC/SCN 1992, Latham 1987). All four major nutritional problems show prevalence of gender differentials also and severity for some specific population subgroups. Three of these represent a more serious problem for females in South Asia (where almost half the world's undernourished people live); and both iron-deficiency anemia and goiter are more prevalent among adult women than in men, while vitamin A deficiency is more among boys than girls.

2.2. Nutrients intake

According to the 1993-94 Round of the National Sample Survey (NSS), about 80 per cent of the rural population and 70 per cent of the urban population had caloric intakes below the recommended values (2400 calories per adult in rural areas and 2100 calories in urban areas), respectively. In 1993-94, the poorest 30 per cent of India's population (or about 300 million people) could consume, on an average, lower than 1700 calories per day. The lowest 10 per cent among these received less than 1300 calories per

day (Shariff and Mallick 1998, World Bank 1998). A multicentric study conducted in India on the use of carotene-rich food to combat vitamin A deficiency revealed that the main factor behind this was low level of consumption of Green Leafy Vegetables (GLVs). The GLVs were non-available during summer season and are reported to be of poor quality in monsoons. The economic affordability was found to be another important factor influencing the consumption of GLVs and other carotene-rich foods (Seshadri 1996).

Income is one major factor, which controls the nutrient intake. In rural Uttar Pradesh (India), significant differences were observed in nutrient intake, except carbohydrates, between different income groups. Households at the higher end of income distribution consumed significantly higher amounts of nutrients, through dairy products, non-vegetarian foods and fruits. Cereals contributed increasingly to nutrient supply at the lower end of income distribution where the consumption patterns were chiefly cereal-based. The implication is that strengthening the policies of diversification of agriculture into animal husbandry and vegetable growing, particularly for the low income households would help them in not only improving their nutritional standards but also providing them with sufficient income to purchase needed high-value food other than the home-produced (Birthal 1996).

2.3. Intra-household allocation

Intra-household food allocation rules or procedures may substantially affect the child health and nutrition. Intra-household allocations are the result of implicit or explicit bargaining among household members, individual bargaining positions (which may depend partly on their individual command over resources), and various cultural norms that could affect individual preferences that shape the bargaining and allocation processes (Behrman 1995).

In a study on intra-household allocation of nutrients in a community in rural South India, Behrman and Deolalikar (1988) have analyzed the effect of income and food prices on individual dietary intake. One of the findings concerning nutrient intakes by women in this study is particularly interesting. It was found that when food prices gone up, the nutrient intakes of girls and women were adjusted downward more than those of boys and men.

2.4. Determinants of food and nutrients intake

2.4.1. Preferences and tastes

Preferences and tastes characterize the trade-offs an individual is willing to make among his/ her consumption of various goods and services. Preferences indicate, for example, how many additional kilograms of coarse grains an individual would like to consume to reduce consumption of good quality rice by a kilogram? The preferences depend on immediate micro-environment under which one is raised, generally including that of the household and the traditional culture and norms of the community of which the household is a constituent (Behrman 1995).

Culinary practices did seem to pose a constraint in the consumption of foods especially by children. Green leafy vegetables were mostly served in the form of a "*sabji*" or "*sag*" which was not prefered by children. Further, these GLVs were cooked with addition of chillies which further deterred the children from consuming them. Although some children liked to eat carrots in raw form, mothers usually seved them as '*sabji'*. Thus, it was found that young children had problems not with these vegetables *per se* but with the form in which they were offered to them (Seshadri 1996).

2.4.2. Income control

Caregiver's autonomy and control of resources effectively influence the childcare. Haddad and Hoddinott (1994), for example, have suggested that mothers are more likely to allocate extra resources under their control to children than fathers in Côte d' Ivoire. And the higher the share of income contributed by women, the greater is their control over resources (Blumberg 1988, Engle 1991, Engle and Nieves 1993). High female wages were associated with an improvement in the nutrient intake of most of the household members. However, little positive effect was found on the nutrient intake of women themselves (Behrman and Deolalikar 1990). Leslie (1988 1989) has reviewed twenty-five studies from sixteen developing countries and could not conclude linking maternal employment with poorer nutritional status of children. Studies that have examined impact of maternal employment as a function of the age of the child, controlling potentially confounding variables, have reported a negative association between maternal earnings and children's nutritional status during infancy (Engle and Pedersen 1989, O'Gara 1989), particularly, when employment starts before the child's second month of life, a finding not observed when mothers were at home for the first three months of the child life (Vial *et al.* 1989).

Some studies have found significant negative association of maternal earnings with nutritional status of the child. In a study covering about 2,000 rural mothers in India, Abbi *et al.* (1991) have found that children of mothers who worked for agricultural jobs on their own farms for 5 to 6 hours a day were likely to be significantly malnourished, regardless of who the alternate caregiver was, if these women did not have control on their earnings.

Studies suporting negative effect (Wandel and Holmboe Ottesen 1992a, 1992b) as well as positive effect of work on children (de Groote *et al.* 1994, in Mali; Brown *et al.* 1994, in Niger; Blau *et al.* 1996, in the Philippines; Engle 1991and 1993 , in Guatemala; LaMontagne *et al.* 1993, in Nicaragua) have been found in the literature. In the Philippines, Blaue *et al.* (1996), using a rigorous model, analyzed the well-paid works; and found that children whose mothers worked in higher paying occupations had equal or better growth rates. When the work was well-paid, or the income was in the hands of the mother, or when the child was more than one year old, the effects on either child nutrient intake or nutritional status were positive.

2.4.3. Customs and beliefs

Household's resources, customs and traditions affect the nutritional status of pre-school children. Even within the same level of resources, the traditional beliefs towards food items influence their intake and hence the nutritional intake. For example, if certain foods through rich in some relatively scarce nutrients, are believed to be bad for children, their intake result will be less satisfactory (Behrman 1995).

Many weaning customs of people in non-industrialized areas also lead to malnutrition (Cassidy 1980). Customs, such as restricting certain protein-rich foods, allowing competition for food within children, specific food to the preferred sex and separating the child from the mother for a long period of time, tended to result in malnutrition.

Many food taboos for young children may limit the types of foods that can be offered (Van 1989). In Iran, the introduction of a variety of food to children is often delayed, based on the perception that young children cannot digest the foods that are served to the family (for example, beans) or that some foods cause stammering and delayed speech (eggs) and impair the intellect if introduced before 18 months of age (cheese) (Rabiee and Geissler 1992). This implies that children may not receive adequate amounts of protein- and micronutient-rich foods until they are 18 months of age (Engle *et al.* 1997).

The practice of excluding lactating women from certain green leafy vegetables was seen prominently in southern India. These GLVs were avoided for fear of diarrhoea or cold in infants. In the eastern India, colocasia leaves had a negative connotation, since they are offered at funerals by the Tea Tribe communities, while the other rural and tribal populations believed that colocasia leaves could cause a wide variety of health disorders (Seshadri 1996).

2.4.4. Sex discrimination

McGuire and Popkin (1989) have compiled data from thirty-two studies that reported dietary intake and or, anthropometric data, for women in the developing countries. With a few exceptions (e.g. Korea, Micronesia, and Singapore), these studies have concluded that women consume only about two-thirds of the WHO-recommended daily allowance for energy.

Ravindran (1986) has summarized much of the literature through mid 1980s about the evidences on parental sex preference, and discriminatory feeding and health care practices in the Third World. The review has reported widespread evidence of expressed preferences for sons on the part of parents. Among the countries for which comparable data were available, (based on the World Fertility survey), all, except Korea, located in either South Asia, or the Middle East, are classified as having a strong preference for sons; many others (including quite a number in West Africa) have a moderate preference for sons; a similar number (including many Latin American and Caribbean countries) has equal preference; and only two (Venezuela and Jamaica) have a slight preference for daughters. It is primarily in those countries of South Asia which showed a strong preference for sons (e.g., India, Nepal, Pakistan, and Bangladesh) that consistent evidence of widespread discrimination against girls was found, resulting in marked sex differences in mortality, morbidity, and malnutrition. Conflicting findings emerged as regards to sex discrimination. In rural north India, Birthal (1996) study did not reveal any sex discrimination in nutrient intake. On the contrary, Jatrana and Sangwan (1996) have found strong evidence for sex discrimination in food intake. They found that in rural north India, there has been a consistent discrimination between a female and a male child. Differential care resulted in higher female mortality in post-neonatal and early childhood period where behavioral factors were powerful to influence mortality. Level of protein-calorie malnutrition (PCM) among girls was substantially higher than in boys. Differential care was also noticed in feeding practices and general care of new born when the mother goes out to work.

A study covering 17 villages in Morinda,(Punjab) has reported that more than any other factor (such as socio-economic status), the sex of a child determines the nutritional status. Within households, the available food is distributed according to the status of the individual in the family rather than according to the nutritional requirements as per the work output and physiological requirements (Gade 2000).

2.4.5. Cash cropping

The studies on the nutrition effects of cash cropping have been reviewed by Fleuret and Fleuret (1980); von Braun and Kennedy (1986); Longhurst (1981); Maxwell and Fernando (1989); Dewey (1989); and Brun *et al*. (1990). No conclusive finding as to the cash cropping was being bad or good for nutrition emerged from these reviews. Fernando (1989) generally concurs with the conclusions of other reviews, that "the naive view that cash cropping necessarily competes with food production and worsens food security is wrong; cash cropping can be associated with increases in the production and availability of food at both household and national levels".

At the household level, IFPRI studies have shown that farm households often expand staple food production along with cash crop production (von Braun *et al*. 1988). The studies indicated that farmers generally attempted to maintain or even increased their food production in the context of commercialization of agriculture, partly as a response to market and production risks. Despite the higher profits from cash crop production shown in all the IFPRI studies, all farmers participating in the scheme maintained staple food production for home consumption. In general, the commercialization of agriculture generated additional employment or increased labor productivity in agriculture (von Braun *et al*. 1988). In general, women were found to work less on the more commercialized crops than men do and to work much more on the subsistence crops, except in Guatemala. Some authors (Valverde *et al.* 1977; Taussig 1978; George 1977) have argued that commercialization of agriculture would aggravate income distribution among farmers through drastic changes in the distribution of land and land-tenure relations, hence jeopardizing the nutritional welfare of the near-landless and landless population groups.

There is little evidence from recent studies that commercialization of agriculture per se alters expenditure on food and consumption patterns in a way that is detrimental to nutrition (Von Braun *et al.* 1988). Commercialization has generally led to increased incomes, which, in turn, have led to higher

calorie intakes. It was generally found that with rising income, the relative proportion of income spent on food decreased, but the absolute food expenditures as well as food calories increased. It also improved diet quality and intake of micronutrients. IFPRI has conducted studies in the Gambia, Guatemala, Kenya, Philippines, and Rwanda on food consumption patterns and malnutrition. Although the prevalence of malnutrition was found to be lower among cash crop–producing households, the difference between cash crop producers and food producers was not always statistically significant. In the case of children, malnutrition remained high among cash-crop-producing families. The effect of increased income on the nutritional status of pre-schooling children, though generally positive, was less than expected, probably because of the existence of poor sanitary conditions, poor quality of water, lack of access to primary healthcare, and poor knowledge about the nutrition-related issues in the households.

2.4.6. Time Allocation

In general, women's role in cultivation of cash crops and direct control over income from the new cash crops was found to be that of much less than men's. Women did not play a significant role as decision-makers and operators of the more commercialized crop production line in any of the schemes; even when typical women' s crops were promoted (e.g. rice in the Gambia).

There was a large variation in the effects of cash cropping on women's time-use patterns, as reported by IFPRI studies. In Kenya, women were found to spend equal amounts of time on farming, animal care, and childcare in both sugar and non-sugar producing households. They spent virtually no time on production of sugar (Kennedy and Cogill 1988). In Guatemala, in contrast, von Braun *et al*. (1988) have indicated that introduction of the new export crops increased women's participation in agriculture by 78 per cent compared to 33 per cent for men, although in absolute terms men were to under take additional work per season (21 days) than women (15 days).

Seasonality and the working pattern of the women also tend to affect the growth of the children. Children in 6-12 months age group are most dependent on the mothers for feeding and care. When women were involved in highly time intensive tasks like transplanting, they were not in a position to give adequate care to children of this age group. This situation was found to lead to virtually zero growth velocity among these children (Stuart and McNeill, 1992)

That women in India work for longer hours in both unpaid/domestic work than men has also been established by a study carried out in Karnataka. The study conducted in 500 households in six villages, has revealed that women had a shortfall of 100 calories while men had a surplus of 800 calories per day. Women's domestic work was also taken into account in the physical activity calculations (Gade 2000).

3. METHODOLOGY

3.1. Selection of study location

The macro-level data on nutrition in different states of India revealed that, Tamil Nadu was at the bottom of the calorie intake by the poorest of the poor. The lowest ten per cent amongst the poor in Tamil Nadu consume only 1551 Kcal per consumption unit per day (Annexure 1) (MSSRF 2001). It may be mentioned there that persons consuming less than 1890 Kcal per consumer unit per day are termed as 'hungry', as the consumption is much lower than the food adequacy norms of ICMR. Tamil Nadu has the highest percentage of the households consuming less than 1890 Kcal. (Annexure 2) (MSSRF 2001). Protein Energy Malnutrition is as high as 41.40 per cent in this state (Annexure 3). The results of micronutrients survey reveal that Tamil Nadu has the highest percentage of population with vitamin A deficiency (Annexure 4). The consumption of thiamin was also found to be less than the required level of 1.20 mg/day. The average intake of niacin is the lowest at 9.70 mg per day, as against the minimum requirement of 16.00 mg per day. Considering the low status of Tamil Nadu in nutrients intake and malnutrition control, this state was selected for the present study.

Within Tamil Nadu, based on the discussion with the officials of State Department of Agriculture and the experts in Tamil Nadu Agricultural University, (Coimbatore), Dharmapuri district, having three agricultural production systems namely rice, vegetables and sugarcane were purposively, chosen. Dharmapuri district, the area of the present study, is in the Agro-climatic region I of Tamil Nadu. Broadly describing, its western and northern regions are dry with moderate temperature where rainfed crops and vegetables are raised. Dairy and sericulture are supplementary activities. The eastern part is endowed with the Krishnagiri river and rice is the major crop in its ayacut, followed by pulses and vegetables. Fruit orchards are raised in uplands. In rainfed areas around north, central and south-east regions, grapes and mango, millets and pulses, and vegetables are grown. In the south and central regions, sugarcane, oil seeds such as groundnut and sunflower are the major crops. The south-eastern part is covered with mango orchards, cashew, and vegetables; and south-western region is with sugarcane under irrigation and millets-pulses in rainfed areas. In rainfed lands, depending on rains mainly, crop mixtures of 15-20 crops of millets,

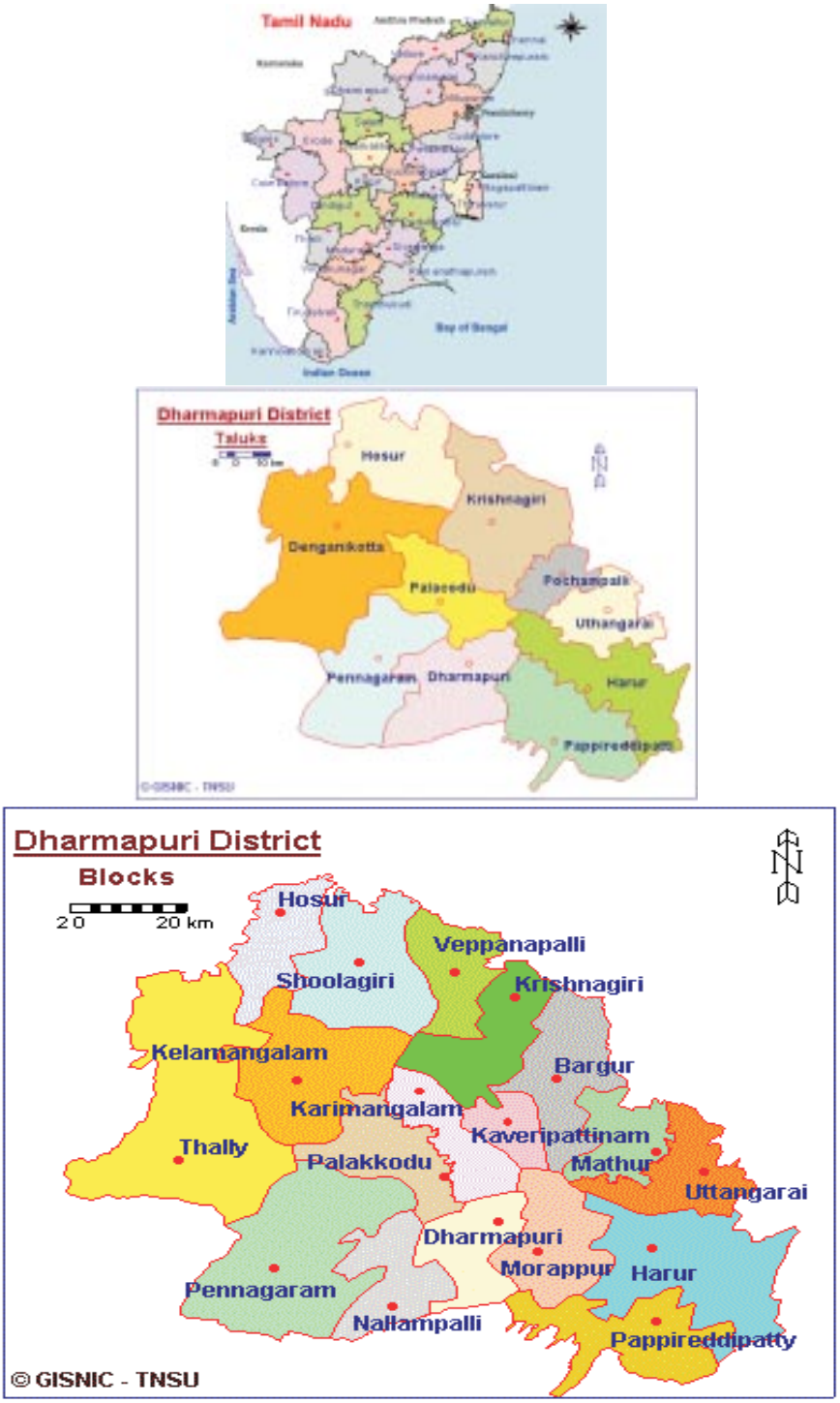

Figure 1. Map of the study area

pulses and oilseeds are common to hedge against risks due to delay and failure of rains.

The district is one of the backward districts in Tamil Nadu with literacy percentage as low as 46 per cent. Further, the district is subject to intensive research dominated by crop and livestock research and development with practically little focus on nutritional security. The demographic and nutritional intervention particulars about the district are given in Annexures 5-10. The study area was restricted to one district because it has been assumed that within a district there would be probably more of agro-biological and socio-cultural homogeneity. Within the district, three sample villages were selected based on primarily crop production systems. Production system was decided based the predominant cropping pattern. For example, a village having more than 40 per cent of the cultivated area under rice was selected as representative of rice production system. Similarly, other production systems were also selected, viz. vegetables and sugarcane production system. One village representing each production system was selected. Thus, there were in total three villages. The villages were selected such that they were quite distant apart. The villages were identified with the help and guidance from senior officers of the state departments of agriculture. Annexure 11 provides the details about the selected villages. The district map of Dharmapuri along with the geographical location of the study area is depicted in Figure 1.

3.2. Collection of information from households

A specially-designed and pre-tested questionnaire was used in this study for collecting information from households. For each village, 60 households were selected at random as respondents. The literature indicated that within those who have agriculture as primary occupation, small and marginal farmers and agricultural landless laborers were at risk in terms of nutritional intake and nutritional status. By following the random sampling method, 20 respondents from each category of small and marginal farmers and landless laborers were selected from each village representing a particular production system. Thus, from three villages, a total sample of 180 households was selected randomly after taking the list of these groups using village records. The sample design is given in Figure 2. In each household, the male and female heads of the household were considered as respondents for collecting the information on nutrient intake pattern of the household members. The survey was conducted during the year 2000-01.

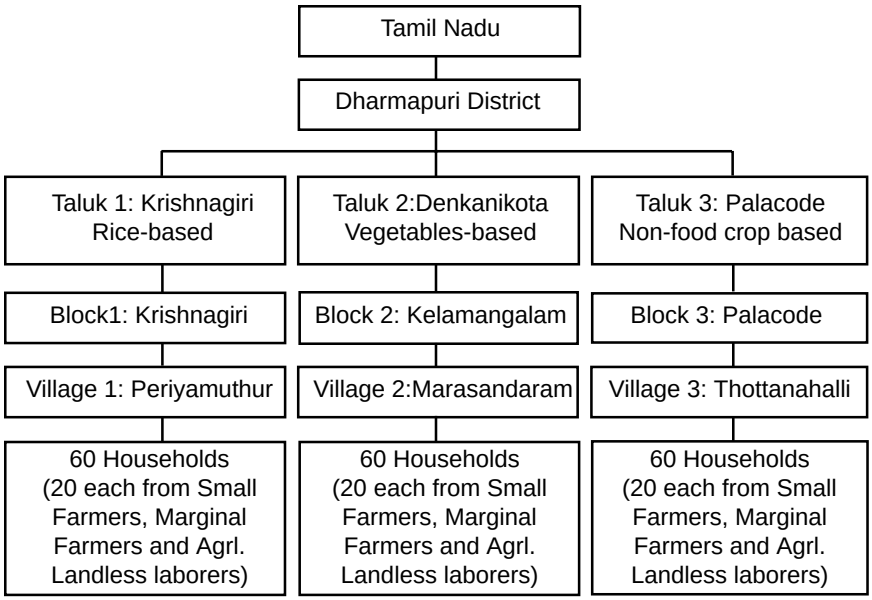

Figure 2. Sampling design of the study

3.3. Collection of information from organizations

Various organizations/development departments from the state level up to village level were visited for collecting secondary data and to elicit the perception of the officials related to the research questions included in this study (Annexure 12). Information about ongoing development programs was collected through publications such as annual progress reports of the organizations. Discussions were held with senior officers of the concerned development departments to find out their information needs for improving the regional nutritional security. The possible linkages among them were examined. The potentiality for agriculture-based interventions in alleviating the problem of malnutrition was explored. Their suggestions for agriculture-based intervention for sustainable nutritional security were recorded.

3.4. Analytical framework

Malnutrition is defined as poor nutritional status caused by certain combinations of lower food intake, illness, and inadequate care (World Bank 1998). Protein-Energy Malnutrition (PEM) and deficiencies of micronutrients (Vitamins A, B and D, iodine and iron) are various forms of malnutrition. Malnutrition results from a combination of three key factors: inadequate food intake; illness; and deleterious caring practices. Underlying these are

household food insecurity, inadequate preventive and curative health services, and insufficient knowledge about proper care.

Food insecurity exists when all people, at all times, do not have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life (FAO, 1996).

Conventionally, food security is defined as the balance of food supply (mainly cereal supply) and effective demand for food, otherwise, termed food self-sufficiency within a territorial entity, usually the country. Although availability of food is a necessary condition, it is not a sufficient condition, to ensure food security for all, because those who cannot afford to buy food are left hungry and undernourished. Recognizing the composition, access and spatial dimensions of food security, an appropriate goal will be 'livelihood security for the households and all members within, which ensures both physical and economic access to balanced diet, safe drinking water, environmental sanitation, primary education and basic health care'. Livelihood security for all should be the country's number one priority (Swaminathan *et al* .1996).

In India, the household food insecurity stems from inadequate employment low income, seasonal migration (especially among tribal populations), relatively higher food prices, geographic and seasonal mal-distribution of food, poor social organization, and large family sizes.

3.4.1. Measuring food and nutrients intake

The study was to examine the pattern of nutrient intake and determinants of intake in different crop production systems. It was assumed that in a single district, the agro-biological socio-economic and cultural differences would not vary considerably. The production systems were identified within a district. Nutrient intake was considered as a dependent variable. Nutrient intake information was collected using questionnaire and the 24-hour recall method, which is the standard methodology, followed by National Nutrition Monitoring Bureau (NNMB), Hyderabad. In the 24-hour recall method, a respondent has to undergo the following processes: (i) recall the names of food preparations/ items that the respondent had brewed or cooked during the last 24 hours (i.e. previous day before the data collection interview); (ii) Recalling information about all leftovers, food brought from outside, food taken in from hotels, shops, and fields; and (iii) Recalling how much each member consumed from each preparation (regardless of source).

The name of all the preparations consumed on the previous day ("the reference day"), including all solid, semi-solid and liquid foods were recorded.

The “recipe” of each preparation was recorded. The variety of foods was noted down. For example, information about the variety of fish or type of pulse (e.g. green gram, black gram) or type of green leafy vegetable used (e.g. amaranthus, spinach, etc.) was included. The condition of the food item, for example ‘parboiled’, ‘milled’, or ‘broken’ were also probed. Oil or fat used in preparation was recorded too.

The respondent was asked to name all the raw ingredients used in each preparation. Wherever possible, the weight (in grams) of each solid ingredient used in the preparation was obtained. In the case of ‘*chappati*’ the total number cooked was asked. In the case of fruits, buns, etc., the total number consumed by the family was found out. Based on the actual quantity of food consumed by each member of the family, intake of various nutrients by the individual was estimated by following the nutritive value standards of different commodities (Gopalan *et al.* 1996). The nutrition gap in terms of food groups and nutrients were worked out as per the formula given below. This method would reveal the pattern of food/ nutrients intake by different members of the family.

$$\text{Nutrition Gap} = \frac{R_N i - A_N i}{R_N i} * 100$$

Where, R_{Ni} =Recommended level of ith nutrition as per Tables 1 and 2
A_{Ni} = Actual consumption level of ith nutrition

Table 1. Recommended dietary allowances (food groups) for adults and children

(Grams/per day/per person)

Food groups	Sedentary		Moderate		Children		
	Man	Woman	Man	Woman	(1-3 years)	(4-6 years)	(7-9 years)
Cereals and Millets	420	300	480	360	120	210	270
Pulses	60	60	90	75	30	45	60
Green Leafy Vegetables	100	100	100	100	50	50	100
Vegetables	100	100	100	100	50	50	100
Fruits	100	100	100	100	100	100	100
Milk *	300	300	300	300	500	500	500
Fats and Oils	20	20	35	30	20	25	25
Roots and Tubers	200	100	200	100	50	100	100
Sugar	25	20	40	25	25	30	30

*ml/per day/per person

Source: National Institute of Nutrition, 1998, Dietary Guidelines for Indians.

Table 2. Recommended dietary allowances (nutrients) for adults and children

Nutrients	Moderate		Children		
	Man	Woman	(1-3 years)	(4-6 years)	(7-9 years)
Protein, g/d	60	50	22	30	40
Energy, Kcal/d	2875	2225	1240	1690	1950
Calcium, mg/d	400	400	400	400	400
Iron, mg/d	28	30	12	18	26
Vitamin A (Retinol),mg/d	600	600	400	400	600
Vitamin C, mg/d	40	40	40	40	40

Source: National Institute of Nutrition, 1998, Dietary Guidelines for Indians.

Nutrition Gap is expressed in terms of percentage. A positive value indicates the extent of deficit from the recommended level, whereas a negative shows excessive nutrient intake. Information on following factors was considered. They are, type of crops grown, crop yields, food availability, socio-cultural and economic indicators such as caste, beliefs, taboos, maternal knowledge on nutrition, type of crop in which agricultural labor works, farm size, total household income, crop income, livestock income, wage income, self-employment income, mother's income, education of the key individual of the household, market access, road access, total expenditure, non-food expenditure, gender of the head of the household, family size, sources of food intake, seasonality and village characteristics. The extent of relationship between independent variables with the dependent variable was analyzed and screened based on their significance. Inter-production system and inter-category comparison in terms of adult male, adult females, and children were also carried out.

3.4.2. Factors influencing food and nutrients intake

Linear estimates of nutrient intake were worked out. Per capita consumption of most important nutrients, viz. protein and energy were included in the analysis. Out of various personal, and socio-economic characteristics that may influence nutrient intake, the influence of only some significant variables like rice area, expenditure on milk and milk products, family size (Birthal 1996), total expenditure on PDS commodities, maternal nutritional knowledge, woman education (Birthal, 1996) and children (1-5 year old) were estimated. Previous studies cited elsewhere in the report also indicate the importance of these variables. In a nutrient consumption study in rural north India, by Birthal (1996), alternate functional forms were tried to estimate

the effect of various personal and socio-economic variables on nutrient intake. He had concluded that based on explanatory power of different functions, linear form was found to give the best fit for most of the nutrients. Hence, in this study also, linear functional form was used, incorporating the above-mentioned variables. The ordinary least square regression model followed in this study is described below. The descriptions of variables are given in Table 3.

$$Y = a + \beta_1 RICA + \beta_2 EMIL + \beta_3 FAMSZ + \beta_4 TOTE + \beta_5 TOTPDS + \beta_6 NUKNOW + \beta_7 WEDU + \beta_8 CHILDREN$$

Where, Y is a dependent variable PCPRO (per capita protein consumed) or PCENER (per capita energy consumed). For each production system, two sets of regressions were run, i.e. one for per capita protein consumed and another for per capita energy consumed. There were thus six regressions.

Table 3. Independent variables included in the regression analysis for per capita intake

Description	Variable	Unit
Intercept	Constant	gram or calories/ per capita / per day
Rice area	RICA	Acre
Expenditure on milk and milk products	EMIL	Rs.
Family size	FAMSZ	Number
Total expenditure	TOTE	Rs.
Total value of commodities availed through Public Distribution System	TOTPDS	Rs.
Maternal nutritional knowledge	NUKNOW	Score
Women education level in the household	WEDU	Score
Dummy for children (1-5 year old)	CHILDREN	—

An analysis on expenditure behavior for foods and non-foods consumed by average household was attempted. The aim of this analysis was to find out the relationship between income and consumption of commodities. The change in this relationship as a result of any change in income and socio-

economic characteristics of households was determined. Average monthly expenditures were collected from the sample households. The model used is a set of Engel functions relating average monthly expenditures on various commodities to a measure of total income.

The average monthly consumption expenditure for each household was used as a proxy for income, because, collecting information about precise income of a household is relatively difficult. Moreover, consumption expenditure is usually considered a better indicator of regular/permanent income, which itself is an important determinant of consumption behavior (Friedman 1952). The total consumption expenditure is considered a better proxy of total income of a household. A flexible functional form, which could provide a good statistical fit to a wide range of commodities, is required to find out the income-consumption relationships. Further, the function must have a slope that is free to change with income. Because, a common set of Engel relations is to be estimated for all the households.

Let us assume for a moment that all households differ only in their total consumption expenditure. A linear functional form would then be too restrictive for these purposes. The linear Engel curve [Equation (1)] is:

$$E_i = \alpha_i + \beta_i E \quad (1)$$

Where, E_i is expenditure on good i, E is total consumption expenditure, and α is a constant, and does not permit the marginal budget share (β_i) to vary at all. Thus, redistribution is implicitly assumed to have no effect on the aggregate expenditure of good i.

It is expected that there could be variation in households' expenditure pattern and marginal budget share. A non-linear function is more appropriate and the modified form of the Working-Leser model was therefore considered. The influence of socio-economic characteristics of the household should be captured for meaningful comparison of consumption expenditure behavior of households. The complete model in expenditure share form as followed by Hazell and Röell (1983), was adopted. The form is [Equation (2)]:

$$S_i = \beta_i + \alpha_i / E + \gamma_i \log E \quad (2)$$

Equation (2) is equivalent to the Engel function

$$E_i = \alpha_i + \beta_i E + \gamma_i E \log E \quad (3)$$

It is expected that the household-expenditure behavior would be affected by the socio-economic characteristics of the household also. Therefore, a few household characteristic variables were also included in the Engel functions. Inclusion of variables in the Engel function was done in a manner that allows them to shift both the intercept and the slope of the Engel functions.

$$E_i = \alpha_i + \beta_i E + \gamma_i E \log E + \sum_j (\mu_{ij} Z_l + \lambda_{ij} E Z_j) \qquad (4)$$

where, E_i is expenditure on good I

i= 1,2……18: items of household expenditure [rice, finger millet, other cereals, pulses, vegetables, fruits, oil, milk and milk products, animal products, sugar, miscellaneous (food expenditure), education, social obligation, health, transport, fuel, clothing, others (non-food expenditure)].

Z_j = jth household characteristics variable

j = 1, 2,……10 : household characteristics, Z factors (total expenditure, log expenditure, land, head education, children, family size, proportionate women, homestead garden, proportionate earning member) μ_{ij} and λ_{ij}= constants

In expenditure share form, it is equivalent to [Equation (5)]:

$$S_l = \beta_i + \alpha_i/E + \gamma_i \log E + \sum_j (\mu_{ij} Z_l/E + \lambda_{ij} E Z_j) \qquad (5)$$

The marginal and average budget shares and the expenditure elasticity ξ can be determined using the following equations for ith good.

$$MBS_l = dE_i/dE = \beta_i + \gamma_i (1 + \log E) + \Sigma_j \gamma_{ij} Z_j$$

$ABS_l = S_l$ = equaltion (1), and

$$\xi = MBS_i / ABS_i$$

A disadvantage of estimating share equations is that the R^2 coefficients are typically smaller. The parameters of the share equations were estimated for each commodity using ordinary least squares regression (OLS). The study sample included farmers and agricultural laborers. So, there could be price differences in food commodities due to whether they were farm-produced or purchased. In the study area even the agricultural laborers also

were receiving kind wages. To adjust this type of problem, possession of land was used in this model similar to the study of Hazel and Röell, (1983).

3.4.3. Factors influencing expenditure behavior of households

The explanatory variables that were included in the budget share equations for three different productions systems which, are shown in Table 4. These variables were identified after screening for the significant results. It was presumed that households having farms had access to larger amounts of home-grown foods at farm level prices; thus, the dummy variable "possession of land" acted as proxy for Massell's subsistence ratio. The homestead garden was also included as a variable.

Table 4. Independent variables included in the regressions for expenditure share

Description	Name	Unit
Intercept	Constant	Rs.
Reciprocal of total expenditure	1/E	Rs.
Log of expenditure	Log E	—-
Dummy for possession of land	LAND	—-
Education of household head	HDEDU	—-
Age of household head	HDAGE	—-
Dummy for children (one to five years old)	CHIDREN	—-
Family size	FAMSZ	Number
Number of women as proportionate to family size	WOMEN	—-
Dummy for possession of homestead garden	HSTEAD	—-
Number of earning members as proportionate to family size	EARNM	—-

4. FOOD AND NUTRIENTS CONSUMPTION

4.1. Food and Nutrients Intake of Sample Households

The agricultural production systems influence, due to the type of crops locally grown and their free access, the food-intake pattern of the households (Valverde *et al.* 1997, Taussig, 1978b; and George, 1977). The findings have established that the increased income due to the cash crops may or may not necessarily translated into having nutritionally-balanced food baskets by rural households. To examine these issues, different production systems were investigated in the present study. From the quantity of food intake by an individual, the nutrients intake gap was worked out. The nutrient gap has been expressed in percentage with respect to various types of nutrients. This is a good indicator of nutritional security of the individuals under different production systems. The percentage of deficit from the RDA for the corresponding food groups or nutrients is depicted in Table 5.

4.1.1. Adults' food and nutrients intake

Actual food intake by adult males and adult females were measured and the percentage of deviation from the recommended dietary allowances (RDA) was worked out for various types of food groups.

Among the food groups, the deficit was more pronounced in the case of fruits and green leafy vegetables (GLVs) for both sexes, and the least for pulses and cereals. Among the production systems, the extent of deficit was comparatively lower in the vegetable production system. The adult males had lower deficit than that of adult females. As referred earlier, a multi-centric study on the use of carotene-rich food to combat vitamin A deficiency in India had revealed the factors responsible for the lower level of consumption of green leafy vegetables. These included non-availability of GLVs during the summer and monsoon months and the reported poor quality of the pro-vitamin A sources, especially GLVs during monsoon.

Table 5. Adults' food and nutrients intake by agricultural production systems

Production	Food groups							Nutrients					
System	Cereals	Pulses	GLVs*	Vegetable	Fruits	Milk	Fats & Oils	Protein	Energy	Calcium	Iron	Vitamin A	Vitamin C
Men													
Rice	2	10	83	27	84	43	77	23	13	-50	21	60	42
Vegetable	7	3	45	17	74	33	66	22	15	-125	14	40	5
Sugarcane	4	15	85	30	90	47	83	25	14	-63	26	65	45
Women													
Rice	2	13	93	28	88	63	77	24	14	-38	33	64	50
Vegetable	8	5	70	18	78	53	63	22	13	-113	23	43	13
Sugarcane	6	18	94	37	93	67	80	26	14	-50	37	67	50

Note:* Green Leafy Vegetables"-" indicates more than RDA

The economic affordability emerged as an important factor influencing the consumption of GLVs and other carotene-rich foods (Seshadri 1996).

Among nutrients, for both adult males (men) and adult females (women), the vegetable production system had highly favored the increased intake of iron, vitamin A and vitamin C, whereas in food and cash crop systems, the deficit was more in respect of consumption of these vital nutrients (Table 5). The deficit in the consumption of iron and vitamin C was significantly low in the vegetable system as compared to the food and cash crop based production systems for both men and women. Calcium intake was found to be excess of the recommended level across both the production systems for both the genders. However, its intake was more in vegetable production system. The macro-nutrients like protein and the energy consumption remained non-significant across production systems. The GLVs are generally rich in carotenoid pigments and 40 to 80 per cent of the total carotene in them is contributed by beta-carotene. Green leafy vegetables are very good source for vitamin A, because these contain beta-carotene that can be biologically converted into vitamin A in an effective manner.

4.1.2. Children's food and nutrients intake

The values of RDA for adults and children are different. Even within the children category, these vary with age group. The percentage of shortages to RDA for children of different age groups is presented in Table 6.

Among food groups, and in the case of green leafy vegetables (GLVs), the children in the age group of 1-3 years across the production systems were slightly more deficit. This was partially due to the non-preference for these food items by children of these groups may be due to non-palatable preparation to suit their taste. Further, some mothers had strong belief that the greens if given to children induce diarrhoea and, therefore they did feed it to the children. Household's resources and other constraints also affected the nutritional status of pre-school children.

Even within the same level of resources, customs and beliefs regarding some food items influence the nutritional intake. For example, if certain foods though rich in some relatively scarce nutrients, were labeled 'bad for children' as per belief. In the study area, it has been observed the intake of 'Agathi' (*Sesbania grandiflora*) was lower in the case of pre-school children, though, it is highly rich in calcium mineral. A significant deficiency was noticed in respect of the consumption of fruits, milk, fats and oils by the children of all age groups, particularly in food-grain-based and cash crop

Table 6. Children's food and nutrients intake by agricultural production systems

Shortage to RDA in %)

Production	Food groups							Nutrients					
System	Cereals	Pulses	GLVs*	Vegetable	Fruits	Milk	Fats & Oils	Protein	Energy	Calcium	Iron	Vitamin A	Vitamin C
1-3 Year age group													
Rice	3	10	85	30	95	36	65	14	10	-14	17	50	55
Vegetable	4	3	50	20	86	29	55	9	12	-75	8	41	38
Sugarcane	3	13	88	32	97	34	70	18	13	-6	20	53	48
4-6 Year age group													
Rice	4	11	80	24	90	50	68	17	11	-30	11	45	43
Vegetable	2	9	43	10	80	43	64	13	13	-100	6	31	33
Sugarcane	5	14	85	28	92	54	76	20	11	-27	17	46	45
7-9 Year age group													
Rice	4	10	80	25	85	50	68	17	13	-35	13	62	45
Vegetable	6	5	38	17	77	43	60	15	14	-75	6	50	10
Sugarcane	5	15	83	28	87	54	72	20	14	-33	15	63	38

Note: * Green Leafy Vegetables '-' indicates more than RDA

based production systems. On the other hand, the consumption of pulses, green leafy vegetables (GLVs), and vegetables consumption was considerably high in the children under vegetable production system than in other systems.

The influence of production system on nutrients intake among children revealed the same pattern as observed in the case of adults (Table 6). At present, the malnourished children are being given supplementary tablets for iron and vitamin A deficiencies. Lower deficit on these nutrients in the vegetable production system indicates its scope to serve as complement in alleviating micro-malnutrition.

4.2. Intra-household allocation of nutrients

The estimate of household level nutritional security may not necessarily reflect the individual level nutritional security in that household. Various studies have highlighted the importance of understanding intra-household allocation of food. Intra household nutrient intake may be influenced by factors such as gender, physiological status, etc. apart from food availability. These studies have indicated widespread differences. Intra-household allocation rules or procedures may substantially affect the child health and nutrition. Therefore, in this study, the gender effect on the nutrient intake within a household was examined. To understand the phenomenon of intra-household nutrient intake, one household was picked up from the sample households from each productions system.

4.2.1. Rice production system

It was observed in the rice system that the female individuals had higher deficit of nutrient intake of vitamin A and iron than the average household deficit. This is mainly because due care was not provided in food consumption needed at that age and the specific requirement of certain nutrients (Table 7). It implies the prevalence of gender differences within a household.

4.2.2. Vegetable production system

In vegetable production system the calcium intake was more than required for all the members of the household. The females had higher deficiency of iron and vitamin A than compared to males in the household. Among children, differences in intake were not observed (Table 8). Gender differences with particular references to iron and vitamins were however prevalent.

Table 7. Intra-household allocation of nutrients in rice system

(Shortage to RDA in %)

Category	Age (Years)	Nutrients					
		Protein	Energy	Calcium	Iron	Vitamin A	Vitamin C
Men	45	23	6	-3	11	52	30
	25	22	10	-2	14	53	18
	20	20	9	-1	18	53	20
Women	40	25	9	-1	27	65	23
	20	24	1	-1	30	60	25
Girl	18	24	3	14	33	54	13
Child-Male	5	20	4	-1	11	44	18
Child-Female	3	18	3	-1	17	45	15
Household deficit		24	6	2	21	52	18

Note: "-" indicates more than RDA

Table 8. Intra-household allocation of nutrients in vegetable system

(Shortage to RDA in %)

Category	Age (Years)	Nutrients					
		Protein	Energy	Calcium	Iron	Vitamin A	Vitamin C
Men	45	4	10	-213	5	38	8
	33	3	10	-200	8	38	13
	28	4	6	-150	9	37	5
Women	70	10	15	-208	19	43	15
	35	10	11	-208	12	42	13
	28	10	11	-211	16	42	10
	22	8	12	-203	19	40	13
Child-Male	2	7	5	-3	6	25	10
Child-Female	5	13	5	-9	9	24	10
Household deficit		7	9	-156	12	38	11

Note: "-" indicates more than RDA

4.2.3. Sugarcane production system

In sugarcane system, all the members had calcium levels more than the recommended values except the adult females (Table 9). One plausible reason could be that physiological status of pregnancy is not given due care in food intake. The deficiencies of iron, vitamin A, and vitamin C were also higher in young women than the household average.

Table 9. Intra-household allocations of nutrients in sugarcane system

(Shortage to RDA in %)

Category	Age (Years)	Nutrients					
		Protein	Energy	Calcium	Iron	Vitamin A	Vitamin C
Men	65	16	10	-6	25	58	30
	38	17	6	-3	25	58	33
Women	50	15	10	-5	33	62	30
	30	20	7	40	33	68	56
Child-Male	7	14	13	-2	35	53	28
Child-Female	2	14	7	-1	25	58	38
Household deficit		16	9	11	30	61	39

Note: "-" indicates more than RDA

It can be inferred from the case studies that the household deficit in nutrient intake does not necessarily reflect the average deficit of an individual. This is because within the household, there are variations in nutrient intake due to the age, sex, and physiological factors, which are not taken considered during food intake within a household. As a result, intra-household disparity of nutrient intake exists. One of the reasons for the lower food intake by female is the customary social norms, i.e. the food is served first to male members in the household, and the female members consume only the balance. Even in these intra-household variations, the household deficit is relatively lower in vegetable system.

5. DETERMINATS OF FOOD AND NUTRIENTS CONSUMPTION

5.1. Factors Influencing per capita consumption of protein and energy

Identification of factors affecting the consumption of nutrients energy are necessary to evolve the policies to influence these factors to fill the gaps in intake of nutrients. Hence, a regression model was conceptualized and estimated for major nutrients, i.e. external energy in different production systems. The specification and econometric estimation details relating to the model have been given in Section 3.4.2.

For the model, various variables were identified and regressed with the dependent variable, viz., per capita protein /per capita energy consumption. For each production system, the regression analysis was done separately. Several versions of regression (Table 10) were tried. The regression results of most appropriate version (version 4) are presented in Table 11.

The data in table 11 reveal that the total expenditure on Public Distribution System (PDS) had significant positive influence on the consumption of protein in rice production system. Consumption of wheat supplied through PDS could be the key component on increasing the per capita protein intake. The presence of children in a household had significant negative effect on protein intake. This might be due to preference for children for protein rich foods depriving other family members from it. And in intra-household allocation of food items, children in the family were given priority over the other members. The per capita consumption of protein came down for lack of minor adjustments in protein rich food items by the household. As per the findings of the study, all the independent variables collectively contributed 34.90 per cent of the variation on the dependent variable, per capita consumption of protein.

A perusal of table 11 reveals that the total expenditure on Public Distribution System (PDS) had significant positive influence on the consumption of energy, as observed in the case of protein. This could be largely due to rice supplied through PDS. Interestingly, the presence of children in the household has a significant negative influence on per capita consumption of energy. As children are given priority, food prepared in the family was not as adequate

Table 10. Versions of regression tried

Version	Constant	Rice area (acre)	Milk and animal prod. expend.	Milk Expend. (Rs.)	Family Size (No.)	Total Expend. (Rs.)	Log Total Expend.	Total PDS (Rs.)	Nutrition Knowledge (Score)	Woman Education (Score)	Children dummy
Version 1	√	√	√		√	√		√	√	√	
Version 2	√	√	√		√	√		√			
Version 3	√	√	√		√		√	√			
Version 4*	√	√		√	√	√		√	√	√	√

Note: *Selected for reporting

Table 11. Factors influencing per capita consumption of protein and energy in different production systems

Production System	Variable	Particulars	Constant	Rice area (acre)	Milk Expend. (Rs.)	Family Size (No.)	Total Expend. (Rs.)	Total PDS (Rs.)	Nutrition Knowledge (Score)	Woman Education (Score)	Children dummy
Rice	Protein	Coefficient	34.28229	-4.91132	-15.539	-0.78631	1.97E-04	4.05E-03	0.131195	-8.83E-02	-4.80677
		t-value	5.883	1.796	0.884	0.995	1.480	2.14*	0.501	0.699	2.416*
		R-Squared =.349047 , N = 60, F Statistics =3.42**, Version = 4									
	Energy	Coefficient	1484.642	-186.802	-91.7159	-3.48035	3.14E-03	0.149932	9.308059	-1.63713	-285.159
		t-value	6.07	1.628	0.124	0.105	0.564	2.161*	0.847	0.309	3.415**
		R-Squared =.346311, N= 60, F Statistics =3.38** Version = 4									
Vegetable	Protein	Coefficient	28.94188	-1.64942	30.54934	0.449696	6.57E-05	2.27E-03	-3.45E-02	0.100629	-8.19538
		t-value	3.659	0.351	1.140	0.618	0.738	1.062	0.157	0.750	4.112*
		R-squared = .284537, N= 60, F Statistics = 2.54* , Version = 4									
	Energy	Coefficient	1188.993	32.212	13.576.	13.99	.398E-02	.147	-2.366	5.514	-391.421
		t-value	3.592	.164	1.211	.459	1.069	1.684	.260	.982	-4.695**
		R-squared = 0.344866, N=60, F Statistics = 3.36** ,Version = 4									
Sugarcane	Protein	Coefficient	33.528	.172	-2.351	-1.015	.116	.197	.368	-.129	-7.966
		t-value	6.760	.073	.183	1.622	1.109	.008	2.182*	1.164	5.208**
		R-squared = .542070, N=60, F Statistics = 7.55**, Version = 4									
	Energy	Coefficient	1462.962	-9.108	1.287	-40.900	.677	.607E-01	13.52	-5.14	1.234
		t-value	7.817	.103	.003	1.733	1.721	.687	2.179*	-359.700	6.233**
		R-squared = .620884, N=60, F Statistics = 10.44**, Version = 4									

Note: * and ** denote significance at 5% and 1 % respectively

to meet the per capita requirement of other individuals in the family. Variables such as knowledge on nutrition, women education, area under rice and expenditure on milk and milk products did not have significant influence on energy consumption. The magnitude of coefficient of multiple determination (R^2) was similar to that of protein intake equation.

It can be seen from table 11 that total expenditure on Public Distribution System (PDS) is not significant. It was observed in the study area that the consumption of finger millet and the protein rich vegetables especially beans was common. The wheat through PDS did not have much influence, whereas, the variable "children" had got significant negative association at 5 per cent level. Lack of special attention in dietary intake to take care of protein requirement of every member of the family had affected the per capita protein intake, the dependent variable. In this regression model also, the R^2 value is low at 0.2845.

The table reveals that the variable "children" had significant negative influence on energy consumption. In a family having children, the quantity of food prepared was not adequate to meet the per capita requirement of each individual in the family. Similar explanation as in rice system can hold good in vegetable system also. In the vegetable system, the households consume finger millet along with rice and hence rice received through PDS could not show significant influence. Moreover, due to higher income received through sale of vegetables, the households tend to buy food items in open market. And the influence of PDS on energy is further subdued. But, still the magnitude of the regression coefficients for PDS is higher and is significant at 10 per cent level.

Nutritional knowledge and the presence of children had significant effect on protein consumption in sugarcane production system (Table 11). While the nutritional knowledge had positive impact on protein consumption, children as observed in other equations, were found to have the negative effect on per capita protein consumption. It has been observed that many households tended to purchase food items especially from open market. Family size also shows negative relationship with protein intake. Though the coefficient is not statistically significant, its magnitude is worth to interpret. Obviously, more members in a family will join the competition for available food. As the sample households belonged to low income group, the availability of food was limited. The R^2 value for this category is relatively comfortable at 0.5420.

The regression results relating to energy consumption in sugarcane production system (Table 11) reveal that the significant variables were

children-dummy, and nutrition-knowledge. While total expenditure had positive influence, family size had adverse impact on energy consumption in this system. The model results are much better with higher R^2 value at 0.6208.

5.2. Frequency of consumption of GLVs, vegetables and fruits

The food frequency is another method of assessing the pattern of food intake especially for fruits and vegetables. A food frequency method counts how often certain food items are taken in a specific period of time. Unlike other dietary methods, such as 24-hour recall, a semi-quantitative food frequency method does not estimate the precise amount of nutrient intake. It can, however, be used to predict whether or not the nutritional deficiency is prevailing in the area (Rosen *et al.* 1993). This methodology has been used to find out the production system influence on the frequency of consumption of fruits and vegetables.

For selected food items, the frequency of their consumption was inquired from the respondent households for each production system and the category- wise results are presented in Table 12. The data indicate that, generally, daily consumption of GLVs, vegetables and fruits was low, given the fact that these were low-income families. Only exception was ripened tomato, which was the most popular vegetable in the study region. But, most of the households consumed it weekly. A closer examination of figures confirms that there was not much variation across production systems in frequency of consumption of GLVs, vegetables and fruits on weekly basis. A sizeable number of households were found to consume papaya once in a month. Higher the frequency of consumption of GLVs, vegetables and fruits, more would be the micronutrients intake. Hence, specific policies and strategies must be designed and implemented to increase their frequency of consumption.

5.3. Nutritional knowledge of women

The maternal knowledge on nutrition is an important factor in influencing nutritional intake of household members. Although a direct evidence of misinformation about the proximate determinants of health of a pre-school child and nutrition is limited, and largely anecdotal, much more systematic evidence has been found concerning the association between the health of

Table 12. Frequency of consumption of GLVs, vegetables and fruits

(% of households)*

Food Item	Production System	Once a day	Once a week	Once a fortnight	Once a month
Fruits					
Banana	Rice	0.00	30.00	57.50	12.50
	Vegetable	5.00	65.00	20.00	10.00
	Sugarcane	3.70	51.85	37.04	7.41
Mango	Rice	10.64	85.11	4.26	0.00
	Vegetable	5.17	94.83	0.00	0.00
	Sugarcane	12.50	87.50	0.00	0.00
Papaya	Rice	0.00	50.00	12.50	37.50
	Vegetable	0.00	50.00	30.00	20.00
	Sugarcane	0.00	36.36	18.18	45.45
Tomato	Rice	91.53	8.47	0.00	0.00
	Vegetable	95.00	5.00	0.00	0.00
	Sugarcane	87.93	8.62	3.45	0.00
GLVs					
Agathi	Rice	0.00	100.00	0.00	0.00
	Vegetable	0.00	85.71	14.29	0.00
	Sugarcane	0.00	92.86	0.00	7.14
Amaranthus	Rice	0.00	76.19	19.05	4.76
	Vegetable	0.00	90.48	7.14	2.38
	Sugarcane	0.00	93.75	0.00	6.25
Cabbage	Rice	0.00	100.00	0.00	0.00
	Vegetable	5.08	94.92	0.00	0.00
	Sugarcane	0.00	97.30	0.00	2.70
Drumstic leaves	Rice	0.00	100.00	0.00	0.00
	Vegetable	0.00	100.00	0.00	0.00
	Sugarcane	0.00	100.00	0.00	0.00
Vegetables					
Beans	Rice	0.00	97.22	0.00	2.78
(Scarlet runner)	Vegetable	19.23	80.77	0.00	0.00
	Sugarcane	0.00	100.00	0.00	0.00
Brinjal	Rice	15.25	84.75	0.00	0.00
	Vegetable	11.86	88.14	0.00	0.00
	Sugarcane	15.00	81.67	3.33	0.00
Cauliflower	Rice	0.00	100.00	0.00	0.00
	Vegetable	10.17	88.14	1.69	0.00
	Sugarcane	0.00	100.00	0.00	0.00
Moringa	Rice	8.33	83.33	8.33	0.00
	Vegetable	0.00	100.00	0.00	0.00
	Sugarcane	11.11	55.56	33.33	0.00
Roots and Tubers					
Beetroot	Rice	0.00	92.00	4.00	4.00
	Vegetable	0.00	95.00	0.00	5.00
	Sugarcane	0.00	75.00	6.25	18.75

Note: * In each production system, for sixty households to which percentage has been worked out.

a pre-school child and nutrition education, particularly maternal education (Behrman, 1995). In this study, the women household heads were asked to provide responses to a set of fifty questions related to nutrition and then the scores were computed for each respondent. It can be inferred from Figure 3 that in all production systems most of the respondents had low level of knowledge. Within these systems, the knowledge level was relatively better in the vegetable production system followed by the rice system.

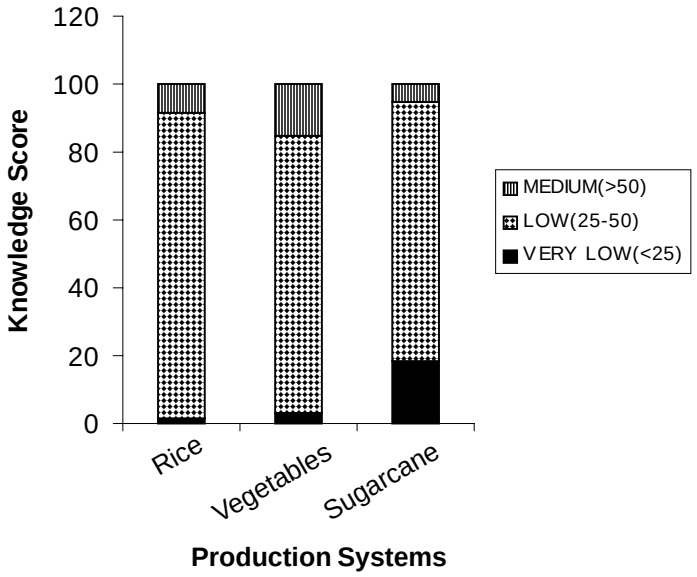

Figure 3. Nutritional knowledge of women

5.4. Share of kind wages in income

Studies conducted elsewhere indicate that the income control by the women do influence the pattern of food consumption in the household. In this context, the kind wages have better chances of directly benefiting the food intake of, particularly, the labor households. Sometimes, the cash income has the disadvantage that sufficient proportion is diverted to non-food expenditure, especially, when the income control is dominated by the male household member. This study reveals that in the vegetable production system, there were diversified sources of kind wages in terms of food groups. In the other systems, kind wages were mainly given as rice (Figure 4).

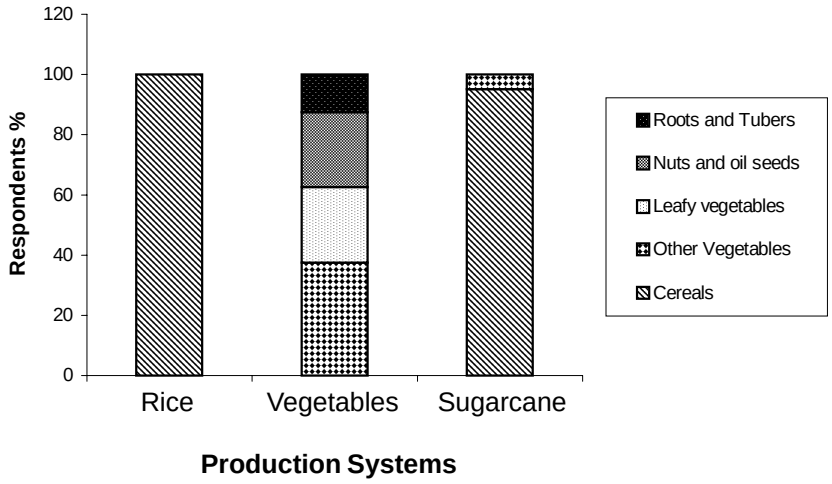

Figure 4. Kind wages in different production systems

6. CONSUMPTION EXPENDITURE BEHAVIOR

6.1. Share of food and non-food expenditure by households

One of the objectives of this study was to find the relationship between income and consumption of different commodities and to know how these change with the income and socio-economic characteristics of households. These relationships were estimated for individual commodities. Total per capita expenditure was used as a proxy for income and Engel relations were estimated in budget share form using the variant of the Working- Leser Model.

The household expenditure was worked out on annual basis to estimate the equation. A number of socio-economic variables influence the household expenditure. Those included in the model are size and composition of the family, the age and education of the household head, farm size and the presence of homestead garden. The equations were specified and estimated in a way that ensured the usual adding-up requirements.

The food and non-food expenditure analysis revealed that the share of food expenditure was lower in the vegetable production system, than in other production systems. (Figure 5). This is in conformity with Engel function, which states that as the income level increases the share of food expenditure

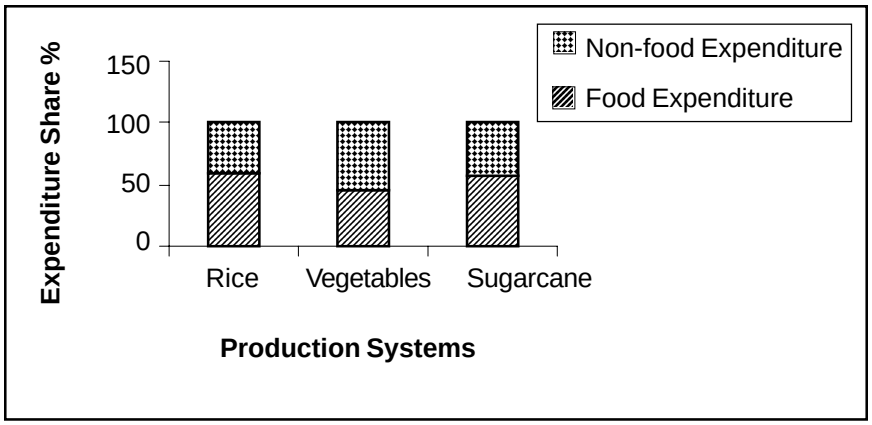

Figure 5. Share of food and non-food expenditure

decreases. The absolute value of food expenditure per household was found more in the vegetable system than in rice and sugarcane systems.

6.2. Expenditure behavior of households

In the study district of Dharmapuri, it was observed that people used to consumed different food commodities but largely confined to select cereals, pulses and vegetables. To study the expenditure pattern, 11 food items and eight non-food items were considered. As the households are generally poor, detailed analysis of food items could not be taken up for many of the households, only zero values were obtained. That is why, the food items were grouped into other cereals, pulses, fruits and vegetables. If disaggregated, we get only a few observations for some food items, with which it was difficult to estimate the Engel curves for these items.

The expenditure behavior of average households in three production systems of Dharmapuri district is summarized in Table 13. It reports average budget share, marginal budget share and expenditure elasticity. These results were obtained using the mathematical equations as presented in chapter on methodology. The values reported here were evaluated at the sample mean values for total expenditure E and all the household Z_j variables.

In the rice production system, 64 per cent of the total expenditure was on food items, and the rest on non-food items. Among food expenditure, the highest share was on rice followed by oil. In the vegetable system, expenditure on finger millet received the highest share followed by milk and milk products. Amongst different production systems, the share of vegetable expenditure was the highest in the vegetable production system. In sugarcane system, a higher share was for rice followed by milk and milk products. Among non-food expenditure share, across the production systems, health care expenditure was the highest in all the three systems; and amongst system the sugarcane system was at the top than other production systems. Share on clothing was more in the vegetable production system than the rest. There was a remarkable similarity in the expenditures on health care and social obligations across the production systems.

The Marginal Budget Share (MBS) indicates the budget share of a particular commodity allocated from the incremental income. In the rice system, though rice accounted for the largest share of consumption expenditure of all the food items, yet its marginal budget share turned out to be negative. Marginal budget share was the highest in the case of milk and milk products in the

Table 13. Expenditure behavior for foods and non-foods of the average household in different production systems

	Average Budget Share (%)			Marginal Budget Share (%)			Expenditure Elasticity		
	Rice	Vegetable	Sugar-cane	Rice	Vegetable	Sugar-cane	Rice	Vegetable	Sugar-cane
Food group									
Rice	17.02	5.67	10.12	-6.16	-6.72	31.97	-0.36	-1.19	3.16
Finger millet	4.64	9.95	5.30	8.08	-17.55	14.63	1.74	-1.76	-2.76
Other cereals	2.83	1.41	3.12	0.65	0.81	-28.97	0.23	0.57	-9.28
Pulses	5.51	7.16	5.19	-2.89	-3.10	2.51	-0.52	-0.43	0.48
Vegetables	2.78	7.00	4.81	5.84	2.91	4.60	2.10	0.42	0.96
Fruits	4.16	2.54	4.42	7.42	3.15	13.37	1.78	1.24	3.02
Oil	7.91	5.58	7.44	1.93	12.35	-3.69	0.24	2.21	-0.50
Milk and milk products	7.31	9.50	8.20	11.68	8.55	-24.13	1.60	0.90	-3.14
Animal products	5.05	7.44	5.18	7.30	8.59	9.76	1.45	1.15	1.88
Sugar	1.68	1.44	1.59	0.08	1.09	-9.04	0.05	0.76	-5.81
Miscellaneous	5.15	5.50	5.62	-5.20	-1.55	20.94	-1.01	-0.28	3.73
Sub total	64.04	63.19	60.98						
Non-food group									
Education	3.38	2.40	3.84	19.08	18.08	25.13	5.64	7.53	6.28
Social obligation	9.75	8.32	8.76	1.57	5.54	-4.11	0.16	0.67	-0.48
Health	9.56	9.41	11.63	33.55	30.44	43.28	3.51	3.23	6.28
Transport	3.77	2.83	3.54	1.34	2.59	-5.24	0.36	0.92	-1.48
Fuel	1.00	1.01	1.02	0.20	2.22	3.09	0.20	2.20	3.03
Clothing	2.07	8.23	4.14	4.31	20.03	23.83	2.08	2.43	5.76
Others	6.42	4.60	6.18	11.21	12.56	14.21	1.75	2.73	2.30
Sub total	35.95	36.80	39.11						

rice system. This means, if an average household gets one rupee additional income, it will allocate 11.68 paise to purchase milk and milk products. In the vegetable system, finger millet expenditure was the highest but its MBS was negative. It shows, as the income increased, the finger millet expenditure decreased. As income increased the consumption pattern shifted towards oil, milk and milk products and animal products. It was because people considered these products superior to finger millet. The MBS for rice was the highest in sugarcane production system. Among non-food groups, health care expenditure was the highest across the production systems. One of the reasons in the sugarcane system could be consuming unbalanced food leading to nutrition deficiency and other health problems. Fortunately, the higher income from cash crop supported the need for increased health care.

Expenditure elasticity indicates the percentage increase in the budget share of a specific item for a given percentage increase in total expenditure (household income). In the case of food groups, the expenditure elasticity ranged from -0.36 to 2.10 in the rice system, whereas in vegetable system, from -0.28 to 0.57 in the vegetable system, and from -0.50 to 3.73 in the sugarcane system. As far non-food group was concerned, in the rice system, it ranged from 0.16 to 5.64. In the vegetable system, it was between 0.67 and 7.53. In the sugarcane system, minimum value was -0.48 and the maximum 6.28.

Some general observations also emerged from this study. In the rice production, though the expenditure on rice was the highest, yet its marginal budget share and expenditure elasticity turned out to be negative. As income increased, people spent their incremental income on milk and milk products, animal products and vegetables, as they became more income elastic (positive MBS) as well as expenditure elastic. It implies that as income increases households diversify their food products, indicating a rise in the standard of living. Furthe, since marginal budget share and expenditure elasticity of pulses were negative, milk and milk products and animal products became substitutes so as to supplement protein in the dietary intake.

Of the non-food items, education, health, clothing and others were expenditure elastic. On account of increasing awareness among the people to reduce wasteful expenditure on social ceremonies such as festivals, marriages etc., people spent relatively less amount on social obligations. The other point to be remembered is that the respondents were marginal, small farmers and agricultural laborers who were resource poor. So, it is

obvious that they tend to spend more on essential items than on extravagant items. Interestingly social obligation turned expenditure inelastic (0.16 to –0.47) across all these production systems.

The effect of household characteristics on average budget shares for selected commodities was examined in different production systems. The changes in the average budget shares for the average household in the rice, vegetable and sugarcane systems are given in Table 14, 15 and 16, respectively with a change in each of the Zi variables.

In the rice system, total expenditure had a significant but negative influence on rice consumption but had positive and significant influence on vegetable consumption. This means that as income increased, people spent more on vegetables and reduced rice consumption. The land size increased the consumption of oil. The education of household head discouraged finger millet consumption. Children's strength in a family reduced per capita expenditure on vegetables, due to more competition for vegetables. Family size had a negative influence on pulses intake. Homestead garden had positively influenced the consumption of fruits and vegetables. In non-food group, education, and family size had got significant negative relationship. Table 14 shows that land size and higher proportion of women led to higher spending on social obligations. Education of household head had a positive effect on expenditure on clothing (Table 14).

In the case of vegetable production system, land size had positive influence on intake of rice, pulses, vegetables and fruits but negative towards finger millet. Quite unexpectedly, land size negatively influenced the expenditure on animal products, which might be due to the diversion of their own production to markets to realize more cash for day to day running of household. Education of family head had a positive impact on consumption of other cereals and sugar. The family size had positively influenced the expenditure on rice and vegetables. And the presence of more women in the family caused more intake of finger millet. Due to social norms men and children, were given priority while serving rice-based food items, whereas, women consumed inferior cereals. Homestead garden, as expected had influenced positively the intake of vegetables and fruits. Higher family earnings reflected in more consumption of rice, fruits and reduction in consumption of finger millet. Among non-food items, the higher income influenced positively the spending on health and fuel. Among non-food expenditure, the increase in family size had a negative impact on expenditure on clothing. Higher the proportion of women in a household, clothing

expenditure increased. Higher proportion of earning members made people to spend more on transport and entertainment (Table 15).

In the sugarcane system, increase in land resulted in greater share in pulses, oils and clothing but had a negative influence on other cereals. Education of family head, showed had positive link with milk and milk products but it was reverse with respect to sugar, transport and entertainment, and clothing. Age of the head of a household, revealed a negative relationship with fruits, animal products and social obligations. Proportion of women had positive effect on social obligations but negative with respect to fuel. Homestead garden had positive relationship with pulses, vegetables, oils and education. Proportion of earning members had positive bearing on oil, milk and milk products and education. It may be that more family members go to low paid work to add to the family income but at the cost of education (Table 16).

Table 14. Effect of household characteristics on average budget shares for selected commodity in the rice production system

Group	Constant	Total Expen-diture	Log Expen-diture	Land	Head Education	Head Age	Child	Family Size	Propor-tionate Women	Home-stead Garden	Propor-tionate Earning Member	RSQ
Rice	**209.35**	**-356634.97**	**-38.73**	**-2.90**	**-0.03**	**0.05**	**-0.43**	**-0.28**	**4.16**	**-2.38**	**-13.75**	**0.15**
	(2.01)	(2.75)	(1.76)	(0.97)	(0.20)	(0.440	(0.20)	(0.310	(0.35)	(1.120	(1.84)	
Finger millet	**-15.29**	**44457.34**	**5.37**	**-1.20**	**-0.11**	**-0.03**	**0.03**	**-0.12**	**-3.49**	**-0.55**	**-1.98**	**0.23**
	(0.40)	(0.60)	(0.67)	(1.10)	(2.28)	(0.68)	(0.04)	(0.360	(0.82)	(0.71)	(0.73)	
Other Cereals	**1.36**	**50677.41**	**0.03**	**-0.25**	**-0.01**	**0.00**	**-0.17**	**-0.01**	**-2.06**	**-0.23**	**0.33**	**0.53**
	(0.08)	(1.47)	(0.01)	(0.50)	(0.65)	(0.04)	(0.47)	(0.09)	(1.04)	(0.65)	(0.26)	
Pulses	**54.66**	**-79965.02**	**-11.88**	**1.12**	**0.00**	**-0.02**	**-0.72**	**-0.91**	**4.20**	**0.30**	**3.59**	**0.30**
	(1.71)	(1.280	(1.76)	(1.21)	(0.01)	(0.570	(1.06)	(3.28)	(1.16)	(0.46)	(1.57)	
Vegetables	**-22.93**	**52788.19**	**5.36**	**-0.27**	**-0.02**	**-0.04**	**-0.54**	**0.25**	**1.72**	**2.77**	**0.48**	**0.23**
	(1.56)	(2.83)	(1.72)	(0.62)	(0.97)	(2.10)	(2.75)	(1.96)	(1.03)	(2.59)	(0.45)	
Fruits	**-7.63**	**9822.41**	**3.69**	**-1.32**	**-0.07**	**0.00**	**-0.91**	**-0.26**	**-6.52**	**2.56**	**0.62**	**0.26**
	(0.17)	(0.11)	(0.40)	(1.04)	(1.38)	(0.03)	(0.98)	(0.67)	(1.31)	(2.68)	(0.20)	
Oil	**53.27**	**-102863.12**	**-10.47**	**5.34**	**-0.05**	**-0.06**	**0.85**	**-0.23**	**2.55**	**3.00**	**9.96**	**0.13**
	(0.52)	(0.52)	(0.49)	(2.82)	(0.38)	(0.50)	(0.39)	(0.26)	(0.22)	(1.44)	(1.36)	
Milk and	**-16.69**	**13480.82**	**4.96**	**1.26**	**0.01**	**-0.03**	**-0.92**	**0.40**	**-5.24**	**1.80**	**4.08**	**0.18**
Milk Products	(0.29)	(0.12)	(0.41)	(0.76)	(0.07)	(0.47)	(0.76)	(0.80)	(0.81)	(1.53)	(0.99)	
Animal Products	**-1.24**	**7249.22**	**2.57**	**0.26**	**-0.13**	**-0.04**	**-0.58**	**-0.12**	**-3.18**	**0.53**	**-1.28**	**0.14**
	(0.03)	(0.08)	(0.27)	(0.20)	(2.33)	(0.75)	(0.60)	(0.29)	(0.62)	(0.57)	(0.39)	
Sugar	**3.33**	**18933.15**	**-0.78**	**0.47**	**0.02**	**0.00**	**0.27**	**0.08**	**-0.72**	**0.04**	**0.08**	**0.20**
	(0.26)	(0.74)	(0.28)	(1.23)	(1.55)	(0.20)	(0.97)	(0.74)	(0.49)	(0.17)	(0.08)	
Miscellaneous	**69.80**	**-100892.21**	**-14.75**	**0.59**	**0.02**	**0.00**	**-0.58**	**0.36**	**5.64**	**-0.30**	**2.26**	**0.15**
	(2.59)	(1.91)	(2.58)	(0.75)	(0.59)	(0.00)	(1.01)	(1.51)	(1.85)	(1.85)	(0.54)	

Table 14. (Contd.)

Group	Constant	Total Expen-diture	Log Expen-diture	Land	Head Education	Head Age	Child	Family Size	Propor-tionate Women	Home-stead Garden	Propor-tionate Earning Member	RSQ
Education	**-98.82**	**157967.30**	**22.59**	**0.53**	**0.02**	**0.03**	**-0.72**	**-0.78**	**-5.82**	**2.52**	**-1.58**	**0.31**
	(1.96)	(1.60)	(2.12)	(0.36)	(0.37)	(0.48)	(0.67)	(2.78)	(1.02)	(2.45)	(0.44)	
Social Obligations	**73.23**	**-126006.29**	**-13.67**	**2.86**	**-0.02**	**-0.04**	**0.63**	**-0.14**	**11.50**	**-0.34**	**-0.56**	**0.30**
	(1.72)	(1.51)	(1.52)	(2.33)	(0.36)	(0.88)	(0.71)	(0.37)	(2.39)	(0.40)	(0.18)	
Health	**-147.40**	**204814.97**	**32.93**	**-2.72**	**0.12**	**0.06**	**3.00**	**-0.25**	**1.57**	**-2.21**	**2.85**	**0.17**
	(1.42)	(1.01)	(1.50)	(0.91)	(0.92)	(0.47)	(1.37)	(0.28)	(0.13)	(1.04)	(0.38)	
Transport and Entertainment	**-0.53**	**56483.62**	**0.04**	**0.98**	**0.04**	**0.01**	**0.15**	**0.27**	**-3.08**	**-0.18**	**-0.01**	**0.17**
	(0.02)	(0.94)	(0.01)	(1.11)	(1.04)	(0.29)	(0.23)	(1.02)	(0.89)	(0.29)	(0.00)	
Fuel	**2.29**	**8141.94**	**-0.45**	**-0.07**	**0.00**	**0.00**	**-0.09**	**0.04**	**0.20**	**-0.10**	**0.64**	**0.58**
	(0.44)	(0.80)	(0.41)	(0.49)	(0.46)	(0.21)	(0.82)	(0.78)	(0.35)	(0.98)	(1.72)	
Clothing	**-23.97**	**60674.43**	**4.89**	**-1.17**	**0.10**	**0.03**	**0.05**	**0.15**	**0.88**	**-0.71**	**-1.03**	**0.21**
	(0.87)	(1.13)	(0.84)	(1.47)	(2.93)	(0.07)	(0.09)	(0.62)	(0.28)	(1.26)	(0.52)	
Others	**-32.80**	**80870.81**	**8.32**	**-2.96**	**0.11**	**0.08**	**0.68**	**-0.28**	**-2.28**	**0.14**	**-4.70**	**0.18**
	(0.70)	(0.88)	(0.84)	(2.18)	(1.91)	(1.46)	(0.68)	(0.69)	(0.43)	(0.15)	(1.39)	

Note: Figures in parentheses indicate |t| ratios

Table 15. Effect of household characteristics on average budget shares for selected commodity in the vegetable production system

Group	Constant	Total Expen-diture	Log Expen-diture	Land	Head Education	Head Age	Child	Family Size	Propor-tionate Women	Home-stead Garden	Propor-tionate Earning Member	RSQ
Rice	**55.94**	**-15129.53**	**-12.92**	**2.94**	**0.01**	**-0.06**	**-0.07**	**1.03**	**1.22**	**2.14**	**6.67**	**0.23**
	(0.66)	(0.06)	(0.75)	(2.23)	(0.12)	(1.10)	(0.06)	(2.50)	(0.23)	(1.77)	(2.12)	
Finger millet	**228.01**	**-495040.88**	**-47.10**	**-1.91**	**0.07**	**0.15**	**0.89**	**0.70**	**7.61**	**1.01**	**-4.94**	**0.40**
	(3.35)	(2.49)	(3.41)	(2.80)	(1.61)	(3.08)	(0.99)	(2.11)	(2.75)	(1.04)	(2.96)	
Other Cereals	**0.55**	**16123.04**	**-0.03**	**-0.02**	**0.01**	**0.01**	**0.08**	**-0.02**	**0.61**	**-0.15**	**0.04**	**0.33**
	(0.07)	(0.70)	(0.02)	(0.15)	(2.14)	(0.96)	(0.81)	(0.46)	(1.21)	(1.31)	(0.13)	
Pulses	**64.02**	**-47654.23**	**-11.95**	**2.22**	**0.01**	**-0.05**	**-0.74**	**0.08**	**2.15**	**-2.53**	**-2.23**	**0.27**
	(0.83)	(0.21)	(0.77)	(2.87)	(0.29)	(1.02)	(0.73)	(0.22)	(0.44)	(2.31)	(0.79)	
Vegetables	**-44.17**	**329835.67**	**7.63**	**1.79**	**0.05**	**0.02**	**0.36**	**0.52**	**-2.29**	**1.87**	**1.98**	**0.33**
	(-0.82)	(2.10)	(0.70)	(2.14)	(1.56)	(0.53)	(0.51)	(2.01)	(-0.67)	(2.30)	(1.00)	
Fruits	**6.74**	**-52363.10**	**-1.25**	**2.21**	**0.05**	**-0.02**	**-0.27**	**0.23**	**3.81**	**1.47**	**5.37**	**0.32**
	(0.11)	(0.30)	(0.10)	(2.36)	(1.41)	(0.40)	(0.33)	(0.78)	(0.99)	(2.54)	(2.40)	
Oil	**183.88**	**-525034.15**	**-36.58**	**-0.19**	**0.00**	**0.08**	**0.63**	**0.01**	**1.38**	**2.39**	**-2.03**	**0.27**
	(2.47)	(2.41)	(2.42)	(0.17)	(0.04)	(1.58)	(0.64)	(0.03)	(0.29)	(2.25)	(0.74)	
Milk and	**107.29**	**-138078.06**	**-20.43**	**-1.28**	**-0.01**	**-0.03**	**-1.31**	**-0.26**	**12.09**	**-0.88**	**-3.13**	**0.49**
Milk Products	(1.82)	(0.80)	(1.71)	(1.40)	(0.37)	(0.67)	(1.69)	(0.91)	(3.22)	(1.04)	(1.43)	
Animal Products	**30.40**	**34317.00**	**-5.62**	**-1.88**	**0.01**	**0.05**	**-0.05**	**-0.08**	**-0.53**	**0.08**	**0.96**	**0.55**
	(0.78)	(0.30)	(0.71)	(3.11)	(0.43)	(1.69)	(0.10)	(0.41)	(0.22)	(0.15)	(0.67)	
Sugar	**-0.95**	**46545.79**	**0.02**	**0.28**	**0.03**	**0.00**	**0.07**	**0.08**	**1.20**	**-0.10**	**-0.35**	**0.26**
	(0.05)	(0.85)	(0.00)	(0.95)	(2.90)	(0.33)	(0.27)	(0.92)	(0.28)	(0.36)	(0.50)	
Miscellaneous	**11.34**	**126688.25**	**-2.56**	**0.38**	**-0.01**	**-0.01**	**-0.93**	**0.25**	**2.18**	**0.49**	**-0.48**	**0.42**
	(0.33)	(1.26)	(0.37)	(0.71)	(0.36)	(0.51)	(2.05)	(1.51)	(0.99)	(0.92)	(0.37)	

Table 15. (Contd.)

Group	Constant	Total Expen-diture	Log Expen-diture	Land	Head Education	Head Age	Child	Family Size	Propor-tionate Women	Home-stead Garden	Propor-tionate Earning Member	RSQ
Education	**43.56**	**-187828.03**	**-7.00**	**-0.26**	**0.04**	**-0.05**	**-1.91**	**0.07**	**-1.30**	**-1.03**	**-0.53**	**0.24**
	(0.76)	(1.12)	(0.60)	(0.29)	(0.99)	(1.37)	(2.53)	(0.25)	(0.36)	(1.27)	(0.25)	
Social Obligations	**51.26**	**-26048.34**	**-9.22**	**-0.65**	**-0.02**	**-0.01**	**-0.16**	**0.04**	**-1.25**	**0.12**	**0.76**	**0.62**
	(2.09)	(-0.36)	(-1.85)	(-1.72)	(-1.16)	(-0.75)	(-0.50)	(0.37)	(-0.80)	(0.35)	(0.84)	
Health	**-968.87**	**2288095.63**	**202.35**	**4.17**	**-0.17**	**-0.16**	**-0.62**	**-0.02**	**1.78**	**-3.61**	**1.77**	**0.69**
	(7.91)	(6.39)	(8.14)	(2.19)	(2.20)	(1.90)	(0.39)	(0.03)	(0.23)	(2.07)	(0.39)	
Transport and	**38.05**	**-68100.88**	**-7.85**	**1.67**	**0.03**	**-0.03**	**0.18**	**0.21**	**-0.27**	**0.12**	**2.55**	**0.28**
Entertainment	(1.08)	(0.66)	(1.10)	(3.07)	(1.26)	(1.10)	(0.39)	(1.22)	(0.12)	(0.24)	(2.25)	
Fuel	**-1.22**	**31917.61**	**0.23**	**0.07**	**0.00**	**0.00**	**0.02**	**0.01**	**0.13**	**0.06**	**0.01**	**0.61**
	(0.29)	(2.59)	(0.27)	(1.14)	(0.94)	(0.88)	(0.37)	(0.53)	(0.47)	(0.95)	(0.05)	
Clothing	**332.80**	**-1402851.89**	**-56.56**	**-3.06**	**-0.08**	**0.03**	**3.33**	**-2.46**	**28.06**	**1.95**	**-5.01**	**0.41**
	(1.95)	(2.81)	(1.63)	(1.16)	(0.79)	(0.24)	(1.48)	(2.97)	(2.58)	(0.80)	(0.79)	
Others	**-38.63**	**84606.09**	**8.84**	**-2.05**	**-0.03**	**0.11**	**0.51**	**-0.41**	**0.42**	**-0.43**	**-1.41**	**0.16**
	(0.50)	(0.37)	(0.56)	(1.69)	(0.53)	(2.05)	(0.50)	(1.08)	(0.09)	(0.38)	(0.49)	

Note: Figures in parentheses indicate |t| ratios.

Table16. Effect of household characteristics on average budget shares for selected commodity in the sugarcane production system

Group	Constant	Total Expen-diture	Log Expen-diture	Land	Head Education	Head Age	Child	Family Size	Propor-tionate Women	Home-stead Garden	Propor-tionate Earning Member	RSQ
Rice	**-66.26**	**0.00**	**17.62**	**-3.12**	**0.01**	**-0.08**	**-1.78**	**1.50**	**10.53**	**0.43**	**-1.68**	**0.0902**
	(0.45)	(0.25)	(0.47)	(1.04)	(0.08)	(0.74)	(0.75)	(1.43)	(0.93)	(0.15)	(0.23)	
Finger millet	**-14.08**	**0.00**	**5.40**	**-0.77**	**0.02**	**0.03**	**0.98**	**-0.04**	**-3.72**	**0.91**	**-1.00**	**0.1534**
	(0.29)	(0.70)	(0.44)	(0.77)	(0.57)	(0.75)	(1.25)	(0.11)	(1.00)	(0.93)	(0.42)	
Other Cereals	**98.67**	**0.00**	**-23.94**	**-1.20**	**0.00**	**0.00**	**-0.24**	**0.21**	**1.61**	**-0.99**	**0.74**	**0.7791**
	(4.68)	(3.27)	(4.38)	(2.77)	(0.04)	(0.20)	(0.70)	(1.42)	(0.98)	(2.31)	(0.71)	
Pulses	**9.60**	**0.00**	**-2.57**	**2.28**	**0.05**	**0.03**	**-1.08**	**0.86**	**0.83**	**1.18**	**0.98**	**0.3387**
	(0.22)	(0.02)	(0.22)	(2.50)	(1.37)	(0.84)	(1.50)	(2.71)	(0.24)	(2.31)	(0.44)	
Vegetables	**6.44**	**0.00**	**-0.96**	**1.28**	**0.04**	**0.02**	**0.29**	**0.19**	**-0.29**	**1.37**	**0.21**	**0.3012**
	(0.16)	(0.16)	(0.09)	(1.55)	(1.26)	(0.77)	(0.44)	(0.66)	(0.09)	(2.68)	(0.11)	
Fruits	**-11.08**	**0.00**	**5.27**	**-0.98**	**0.01**	**-0.07**	**-0.50**	**0.23**	**-0.46**	**3.75**	**-2.22**	**0.3394**
	(0.25)	(0.72)	(0.46)	(1.08)	(0.27)	(2.25)	(0.70)	(0.73)	(0.14)	(1.84)	(1.02)	
Oil	**19.89**	**0.00**	**-5.88**	**9.20**	**0.09**	**0.02**	**-1.26**	**-0.29**	**2.37**	**3.74**	**8.23**	**0.5425**
	(0.21)	(0.48)	(0.24)	(4.80)	(1.12)	(0.27)	(0.83)	(0.44)	(0.33)	(2.49)	(2.78)	
Milk and	**88.50**	**0.00**	**-22.42**	**1.92**	**0.20**	**-0.02**	**-0.82**	**0.77**	**-9.56**	**-1.13**	**8.33**	**0.2282**
Milk Products	(1.01)	(1.13)	(-0.99)	(1.06)	(2.54)	(-0.24)	(-0.58)	(1.22)	(-1.40)	(-0.64)	(2‘.91)	
Animal Products	**-5.71**	**0.00**	**3.17**	**-1.40**	**0.01**	**-0.06**	**-0.32**	**0.42**	**4.99**	**0.37**	**-3.38**	**0.1952**
	(0.14)	(0.29)	(0.29)	(1.62)	(0.39)	(2.39)	(0.47)	(1.38)	(1.53)	(0.43)	(1.62)	
Sugar	**29.96**	**0.00**	**-7.33**	**0.34**	**-0.02**	**0.02**	**0.17**	**-0.09**	**-0.49**	**-0.55**	**0.47**	**0.3311**
	(2.30)	(2.17)	(2.17)	(1.25)	(2.84)	(1.60)	(0.78)	(0.93)	(0.48)	(2.06)	(0.73)	
Miscellaneous	**-29.12**	**0.00**	**9.09**	**0.59**	**0.01**	**0.05**	**-0.41**	**0.17**	**-0.72**	**-0.91**	**-2.21**	**0.3447**
	(0.91)	(1.66)	(1.09)	(0.89)	(0.36)	(1.88)	(0.79)	(0.73)	(0.29)	(1.39)	(1.39)	

Table 16. (Contd.)

Group	Constant	Total Expen-diture	Log Expen-diture	Land	Head Education	Head Age	Child	Family Size	Propor-tionate Women	Home-stead Garden	Propor-tionate Earning Member	RSQ
Education	**-119.97**	**0.00**	**35.04**	**-0.63**	**-0.12**	**-0.05**	**-0.12**	**-0.69**	**0.39**	**3.46**	**10.10**	**0.1936**
	(1.17)	(1.54)	(1.32)	(0.29)	(1.35)	(0.69)	(0.07)	(0.94)	(0.05)	(1.66)	(2.98)	
Social Obligations	**56.55**	**0.00**	**-11.75**	**0.85**	**0.02**	**-0.04**	**-0.60**	**0.66**	**4.33**	**-0.09**	**-0.83**	**0.5251**
	(2.07)	(0.35)	(1.66)	(1.51)	(0.70)	(2.36)	(1.34)	(3.40)	(2.24)	(0.16)	(0.61)	
Health	**-166.21**	**0.00**	**43.56**	**-4.99**	**-0.09**	**0.03**	**2.70**	**-1.96**	**6.85**	**-0.36**	**10.53**	**0.2634**
	(1.04)	(0.50)	(1.06)	(1.52)	(0.64)	(0.25)	(1.04)	(1.72)	(0.55)	(0.11)	(1.33)	
Transport and	**25.93**	**0.00**	**-5.95**	**1.13**	**-0.08**	**0.03**	**0.01**	**-0.06**	**-1.19**	**0.62**	**0.37**	**0.3040**
Entertainment	(0.72)	(0.65)	(0.64)	(1.52)	(2.47)	(1.00)	(0.01)	(0.24)	(0.43)	(0.85)	(0.21)	
Fuel	**17.15**	**0.00**	**-3.82**	**0.05**	**0.00**	**0.00**	**-0.06**	**-0.02**	**-0.49**	**0.06**	**-0.09**	**0.8152**
	(4.71)	(1.61)	(4.05)	(0.62)	(1.45)	(0.56)	(1.06)	(0.62)	(2.72)	(0.82)	(0.49)	
Clothing	**137.12**	**0.00**	**-34.63**	**3.95**	**-0.22**	**0.02**	**2.22**	**-0.23**	**-4.67**	**2.13**	**-3.10**	**0.3696**
	(1.39)	(2.01)	(1.36)	(2.94)	(2.49)	(0.32)	(1.38)	(0.33)	(0.61)	(1.07)	(0.63)	
Others	**22.62**	**0.00**	**0.11**	**-0.60**	**0.05**	**0.09**	**0.84**	**-1.62**	**-10.32**	**0.35**	**-5.25**	**0.3083**
	(0.20)	(0.61)	(0.00)	(0.26)	(0.52)	(1.05)	(0.46)	(2.03)	(1.19)	(0.15)	(0.95)	

Note: Figures in parentheses indicate |t| ratios.

7. INSTITUTIONAL LINKAGES AMONGST AGRICULTURE, HEALTH AND NUTRITION DEPARTMENTS

Using the structured and non-structured interview methods and the secondary data, the existing development programs being implemented by different development departments and the linkages amongst them were examined, keeping in mind their potentiality for agriculture-based interventions in alleviating malnutrition. The salient observations are presented in this section.

7.1. Health and nutrition intervention programs

At the block level, State Health Department runs Primary Health Centers (PHC). For every 5,000 population, one health sub-centre is functioning which is looked after by a Village Health Nurse (VHN). PHC is concentrating on health education, nutrition education, family welfare program, reproduction and child health program, disease eradication and immunization programs for the better health of the society (Annexure 13).

The Directorate of Social Welfare implements Nutrition intervention programs. The Tamil Nadu Integrated Nutrition Project II (TINP), which was implemented with the World Bank assistance in 318 blocks covering 24 districts of Tamil Nadu from 1991, came to a close in 1997. In continuation of TINP II, the Government of India gave its approval to implementation of World Bank assisted ICDS III project with effect from January 1998. The ICDS is being implemented in all the 318, Rural Blocks, 19500 centers in 24 districts. The program details are presented in Annexure 14. These intervention programs are implemented through *Anganvadi* centres located at the grass root level.

There seems to be a considerable close linkage between health and nutrition departments/ programs. The officials of PHC and ICDS scheme have close co-operation and are conducting their activities with mutual support. Block level joint training programs are organized by Social Welfare Department for health and nutrition workers and supervisors. At Health Sub Centre, VHN with the help of nutrition workers at A*nganwadi* centre provides various services for improving health and nutritional status of women and children (Annexure 15).

Functionaries from these departments jointly identify households at risk having malnourished children and women and facilitate improving their nutritional status. The approach is primarily the distribution of vitamin tablets and provision of nutritive food to some extent. To alleviate the micronutrient malnutrition, the A*nganwadi* workers at village level educate the women about the importance of consumption of fruits and vegetables and green leafy vegetables. For women having anemia, PHC doctors were found to recommend them to take more quantity of green leafy vegetables such as moringa (*Moringa oleifera*).

Supplementary feeding programs being implemented by nutrition agencies through A*nganwadi* centers revealed some weaknesses and the need for strong linkages with agriculture and horticulture departments. For instance, in the supplementary feeding programs, at present Re.0.17 is being provided per child to A*nganwadi* centre for purchasing of vegetables. The A*nganwadi* workers were of the perception that the financial assistance provided through the scheme was grossly inadequate to buy vegetables even from the local market. This constraint was more experienced in those villages which had the rice and sugarcane systems. Further, the A*nganwadi* workers had to buy the vegetables from nearby markets, which were also not fresh. To counter such problems, nutrition gardening component was included in the functioning of A*nganwadi* centres. As per that, each A*nganwadi* centre maintains a nutrition garden around the centre. In monthly meetings, monitoring of kitchen gardening is done. On the advice of District Collector, horticulture department is supplying saplings to kitchen gardens. However, grass root level nutrition functionaries at *Anganwadi* centres have poor technical know-how in the area of plant protection and maintenance of nutrition garden. As a result, by and large, laying out and maintenance of nutrition gardens near by *Anganwadi* centre was found to be poor. In mothers group meetings, women were educated on kitchen gardening and encouraged to establish nutritional gardens. But, for want of proper expertise, they were not in a position to properly guide the women to establish and maintain the nutrition gardens. This kind of situation reflects the existing weak linkages between nutrition agencies and horticulture department.

7.2. Horticulture department development programs

Horticulture department is implementing various development schemes (Annexure 16), some of which are relevant for ensuring nutritional security. For instance, at present the department is implementing a scheme for promoting nutritional gardening. In that scheme, around 50 households are

covered every year and seedlings worth of Rs.50 for each are distributed. The focus of the scheme is mainly on input distribution and not on sensitizing the vulnerable households about the importance of nutritional gardening in improving their access to nutritious food items. Unfortunately, extension personnel were found to have inadequate knowledge on these aspects. As a result, this aspect of the message was found missing during the technology transfer to the farmers. The department identifies the scheme beneficiaries in general based on land size and community, i.e. mostly small, marginal farmers and scheduled caste farmers. Since the scheme benefits can be extended to only a limited number of households, the nutritional vulnerability should also to be considered as one of the criteria. While identifying beneficiary households,the ICDS scheme being implemented through Social Welfare Department and Primary Health Centers is identifying nutritionally risky households for extending the benefits of nutritional intervention scheme. At present, there is no proper arrangement for mutual sharing of database on these lists of beneficiaries who constitute weaker sections of the community among development departments. As a result the most vulnerable and needy households may not necessarily avail the benefits of the scheme.

7.3. Agriculture department development programs

The State Department of Agriculture is also implementing various schemes, which are beneficial to the weaker sections of the farming community (Annexure 17). Some of these schemes focus on the reduction in the input costs. Such schemes help these farmers to increase their farm productivity and earn more income. The agriculture department distributes some of the plant micronutrients, which are mainly recommended to the rice, minor millets, groundnut, sesame and sunflower at subsidized rate. The other program, which is of greater importance, is National Pulse Development Program (NPDP) being implemented by this department. The small and marginal farmers are provided all assistance to increase the production and productivity of pulses like black gram, green gram, cow pea, etc.,

Another importance scheme is “Integrated Cereal Development Program”, whose objective to increase the area, production and productivity of cereals. Under this scheme, apart from paddy, millet seeds like pearl millet and finger millet are distributed at subsidized rates. Though, the national nutritional policy emphasizes the inclusion of nutritional objectives in development programs including agricultural programs, at grass root level, at the implementing level of agricultural developmental schemes, there seems to

be no specific strategy for inclusion of nutritionally at risk households for distribution of subsidies, or technology transfer, aiming at improving of overall nutritional status those households. This is due to lack of sensitivity to the regional malnutrition concerns and the lack of linkage with nutritional agencies of Directorate of Social Welfare.

7.4. Development programs of animal husbandry department

This department is mainly providing healthcare services for cattle and implements artificial insemination scheme for breed improvement. The department linkage with other departments in implementing programs is negligible. During the discussion with the Department of Animal Husbandry officials, it was revealed that availability of livestock feed was one of the main constraints and suggested that livestock fodder could be supplied at subsidized rate to boost the milk yield. Though the possible interventions that can be taken up by the department of agriculture which can facilitate to boost up dairy and poultry sector is felt by the officials those needs/ ideas are yet to be put into to agriculture department as concrete proposals. It was observed that, the officials and grass root workers in the animal husbandry department are yet to realize the potentiality of animal husbandry department to play a proactive role to address the issues of nutrition in its jurisdiction.

7.5. Block development office programs

Various state and central government schemes are being implemented through Block Development Officer (BDO) Office (Annexure 18). These schemes are mainly meant for poverty alleviation. BDO office in liaison with Village Panchayat offers some employment opportunities. Some schemes provide financial focus on improvement of health and sanitation in the community for instance, providing safe drinking water and providing financial assistance for construction of toilets. While prioritizing the region and the target groups for funding, BDO office and the Village *Panchayat,* there seems to be no proper coordinated efforts with other development departments to address the nutritional security-related issues in the area of operation. At present, the role of these institutions in location-specific strategies and integrating schemes for nutritional security of the community is negligible.

7.6. Regional research station activities

In the study area, nearby sample village, at Paiyur, there is a Regional Research Station of Tamil Nadu Agricultural University. It mainly focuses on plant protection and productivity enhancement technologies. It was found that there were no specific research programs for addressing human nutrition related problems. As a result, there was absence of an integrated focus on information about nutritional status, agricultural development adequacy options for nutritional security.

8. CONCLUSIONS AND IMPLICATIONS

At present, the main component of alleviating nutrition intervention programs is supplementary feeding, which may not be cost-effective in the long run, whereas, agriculture-based nutritional interventions are sustainable. National Nutritional Policy (1993) emphasizes on incorporating nutritional objectives in agricultural development programs. But, its actual implementation requires systematized efforts. Understanding of the nutrient intake pattern of rural households in different agricultural production systems will signal the needed adjustments in agricultural development programs to address the nutritional issues of at-risk households, apart from focusing the national food security. Therefore, the nutrient intake pattern was examined in different production systems viz., rice, vegetable and sugarcane. Further, the existing inter-institutional linkages among development departments for nutritional interventions were also studied and the scope for effective linkages was explored.

8.1. Production system wise food and nutrients intake

The analysis of data collected in the study revealed that, the food group-wise intake in general was lower than the RDA. Higher deficit was observed with regard to consumption of fruits and vegetables. However, consumption of these commodities was found better in the vegetable production system than in the rice and sugarcane systems. Children in the vegetable system consumed more pulses. A similar trend was observed in intake of micronutrients, i.e. intake of nutrients viz. iron, vitamin A and vitamin C were comparatively higher in the vegetable system. This depicts the potential of vegetable system in supporting healthy food to the weaker sections. Location-specific assessment is to be made on poor people's nutritional security in the rice and sugarcane systems and the needed adjustments are to be carried out.

The intra-household allocation of nutrients revealed no conscious discrimination of females. The general society norm that females should take food only after male in a household seems to influence the female nutrient intake to a large extent. Further, unawareness about the special requirements of nutrients for females due to age and other physiological factors like pregnancy resulted in lower nutrient intake of females. It implies whatever be the reason, women are more vulnerable to nutritional insecurity.

The factors influencing per capita protein and energy intake in different production systems were found out using regression model. Public Distribution Systems do serve the cause of nutritional security, especially in the rice system for improved protein intake through wheat consumption. Region-specific PDS plan with regard to types of food commodities to be distributed at nominal rate would help balanced dietary intake.

A higher number of children in a family increased competition for the available protein and energy across the productions systems. The number of children per household should be considered as one of the indicators for the identification of 'at-risk' households. Nutrition knowledge has influenced positively the per capita protein and energy intake in the sugarcane system. It was found that in farmers and agricultural laborer households, the cash income flow was not directly translated into a higher consumption of nutrient-rich foods. Instead, it was diverted to non-food items, ignoring the household nutrient requirements. One of the reasons for this was insufficient nutrition knowledge. Such a consumption behavior leads to increased health expenditure. Hence, the nutrition education was more crucial in non-vegetable systems.

The frequency of consumption of leafy and other vegetables was more in the vegetable system. At the rural level, the production environment influenced much on food habits of the households. In the non-vegetable production area, better market and transport infrastructure was to be created for increasing the access of households, especially for fruits and vegetables. Indigenous crops helped to improve the nutrient intake. Vegetable co-operative models that are successful in the urban environment could also be established with appropriate modification as needed by the rural settings.

Kind wages positively influenced the agricultural laborers' nutrient intake in vegetable system. Households' receiving various types of vegetables as kind wages (a part of total wage) and perks had opportunity for better nutrient intake. On the contrary, in most of the households which were receiving mostly cereals and/ or cash income not necessarily purchased vegetables to the extent of fulfilling balanced nutrient intake of the household members.

8.2. Food and non-food expenditure share

Share of food expenditure was found to be comparatively lower in the vegetable production system. One of the reasons could be the access to farm-produced food items as mostly vegetables were valued at lower cost.

The perks and kind wages also reduced to some extent the food expenditure. Further, due to higher income received from the sale of vegetables, the households could spend more money on other non-food commodities and services. Lower budget share on food is a good indicator of better living standard of a family.

In the rice and sugarcane systems, among food expenditure, the highest share went to rice. Next in the order were oil and milk and milk products. The plausible reason could be that two commodities were readily available through well-established market channels at reasonable rates. The high marginal budget share in the case of oil and milk and milk products further supports this fact. The fruits and vegetables, being perishable in nature, purchased through market were highly influenced by the price fluctuations and the supply to local market. Therefore, share on vegetable expenditure was lower. In contrast to the rice and sugarcane production systems, food expenditure share in the vegetable system was equally distributed, mainly due to greater availability of all food items through either farm production or market channels. Therefore, it is essential to increase the fruits and vegetable supply in the rice and sugarcane system by appropriate agricultural intervention programs, including creation of an efficient market infrastructure.

In systems other than vegetable system the, the incremental income promoted the purchases of milk and milk products. So, introduction of dairy enterprises would be beneficial so that even weaker sections would be in a position to buy milk. Interestingly, in the vegetable system area in this study, people though eat finger millet traditionally as one of the staple foods, over the period however, there has been shift in the food preference. As a result, the income increase led to a change in food intake from finger millet to rice. The reason lies in the people's growing perception that finger millet was an inferior commodity. In reality, the finger millet is rich in calcium and is a good source of minerals. Hence, for resource-poor farmers, finger millet is a very good substitute for nutritious food. Keeping this in mind, the agriculture and nutrition department can take up joint campaign for educating about the nutritive value of finger millet and the importance of growing and consuming finger millet. This extension strategy can be integrated with the Integrated Cereal Development Program being implemented by the agriculture department.

Among non-food expenditure, health expenditure was the highest in the sugarcane system, compared to that in other systems. Since sugarcane system is a cash crop, access to farm produced foods was limited to the

population in that area. The source for food commodities was mainly through market purchase. The price fluctuations of food commodities considerably affected the vulnerable households, especially during off-seasons. This is highly relevant for perishable green leafy vegetables and vitamin-rich fruits. Consuming less nutritive food may lead to increased expenditure on health care. Therefore, special agricultural programs need to be designed to provide scope for increased access to fruits and vegetables, thereby, addressing micronutrient deficiencies.

In the rice system, the higher income and more farm size lead usually to reduction in rice consumption and increase in vegetables and oils consumption through market purchases. The marginal farmers and agricultural laborers can be provided assistance for establishing nutrition gardens and cultivation of vegetables in marginal lands. In nutritional gardening, seasonal and perennial varieties of green leafy vegetables such as creeper spinach (*Basilla alba*), amaranth (*Amaranth gangeticus*), moringa and yellow-orange fruits, and vegetables like mangoes, papaya and yellow pumpkin can be promoted. Vitamin C-rich fruit such as guava and amla can be introduced. Even introduction of cruciferous vegetables like cucumbers, watermelon, muskmelon would help in increasing the intake of vitamins and minerals. This approach would generate additional income through sale of these farm produce and improve overall quality of their food intake.

It has been found that formal education negatively influenced the consumption of finger millet. More formal education leading to higher earnings resulted in a shift in the consumption pattern from finger millet to rice based food preparations. Therefore, nutrition education is more important, irrespective of formal education of the household member for proper utilization of available food as well as improving the health and nutrition status of these people. People should be sensitized about the nutritive value of finger millet and their mind-set should be changed. Households having more number of children generally suffer from greater variation in intra-household food intake, mainly fruits and vegetables. So, the number of children per household can be one of the indicators while identifying the target beneficiaries for extending other agricultural scheme benefits with the intention of improving their nutritional security. There is clear evidence across the production systems, supporting that homestead gardens greatly contribute increased intake of fruits and vegetables. This should be taken as a cue for higher potential for and importance of nutritional and other agricultural diversification programs.

In the households with high proportions of earning members, the intake of pulses had gone up, suggesting that the increased income flow or direct access to pulses as perks contributed a higher protein intake. Though, the agricultural laborers working in the sugarcane system had the same amount of income as that of laborer in rice system, the incidence of market purchase of pulses was lesser. An Increase in income leading to higher intake of nutritionally balanced food was too much to expect. In lower income households, a direct physical access to the food produced had greater influence on food consumption than the recycling of cash income to food items and balanced nutrition intake. For cash income, to get recycled into improved nutrition intake, other factors, like nutrition knowledge, easy market access to vitamin rich foods, income control by women, etc., were found to be of great importance.

8.3. Scope for institutional linkages among agriculture, health and nutrition departments

It has been found that nutritional objectives are not included in the agricultural plans and programs. It looked as though these programmers/schemes were insensitive to the food-insecure households. The link between health and nutrition agencies with agriculture and allied departments is negligible. Combating malnutrition based on diet diversification through regional nutritionally rich food production systems is to be emphasized.

Implementing agriculture-based interventions warrants a strong co-ordination of all the state development departments for achieving the goal of sustainable nutrient security in a cost-effective manner. Institutional arrangement for a sustained co-ordination assumes much significance. The role of each development department should be assessed and redefined (if needed) for complementing each other. In this study, various programs of developmental departments were examined. Figure 4 and Table 17 depict the possible roles and linkages between the development departments. The salient observations and suggestions for their increased interaction in different areas are discussed here under.

8.3.1. Database sharing

Health Department and Social Welfare Department along with nutrition agencies generate data related to nutritional issues. Primary Health Center (PHC) and ICDS scheme officials were formally coordinating and identifying ‘at-risk’ households. The target beneficiaries were those households which

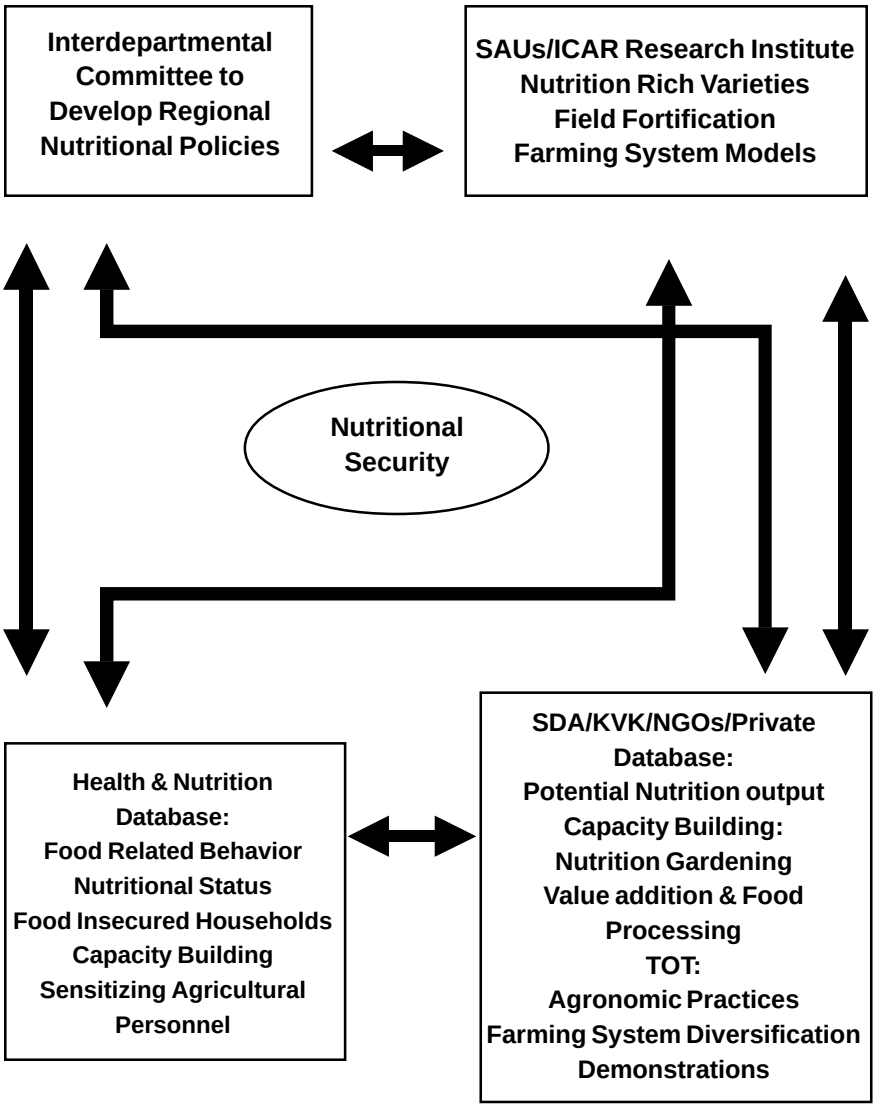

Figure 6. Institutional linkages for sustainable nutritional security

had malnourished children and weaker mothers, requiring maternal healthcare. It was also observed that the information on nutritional status is being gathered at various levels from village up to state level. But these data were rarely analyzed at local levels for preparing regional nutritional security strategies for addressing the real causes of malnutrition. The data were sent to ICDS Central office at national level and analyzed. As a result,

Table 17. Interdepartmental joint activities for improving nutritional security

Departments		Activity	Benefit
Primary role	Secondary role		
Health, Social welfare, Nutrition	Agriculture, Horticulture, Animal Husbandry	Identification of “at-risk” households	Integrated targeting of developmental schemes to ‘at-risk’ households
Health, Social welfare, Nutrition	Agriculture, Horticulture, Animal Husbandry	Decentralized analysis of nutritional status data of ICDS	Development of region-specific policy alternatives
Health, Social welfare, Nutrition	Horticulture	Estimation of nutritional requirements of average poor household in the region	Effective planning of nutritional gardening for poor households
Horticulture, KVKs	Social welfare, Nutrition	Processing and value addition of mushroom, vegetables	Increased shelf-life, enhanced nutrient intake, access to nutritive foods in off-season.
Horticulture	Social welfare, Schools	Tree planting, nutrition gardening	Utilization of common land for increased supply of fruits and vegetables
Agriculture	Horticulture	Farming system diversification-intercropping, mixed cropping and border cropping	Enhanced nutrient supply from food systems
Agriculture	Nutrition	Joint campaign on benefits of millets consumption	Sustaining millets cultivation and consumption
Agriculture	Animal Husbandry	Developing integrated farming system model for promotion of dairy and poultry	Low cost feed, cost-effective maintenance of livestock and poultry, increased production

Table 17. (Contd.)

Departments		Activity	Benefit
Primary role	Secondary role		
Panchayat union, Village Panchayat	Development departments	Coordinated proactive role in implementing development programs	Integrated targeting, enhanced nutritional security through poverty alleviation
Horticulture, SAUs University, KVKs, NGOs,	Social welfare, Nutrition	Identification of Micronutrient-rich indigenous crops	Crop introduction and or area expansion
State Agricultural University, ICAR, KVKs, Agriculture	Health, Social welfare, Nutrition	Development of nutrient rich transgenic varieties	Field fortification
Horticulture, KVKs	Social welfare, Nutrition	Technical know-how on nutrition gardening	Effective management of nutrition gardening by *Anganwadis*
Health, Social welfare, Nutrition	Agriculture and allied	Sensitizing extension personnel	Extension system incorporates nutritional objective in its technology transfer
Horticulture, NGOs	Social welfare, Nutrition	Social marketing- co-operative units	Awareness about nutritive value of foods and increased food and vegetable intake
Social welfare, Nutrition	Agriculture, Horticulture	Self-h1elp Groups (SHGs) from ‘at-risk’ households	Empowering ‘at-risk’ households to solve malnutrition problems
Agriculture, Horticulture, KVKs, NGOs,	Social welfare, Nutrition, NGOs	Large-scale co-operative operations	Agro processing and sale of dehydrated and fortified greens/vegetables

though the guidelines were given, generally, they were broader in nature without much relevance to the location specific problems. Therefore, decentralized analysis of nutritional status information may be done and translated to policy alternatives at the local level. These information on food related behavior, nutritional status, food insecure households etc. generated by health and nutrition agencies may be shared with the Agriculture, Horticulture and other development departments. Such data sharing would help agriculture and allied departments to go for integrated targeting of nutritionally vulnerable ('at-risk') households and extend the relevant developmental schemes for their upliftment.

One of the important schemes being implemented by Horticulture department is nutrition gardening. The scheme mainly deals with distribution of greens, fruits and vegetable seedlings. The target beneficiaries are small, marginal, agricultural laborers, and scheduled caste farmers. But, the beneficiary households may not necessarily be those who are actually nutritionally vulnerable. But, with the help of database on 'at-risk' households, those households can be included as a part of beneficiary list while distributing fruits and vegetable seeds and/ or seedlings. For instance, when horticulture department distributes *Moringa* seedlings, it can be given precisely to those households which are in need of horticulture intervention for combating anemia and other nutritional deficiencies.

The State Department of Agriculture is implementing various schemes, which are beneficial to the weaker sections of the farming community. The strategies behind these programs are mainly input subsidies and dissemination of technologies for yield enhancement. The other significant schemes are promotion of pulses and millets. Database on 'at-risk' households would be able to provide assistance to those nutritionally-vulnerable households in increasing their income as well as access to nutrient rich pulses and millets.

In the study area, dairy and poultry contribute income to the households to a considerable level. These enterprises are a good source of increasing the access of animal protein and calcium for resource-poor households. It was observed during the study that the agricultural landless laborers greatly benefited from the dairy and poultry sector as an alternative source of income. Therefore the Animal Husbandry Department has a complimentary role to play for the household nutritional security and it should extend its schemes to those also who have been identified as 'at-risk' households.

In brief, these departments should attempt at developing appropriate indicators for properly identifying households which are food and nutritionally insecured and should jointly address the nutritional issues jointly with their programs.

8.3.2. Reinventing ongoing schemes

Horticulture department is implementing various schemes for the development of fruits and vegetables in the state. Some of the significant schemes are nutrition gardening, mushroom cultivation and vegetable minikit scheme for popularizing hybrid vegetable seeds. Before, supplying seed/ planting materials, the real nutritional requirement of average poor household in the region is to be worked out. This would facilitate establishment of well-organized nutrition gardening. Similarly, in schemes like mushroom cultivation, its processing and value-addition can be taught to the beneficiaries. For these activities, the expertise available in social welfare department, nutrition agencies and *KVK*s can be utilized. The department implements another scheme for tree planting in educational institutions. Such schemes can be reoriented to address the nutritional security issue also in the villages. Social Welfare Department and Horticulture Department can have tie up with local educational institutions. The horticulture officer can provide technical knowledge to the school children on maintaining nutrition gardens and tree planting in the wastelands around the school. It would benefit the A*nganwadi* centers to procure vegetables at a lower cost. Children in A*nganwadi* centers and schools will have opportunity to get fresh nutritive vegetables.

8.3.3. Farming system diversification

The agricultural extension system, which was one of the three pillars of the Green Revolution in India, must be linked to community welfare (Babu 2000). It has been found that during the study that the role of extension functionaries' is mostly confined to the distribution of subsidized seeds. Further, agricultural plans lay stress only on the production targets. These do not give adequate importance to "Farming system diversification". What is expected is a more intensified effort to promote technologies like inter-cropping, mixed-cropping and border-cropping which would help farmers in utilizing the inputs received through the scheme in a much productive way. Further, it has been observed that the linkage between horticulture and agriculture departments requires further strengthening. Coordinated implementation would facilitate promotion of this kind of cropping system. For instance, growing pulse crop in field bunds by agriculture-sponsored schemes and growing papaya tree around

the field by horticulture-sponsored schemes would contribute to reducing protein and vitamin A deficiencies. National Pulse Development Program (NPDP) beneficiaries can be identified with the help of nutrition department. This would help farmers to increase their income as well as improve the consumption of pulses and fruits of a household. The landless agricultural laborers also indirectly would derive benefit by getting pulses as kind wages or gifts from farmers. This provides a scope for increasing their intake of protein rich pulses.

8.3.4. Sustenance of millets consumption

Millets have high nutritive value with high calcium and other minerals. Promotion of millet cultivation assumes significance especially for the poor farming community. Because there is an apprehension that shifts from traditional foods, many of, which are rich in vitamins and micronutrients, would result in decline in nutritional quality of diets. Substitution of millets by wheat and rice, for example, does not augur well for poor consumers who cannot afford supplementary alternatives (NAAS 2001). Therefore, agriculture department should prepare appropriate location-specific strategies in encouraging farmers for millet production. The agriculture and nutrition departments can take up joint campaigns for educating about the nutritive value of finger millet and the importance of growing and consuming finger millet. This extension strategy can be integrated with Integrated Cereal Development Program (ICDP) that is being implemented by agriculture department. Such initiatives would support indigenous food-based systems for alleviating malnutrition.

8.3.5. Strengthening livestock and poultry enterprises

The Animal Husbandry department implements various schemes for the promotion of dairy and poultry enterprises without much co-ordination with other line departments. Agriculture and Horticulture Departments in co-ordination with Animal husbandry Department can develop an integrated farming system model suitable to the area taking into account the existing cropping pattern and other resources. Such efforts would maximize the profit from all the enterprises, including dairy and poultry enterprises. For the resource-poor farmers, recycling of agricultural byproducts for these enterprises would be more cost-effective and sustainable in the long run. Since women are involved considerably in dairy management and backyard poultry, any additional income gained through these enterprises would directly ensure better food and nutrition as women have a major say in food expenditure. Moreover, the improved physical access to milk and egg would

help the women to improve their nutrient intake in terms of protein, calcium, and iron.

In brief, effective participatory planning by Agriculture, Horticulture and Animal Husbandry departments in co-ordination with Health and Social welfare department would help to reorient the existing schemes and subsidies to address the issues of agricultural development, economic empowerment and sustainable nutritional security of the vulnerable farming households.

8.3.6. Proactive role by rural institutions

As of now, the rural development agencies like *Panchayat* Union at Block level and Village *Panchayat* follow top to down approach. They implement state level schemes that are routinely routed through them. What is required is a more proactive role of these institutions in collaboration with other development departments at the grass root level to identify first what are their needs and then addressing them through the program implementation. Poverty and food insecurity are highly correlated and therefore, schemes from rural development agencies would help to alleviate poverty, as these would help improve household nutritional security also.

8.3.7. Promotion of nutrient-rich indigenous crops

The Horticulture Department with the nutrition agencies can jointly identify micronutrient rich fruits and vegetables that are indigenously available in the region keeping in mind the beliefs, tastes and preferences of the local community. Special programs to revive the use of 'forgotten' indigenous fruits and vegetables rich in vitamin A and iron should be designed as part of the renewed nutrition strategy. Distribution of seeds and maintenance of nursery for such indigenous plants would be beneficial to the local community. For example, "*Moringa*" trees that are rich in vitamin A and iron can be introduced again. The horticulture department can provide feed forward information about indigenous plants. In turn, the State Agricultural University can develop nutrient-rich varieties from these indigenous plants.

8.3.8. Nutrition as an agenda in research

The agricultural regional research station can play a greater role in developing regional nutritional security plans and strategies in co-ordination with district level departments. Population living in the rice and sugarcane production systems suffers from relatively high level of micronutrient deficiency, like vitamin A. It is a good initiative that research systems at national level are

focusing on transferring pro-vitamin A gene into rice through biotechnology. This requires further attention. Such initiatives can be field-tested and their impact can be assessed for further refinement at the field level for alleviating malnutrition, which may be cost-effective in the long run. A study conducted in Kenya by International Center for Research on Women indicated that orange-fleshed sweet potatoes grown in on-farm trails performed well with respect to yield and pest resistance and also had a high beta-carotene content. This variety of potato contributed to the alleviation of vitamin A deficiency in the study area (ICRW 1999). In India also, on-farm experiments can be conducted at regional research stations of National Agricultural Research System. These studies warrant active participation of different developmental departments. *Krishi vigyan Kendras* (KVKs) can provide link with State Departments of Agriculture, Health Department, and Department of nutrition under Directorate of social welfare, etc.

8.3.9. Capacity building

Another area for interdepartmental linkages is capacity building. During the study, the discussions with the officials of the Directorate of Social Welfare and nutrition workers revealed that in A*nganwadi* centers, though the nutrition gardening was given importance as a part of intervention programs, its impact wasnegligible. A plausible explanation for the poor impact lies in the lack of technical know-how of nutrition workers and lack of adequate link with Horticulture and other departments. The Horticulture Department can train the nutrition workers in plant protection measures and other management practices for nutrition gardens. Nutrition gardening scheme needs to be further reoriented so that it serves the purpose of addressing the nutritional issues. While promoting nutrition gardening and its dissemination of related technologies, the nutritive value of fruits and vegetables and its importance in human nutrition need to be highlighted. This would sensitize farmers and village women and enhance greater adoption. Though nutrition gardening is not mainly for economic returns, it reduces household food expenditure and more significantly, the health expenditure arising out of malnutrition.

*KVK*s can train A*nganwadi* workers and farm women for developing nutritional gardens in their households. Training on other enterprises like, mushroom cultivation, apiculture and other value-addition activities would greatly benefit 'at-risk' households to generate additional income. For identification of trainees for kitchen gardening promotion schemes, health and nutrition department can provide list of 'at-risk' households to the horticulture department.

The extension functionaries in agriculture and allied departments lack awareness about nutritive value of crops, the knowledge about the crop varieties which have better nutritive values and the prevailing nutritional status in the area. As a result, this aspect of the message is missed during technology transfer to the farmers. Health Department and Directorate of Social Welfare are organizing a number of innovative communication activities. Sensitization and awareness creation workshops and orientation sessions are being organized for the beneficiaries as well as for the key functionaries of the project. Similar workshops can be organized for extension functionaries in agriculture and allied departments to increase the awareness on nutritive value of crops and other products. For the workshops organized by health and nutrition agencies, those functionaries can be invited to participate wherever it is applicable. State Agricultural Universities can organize joint training programs for nutrition and extension professionals. Nutrition education may be included in the undergraduate courses and at post-graduate level curriculum in State Agricultural Universities.

8.3.10.Innovative market institutions

It has been observed that resource-poor households living in areas of rice and sugarcane production systems experienced difficulty in physical access to fruits and vegetables, because, their consumption of these items was through market purchase. The poor economic conditions of these households limit their market purchase. Further, they were not in a position to get fresh vegetables and fruits because the rural market infrastructure was inadequate to preserve and sell the perishable commodities.

In an another study about horticultural development in Tamil Nadu, conducted by Rajasekaran (2002), marketing of horticultural produces emerged as the first and foremost important constraint, primarily due to unorganized marketing. Innovative market institutions with social marketing concept can be introduced. In this kind of marketing, along with sales, the nutrition education could also be carried out by displaying appropriate posters and other educational aids highlighting the nutritive value of fruits and vegetables. Horticulture department can start village cooperative sale units exclusively for the sale of fruits and vegetables. Social marketing is a viable technique, which can boost up the consumption of vegetables in non-vegetable production systems areas. For instance, Dangoria Charitable Trust, Non-Governmental Organization in Hyderabad, is successfully implementing home gardening and social marketing of micronutrient-rich fruits and vegetables in Narsapur *mandal* of Medak district of Andhra Pradesh. The activities were carried out jointly by horticulture, health and nutrition

functionaries. This project was implemented with the guidance of National Institute of Nutrition and Department of Science of Technology. The health and nutrition functionaries visit the village, and the nutrition and health values of fruits and vegetables are disseminated using educational aids. As a result, the consumption of those commodities by village population has gone up. The agricultural landless laborers, marginal and small farmers were greatly benefited (Bamji and Murthy 2000). Similar experiments can be carried out by the public sector on a large scale. The agriculture line departments can tie up with health and nutrition agencies in establishing such social marketing units.

8.3.11.Empowering local community

At present the people are passive receivers of governmental nutritional programs. There is a need to initiate people's participation in this direction. State Departments of Agriculture and Horticulture with Social Welfare Department and nutrition agencies can help in forming Self-Help Groups (SHGs) from out of 'at-risk' households and they can exchange ideas on improving their nutritional security. Training programs can also be organized for these SHGs. This SHGs approach can be useful for their own financial management, knowledge sharing, establishing grain bank, etc., In states like Orissa, Food Grain Banks have been found a useful means to tackle food insecurity. Households could borrow food grains from these banks during times of need and return the same amount, with marginal interest, in the form of food grain later. In some areas, food grain banks have been started with the contribution of food material from the community (Vijayraghavan 2000).

8.3.12. People's partnership in intervention programs

During the discussion with the ICDS officials, it was found that quality and quantity of supplementary feeding was one of the main concerns in implementing the schemes in a sustained manner. Even World Food Program endorsed this view. The food component was the largest single expenditure in ICDS. Efficient use of the food allocation is a prerequisite for sustainability and expansion of the program. However, many states are unable to provide adequate funding to maintain the level of beneficiaries at the end of the plan period. Budget constraints often result in reduction of rations and feeding days. To tackle this problem, at national level, World Food Program (WFP) has introduced Indiamix project to produce a nutritious product that is affordable for state governments to feed children and mothers at nutritionally critical times in their lives. Community level production of Indiamix has

generated income and employment and has encouraged the local agricultural production (WFP, 1997).

Drawing lessons from such successful experience, the following food-based model has been suggested to encourage people's participation in nutrition intervention programs with active role of agriculture department along with other departments. The development departments can jointly assist in the formation of large-scale cooperative community operations at the grass root level. These cooperatives can develop expertise on modern intensive bio-agro technological methods, production and processing of high nutritive value varieties of vegetables and fruits. State Department of Agriculture, KVKs, NGOs can organize training programs for rural unemployed youth in these subject matter areas. These trained youth would function as a liaison between co-operatives and State sponsored supplementary feeding programs. They would also assist in organizing social marketing concept-based local sale units.

Small scale agro-processing units can be organized. Such units would help in development of financially self-supporting enterprises producing for local commercial and institutional markets. These units can produce dehydrated leaf powder of Spinach, Moringa, Agathi, Spirulina, etc., The nutritive-rich products from these units would be useful in fortification of supplementary feeds which is being supplied through A*nganwadis*, and to supply rural and urban Markets.

8.3.13. Linkages and coordination model

Establishing of a sound institutional mechanism for effective linkage and co-ordination among development departments is a pre-requisite for the suggested strategies to get translated into action in the field. Such mechanism would make policy alternatives related to agricultural interventions for nutritional security more dynamic. The linkage and co-ordination model, suggested by Perumal and Ponnusamy (1994), can be conveniently modified to effectively implement the agricultural-based interventions for nutritional security with strong support of health and nutrition agencies, apart from other agriculture and allied departments. The modified model is given in Table 18. In this table, different interdepartmental coordination committees have been suggested at various levels for periodic monitoring and evaluation and to evolve dynamic policy alternatives from time to time. There would be two way vertical flow of communication among these committees across the hierarchical levels. The main emphasis of this coordinated model is on participatory planning, implementation and evaluation of development

Table 18. Interdepartmental linkages and the coordination model

State Level Coordination Committee	Sub-State Level Co-ordination committee	District Level Co-ordination Committee	Sub-division Level Co-ordination committee
One-day duration	One-day duration	One or two day duration	Two days duration
Half yearly	Half yearly (as and when required)	Bimonthly	Bimonthly
Structure			
• Chief Secretary (Chairman) • Secretaries and Directors of Agriculture, Health and Social Welfare and other development departments • Director of Extension Education of State Agricultural University • One or two representatives of NGO • Representatives from supporting organizations (if needed)	• Convenor-to be rotated among Directors of Development Departments • Directors of Agriculture, Health and Social Welfare and other development departments • Additional Directors of all Development Departments • Director of Extension Education • Non-Government Organizations • Representative from supporting organizations	• Convenor - to be rotated among the Joint Directors of Development Departments • Joint Directors of Agriculture, Health, Social Welfare and other development departments • Deputy Directors of Agriculture and other development departments • SAU Scientists • NGOs • Representatives from supporting agencies • A few selected farmers/ farm women, food-insecure households representative	• Convenor - to be rotated among Assistant Directors of Development Departments • Agricultural Development Officers and officers of same cadre from other development departments • NGOs and a few selected farmers, farm women, and representatives from food insecure households

Table 18. (Contd.)

State Level Co-ordination Committee	Sub-State Level Co-ordination committee	District Level Co-ordination Committee	Sub-division Level Co-ordination committee
Functions			
Making policy decisions on major issues relating to: • Orienting the overall extension work in line with the policies of the government concerning nutritional security • Assessing the overall requirement of resources and modalities of making them available to resource-poor farmers • Considering the recommendations and issues emerging from the sub-state level committee meeting • Suggesting suitable marketing strategies for the benefit of the poor community, especially for greater access to perishable	• Preparing action plan for the State as a whole based on the recommendations of the State level coordination committee meeting and the proposals received from the District level coordination committees • Working out the mechanism for better co-ordination among development departments at district level • Prioritizing the district needs based on nutritional status and other information received from development departments	• Preparing an action plan for the district as a whole based on the recommendations of the Sub-Divisional Meetings and the outcome of BLP meetings • Synchronizing the activities of the development departments in line with the sub-divisional priorities • Assessing and reviewing the progress of the nutritional status in all the sub divisions and making contingency plans whenever required • Working out the modalities of involving scientists, NGOs, other supporting agencies and farmers in the planning and implementation	• Analyzing the outcome of the BLP meetings and checking the interventions/ enterprises suitable for introduction in different blocks • Working out the modalities for involving the extension functionaries of development departments up to grass root level • Familiarizing the extension workers/ nutrition workers with the schemes/ priorities of all line departments • Analyzing the problems encountered during the implementation of intervention programs and finding solutions compatible and

Table 18. (Contd.)

State Level Co-ordination Committee	Sub-State Level Co-ordination committee	District Level Co-ordination Committee	Sub-division Level Co-ordination committee
nutritious foods • Guiding and counselling for better co-ordination among development departments • Evolving short-term and long term food and nutritional security plans for the State as a whole and at regions/ districts levels	• Fixing the goals and targets at district level • Working out the resource (schemes) allocation patterns for all the districts in line with the requirements, as proposed by the District co-ordination Committee meetings • Preparing agenda notes including major policy issues for placing before the State level meeting. • Fixing the date of next meeting and the convenor from among other Directors of Development departments	• Preparing agenda notes for Sub-State level meetings • Mobilizing and making available the resources • Assessing the training needs of grass root functionaries of each division • Fixing the date of next meeting and the Convenor from among other Joint Directors of development departments	feasible to all development departments • Assessing the progress of nutritional status in terms of its sustainability, and the impact of interventions programs on socio-economic status of the 'at-risk' households • Assessing the training needs of grass root level extension/ nutrition workers • Preparing agenda for placing before District level meetings • Fixing the date of next meeting and the Convenor from among the Assistant Directors of other Development Departments

programs. Coordinated efforts among development department may face unforeseen problems. Therefore, political will also essential to implement these polices and strategies to ultimately reach the goal of sustainable nutritional security.

8.3.14.The long-term strategy

Agricultural extension systems can draw policies such that agriculture can have a major intervention in improving nutritional status. The experiences and approaches followed by the extension system may be well applicable to translating food availability into nutrition security at the household level. It will be useful to test a system of nutrition extension on a pilot basis, combining the resources of several sectors acting at the village levels (Babu 2000). Once nutritional-friendly agricultural policies are framed and programs are implemented, it would serve as complementary and supplementary to those direct nutritional intervention programs. For instance, if the benefit of supplementary food component of the intervention programs can be substituted by the appropriate agricultural interventions having sound policy support, then the expenditure on such component would come down. Those resources could be diverted towards better health care and nutritional education programs. Similarly, if some target group of 'at-risk' households could be taken care of by the agricultural interventions, resources can be diverted to the more vulnerable group for providing direct intervention programs. In the long run, the expenditure on food intervention programs could be minimized.

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ANNEXURES

Annexure 1. Calorie intake in different states of India

State	Average intake per consumer unit per day kcal	Average per capita intake per day kcal	Calorie intake of the lowest decile (kcal) per cu/day
Andhra Pradesh	2559	2052	1858.39
Assam	2406	1983	1842.48
Bihar	2637	2115	1790.88
Gujarat	2470	1994	1788.34
Haryana	3109	2491	2022.33
Himachal Pradesh	2916	2324	2170.65
Karnataka	2575	2073	1803.85
Kerala	2451	1965	1556.33
Madhya Pradesh	2697	2164	1894.03
Maharashtra	2427	1936	1747.75
Orissa	2740	2199	1918.96
Punjab	3007	2418	2116.48
Rajasthan	3090	2470	2249.85
Tamil Nadu	2347	1884	1551.38
Uttar Pradesh	2899	2307	2103.15
West Bengal	2733	2211	2012.57
All India	2683	2153	1954.03

Source: Sarvekshana, Vol XXI, No.2 73rd Issue, (1997)

Annexure 2. Deficient calorie intake (per cu/day)

State	Percentage of Households consuming less than 1890 kcal
Andhra Pradesh	14.10
Assam	13.30
Bihar	14.10
Gujarat	20.40
Haryana	8.70
Himachal Pradesh	5.30
Karnataka	17.40
Kerala	23.70
Madhya Pradesh	12.20
Maharashtra	21.90
Orissa	10.40
Punjab	6.30
Rajasthan	4.20
Tamil Nadu	28.20
Uttar Pradesh	8.00
West Bengal	7.40
All India	13.40

Source: Sarvekshana, Vol XXI, No.2 73rd Issue, (1997)

Annexure 3. Protein calorie inadequacy

(Percentage of population with protein and/ or calorie deficiency)

State	P- C-
Andhra Pradesh	10.4
Assam	27.9
Bihar	12.3
Gujarat	2.5
Haryana	4.6
Himachal Pradesh	6.7
Karnataka	14.9
Kerala	19.9
Madhya Pradesh	19.7
Maharashtra	19.7
Orissa	24.1
Punjab	3
Rajasthan	15.0
Tamil Nadu	41.0
Uttar Pradesh	NA
West Bengal	NA

P: Protein C: Calorie + : Adequate – : Inadequate

Calorie Adequacy: 2425 kcal per consumer unit per day

Protein Adequacy: 60 gram per consumer unit per day

Source: Ministry of Human Resource Development, India Nutrition Profile (1998)

Annexure 4. Percentage of population with vitamin A deficiency

State	Percentage of population with Vitamin A deficiency
Andhra Pradesh	0.79
Assam	0.45
Bihar	0.35
Gujarat	0.20
Haryana	0.05
Himachal Pradesh	0.01
Karnataka	0.77
Kerala	0.25
Madhya Pradesh	2.62
Maharashtra	0.72
Orissa	0.86
Punjab	0.13
Rajasthan	0.56
Tamil Nadu	3.11
Uttar Pradesh	NA
West Bengal	NA

Source: Ministry of Human Resource Development, India Nutrition Profile, (1998)

Annexure 5. Profile of Dharmapuri district

Particulars	Number
Total population, No	24,28,596
Male, No	12,50,671
Female	11,77,925
Population density (per sq km)	249
Male Female ratio	944
Total workers	1162187
Male	716216
Female	445911
Literacy rate (%)	46.02
Total number of Blocks	10
Total number of *Panchayats*	588
Total number of villages	1106
Schools	
Primary	2120
Middle	217
High	156
Higher Secondary	78
Colleges	4
Hospitals	11
Primary Health Centers	18
Sub Primary Health Centers	62
Banks	40
Post Offices	564
Telephone Connections	9012
Theatres	142
Road length (km)	5796
Vehicles	18640
Rivers	3

Annexure 6. Land-use pattern in the study area

Particulars	District		Block	
	Dharam-puri ha	Srishna-giri ha	Kela-mangalam ha	Denkani-kota ha
Forest	366231	1648	28834	110762
Uncultivable fallow land	48982	162	2230	5948
Land put into non-agriculture use	43846	362	1688	4483
Fallow lands	15560	28	1467	3848
Permanent pastures and other grazing lands	12931	26	2032	3251
Land under miscellaneous crops. (Crops & groves not included in net area sown)	8558	37	536	7431
Current fallows	44003	197	2369	9997
Other fallow land	11124	26	899	2406
Net cultivable area	410694	2036	20648	56783

Annexure 7. Particulars of Integrated Child Development Service (ICDS) Scheme for Dharmapuri district

No. of *Anganwadi* Centers	691
No. of *Anganwadi* workers reporting	335
No. of Children 6 months-2Years	5702
Children (2 to 4)	28253
Mothers	4306

Annexure 8. Nutritional status of children in Dharmapuri district
(ICDS Project : Krishnagiri)

(in numbers)

Grade	Male	Female
Normal	5604	7770
I	5026	4661
II	2511	2574
III	31	70
IV	2	4

Annexure 9. Supplementary nutrition to beneficiaries

(in numbers)

Children								Women	
6 months to 2 years				2 to 4 years				ANC/PNC*	
En-rolled	Spot fed	Total W.F con-sumed	Avg. consum-ption	En-rolled	Children fed	Total W.F con-sumed	Avg. con-sumption	En-rolled	Actually received
13343	12396	24858	2	27589	25117	50234	2	10276	9603

*ANC: Anti-natal Clinic, PNC: Post-natal Clinic

Annexure 10. Number of A*nganwadi* workers and beneficiaries

Project	AWW reporting	Children		Mothers
		6 months-2 year	2+ to 4Years	
Thally	144	2560	5955	2263
Morappur	91	1770	3515	1137
Hosur	100	1372	3794	906

Annexure 11: Demography of selected sample villages

Particulars	Villages		
	Periyamuthur	Marasandaram	Thottanahalli
Number of households	177	354	278
Total population	757	1888	1424
Male population	390	1046	864
Female population	367	842	560
Number of SC households	20	40	35
Male literacy percentage	70	64	51
Female literacy percentage	48	41	38
Families below poverty line	47	52	43
No. of farm households <0.5ha	25	430	75
No. of farm households 0.5-1ha	45	270	50
No. of farm households 1-2ha	70	100	60
No. of farm households 2-3 ha	6	10	7
No. of farm households 3-4 ha	5	10	8
No. of farm households >4.0 ha	7	12	10

Annexure 12. Departmental visits for collecting secondary information

State level

- Directorate of Agriculture
- Directorate of Horticulture
- Office of Commissioner of Social Welfare

District level

- Office of District collector
- Office of Joint Director of Agriculture
- Office of Deputy Director of Horticulture
- Office of Joint Director of Animal Husbandry
- Office of Deputy Director of Health Services

Block level

- CDPO
- Office Block Development Officer
- Primary Health Centres
- Office of Agricultural Development Officer
- Office of Assistant Director of Animal Husbandry

Village level

Anganwadi centre
Panchayat office
Office of Village Administrative Officer

Annexure 13. Activities of Primary Health Center

1. Identification of malnutrition cases
2. Distribution of Vitamin A tablets for 6 month – 6 year old children
3. Distribution of de-worming and folic acid tablets
4. National immunization program: vaccination for DBT, BCG, Polio
5. Health education
6. Family welfare programs
7. National Tuberculosis (TB) Control Program
8. Family Welfare Scheme for Mother and for Child care
9. Eye Vision Scheme
10. School going children welfare scheme
11. ANT Care / Pregnant women care program

Annexure 14. Features of Integrated Child Development Service (ICDS) Scheme

Objectives:

1. To improve nutrition, health and psycho-social status of children of 0-6 years of age with particular emphasis on preventing malnutrition in under 3 years children and improve child care practices at the household level.
2. To improve nutrition and health of women particularly pregnant and breast-feeding mothers and adolescent girls, and
3. To empower women and adolescent girls through increased awareness to take better care of their personal and household health and nutrition issues.

Package of services delivered at *Anganwadi* Centres:

1. Growth promotion
2. Selective supplementary nutrition
3. Early childhood care and pre-school education
4. Nutrition and health education
5. Health services by health personnel (VHN/MO)
6. Referral services

Nutrition delivery services:

1. The children in 0-6 years age group are weighed every month regularly and their growth are monitored
2. Supplementary food is given to the children of 6-36 months for those who have not attained weight for age. The feeding is provided for a period of three months or till the child gets graduated.
3. Supplementary feeding is also given to Anti-natal Mother from the 6th month of pregnancy and up to 6 months after delivery.

The children of 3 to 6 years, Anti Natal mothers and old age pensioners are provided with noon meal. Nutrition balls are provided to 6-36 months old children based on their nutritional status.

Age	Nutrition status	
	Normal I and II	Grade III and IV
6 – 24 month	50 g	100g
24-36 months	100g	150g

Following nutrition mealas are provided to 37-60 months old children

Rice	80g	Rs.0.72
Dal	10g	Rs.0.15
Sambar, including vegetables	-	Rs.0.175
Total expenditure per child		Rs.1.045

Vitamin tablets are given to children and women

Annexure 15. Services at Health Sub-centre

1. Registeration of Anti-natal mother
2. Neo-natal care
3. Referral of high risk mother to Primary Health Centre
4. Post-natal Care
5. Immunization
6. Administration of Vitamin A
7. Management of Diarrhoea
8. Supply of Iron and Folic Acid
9. Acute respiratory infection management
10. Deworming

Annexure 16. Schemes of Horticulture Department

I. Integrated Horticultural Development Schemes

1. Area Expansion Program

Distribution of vegetables and fruits seeds / seedlings at 50% subsidy

Mango seedling distribution	100 seedlings/ha	Rs20/plant
Sapota seedings	160 seedlings/ha	Rs30/plant
Guava seedlings	270 seedling/ha	Rs8/plant
Lime seedling	270 seedling/ha	Rs2/plant
Jake fruits / Tamarind seedling	100 plants/ha	Rs30/plant
Tomato seeds *	400 gm/ha	Rs60/100g
Beans Seeds	12 kg/ha	Rs60/kg
Cabbage seeds	-	Rs70/10 g

*Subsidy Rs30 per Kg

2. Wasteland Development Scheme

- Identification of barren / waste land for improvement
- Construction of tanks / check dam with the help of Agricultural Engineering Department.
- Maximum 5 ha. / individual
- Coordinated project with Agriculture department. 50% subsidy to all the inputs

3. IHDS – Special Component Program

- Mainly for SC and ST
- Providing technical know-how about all the horticultural crops
- Other components are same as that of IHDS area expansion scheme

4. Mango Demonstration

- Target groups: Small and Marginal Farmers.
- Distribution of inputs worth of Rs2000 per acre for improvement of orchards
- Provision of plant protection chemicals and fertilizers

5. Tree Planting in Educational Institutions

- To create awareness about tree planting and its importance among school children

- Provision of Rs500 worth seedlings
- Twenty five schools per district
- Technical knowledge to be provided to the children by Horticulture Officers (HO) and Assistant Agricultural Officers

6. Nutrition Garden

- Mainly for development of nutritional garden in the farmers field / homestead
- Ten seedlings / house are provided for 50 families
- Rs50/- worth seedlings or seeds are provided

7. Tropic Arid Zone

- Distribution of specific crops inputs for increasing the area, production and productivity and in the Tropic Arid Zone
- Rs3500/ha worth inputs are given mainly for small and marginal farmers and SC and ST farmers.

8. Root and Tubers

- Rs200 worth seed material is distributed free of cost e.g. Sweet Potato, Potato

II. Other schemes

9. Improving Productivity

Rs.1200/ha are given as subsidy to improve the productivity of mango, guava, sapota and miscellaneous crops

10. Mushroom Cultivation

- Rs500/ beneficiary with 100% subsidy
- One-day training with free inputs

11. Vegetable Minikit Program

- To popularize the hybrid vegetables
- Rs180 worth of inputs with 50% subsidy
- Distribution of seeds mainly for small and marginal farmers and SC and ST farmers

Annexure 17. Schemes of Department of Agriculture

1. Bio-fertilizer distribution scheme

(50% subsidy)

Azospirillum	Rs5/- packet
Phosphobacteria	Rs5/- packet
Rhyzoibum	Rs5/- packet
Micronutrient	Rs18.50/-kg
Blue green algae (BGA)	Rs2/- packet
Green leaf manure seeds	Seeds distributed Rs.10/ kg

2. National Pulses Development Program (NPDP)

- Objective: to increase the area, production and productivity of the pulse crops
- The target groups small and marginal farmers.

1. Distribution of black gram, green gram and cow pea seeds: 20 kg of any of the seeds for maximum one ha/farmer.

Black gram	Rs37/kg;*
Cow pea	Rs27/kg;*
Green gram	Rs35/kg;*

* Subsidy Rs3/-kg

2. Distribution of seed treatment chemical:
100 gram / ha. ; 50% subsidy.

3. Procurement of foundation Seeds:
Procurement from farming community. Local market rate + premium of Rs. 4 for one Kg

4. Compact block demonstration
Demonstrations in 10 ha. in the selected fields with 50% subsidy for all the inputs. Maximum area per farmer is one ha.

3. Integrated Cereal Development Program

Paddy seeds	Rs.12/kg with Rs.2/kg subsidy
Finger millet	Rs.4/kg
Pearl Millet	Rs.4/kg

Other schemes

State Schemes:

- Tamil Nadu Women in Agriculture (TANWA)
- Minikit program for coarse cereals
- Intensive cultivation demonstration of coarse cereals in SC/ST areas

Centrally-sponsored Schemes:

- Accelerated maize development program under Technology mission on maize
- Mechanization of agriculture assistance to small and marginal farmers

Annexure 18. Schemes of Block Development Office

1. Anna Marumalaratchi Thittam (AMT)

The village having more than 600 population and predominantly occupied by the SC & ST. Based on decision desired by the *Gram Sabha*, the development work has been implemented.

2. Namakku Nama Thittam

To involve the people's participation in the development work, 10% of the share is obtained from the people and 90% of the share is provided by Government and the work is implemented by the people themselves based on their felt needs.

3. Employment Assurance Scheme

Those who registered their names with the *Panchayat* Office as a laborer will be benefited through this scheme

4. MLA and MP Area Development Scheme

MLA – 50 lakh alloted by the State Govt. for their constituency development.
MP – 1 crore – for developing their constituency

5. Jawahar Grama Sabha Yojana (JGSY)

Central scheme – based on the population and situational needs, the fund will be shared work will be implemented based on the *Grama sabha* decision

6. Swarana Jayanthi Yojana Scheme (SGY)

SGY as same as that of JGSY.

7. Indira Awaas Yojana (IAY)

It is a special project for home constructions and well diggings

8. Central Rural Sanitation Program

Toilets would be constructed and given to the beneficiaries on a sharing basis of 50: 50 percentage.

9. State Finance Commission, Tenth Finance Commission, District Decentralized Program

Provision of:

- Safe drinking water
- Roads
- Lights
- Drainage facilities.

10. Million Wells Scheme

Providing subsidy for digging of wells for the vulnerable groups

11. Integrated Rural Development Program (IRDP)

Implemented up to 1999

12. Dhoti and Saree Gifts Scheme

Implemented through RDO and VAO, distributing *Dhoti* and *Saree* to the people below poverty line for *Pongal* festival

13. Community TV Programme

Installation of TV and construction of a TV room for every village for the benefit of community. (village people).

14. Provision of Basic Amenities

- Water supply
- Street light
- Link road for more than population 500
- Bituminus tar road for more than population 1000
- School building.
- Health campaign
- PDS building

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It is a good piece for publication.

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Center for Development and Policy Studies, Thanjavur and
Former Vice chancellor, Tamil Nadu Agricultural University, Coimbatore

This is a very good paper and brings out fact-based evidence and suggestions for achieving an important objective of sustainable nutritional security.

S.S.Acharya, Director
Institute of Development Studies, Jaipur

This manuscript if introduced in a book form will serve as a tool for the policy planners.

A.Susheela Thirumaran, Vice Chancellor
Thiruvalluvar University. Vellore

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