SOCIAL AND ECONOMIC CHANGE MONOGRAPHS

60

Contemporary Issues in Indian Agriculture

Edited by
Meenakshi Rajeev

NABARD

INSTITUTE FOR SOCIAL AND ECONOMIC CHANGE

Bangalore
(ISEC is an ICSSR Research Institute,
Government of India and the Grant-in-Aid
Institute, Government of Karnataka)

UNDERSTANDING THE LINKS BETWEEN FARMER'S INCOME AND NUTRITIONAL STATUS: A PANEL DATA ANALYSIS IN THE SEMI-ARID TROPICS OF INDIA

Padmaja Ravula, Soumitra Pramanik and Kavitha Kasala

Abstract

Despite the strong economic growth, India continues to perform poorly on its nutritional indicators. The literature seems to suggest that there is a disconnection between economic growth and nutrition. The increasing understanding of nutrition and the shifting landscape of malnutrition in India and across the world has led to a focus on diet quality, an important ingredient for enhancing the nutritional status of women, men, boys and girls. There is a void in data and metrics on nutrition, especially linking to agriculture. This lack of data and evidence has led to little knowledge about dietary patterns, and limited understanding of how economic growth, agriculture, trade, food industry and health policy may be used to improve diet quality. Drawing extensively on micro-level data from 433 households covering eight villages of Andhra Pradesh, Telangana and Maharashtra, this paper basically attempts to answer the question on whether enhancing farmer's income will lead to better food and nutrition security and therefore focuses on understanding how increases in income may have impacted on the nutrition of the members of the household. The data was collected from 2009 to 2014 as part of the Village Dynamics Studies in South Asia (VDSA) by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). Diet quality was measured using the dietary diversity scores calculated based on the consumption expenditure pattern. The analysis reveals significant changes in expenditure patterns on different food groups both temporally and spatially. Simpson Diversity Index on food expenditure varies from 0.81 to 0.86 in all the selected households across the three regions on an average. The food expenditure diversity among the sample households varies from 70 percent to 90 percent in the entire study period. Further, using Body Mass Index (BMI) as an outcome variable in all the study villages, obesity and overweight was showing an increasing trend while underweight and normal nutritional status were found to be stable. The Tobit regression analysis

revealed that income and food expenditure play a significant role to enhance the household's nutritional status. It can be inferred that, though improvements are made in reducing under nutrition, tendencies towards overweight or obesity are increasing. The paper suggests that diversification of agriculture towards high value commodities like fruits and vegetables can improve the diversity in the diets of the rural population especially for women, children and adolescents and thus bring about the desired nutritional outcomes.

Keywords: Income, Dietary Diversity, Consumption Expenditure Pattern, Semi-Arid Tropics, Tobit Regression.

3.1. Introduction

The semi-arid regions where small holder farming is dominant; with about115 million more mouths to feed between now and 2020; continue to be plagued by a myriad of issues ranging from poverty, malnutrition, environmental degradation, conflicts to climate related stresses (Ryan and Spencer, 2001; Sharma *et al* 1996, Dar 2011). There is a corpus of literature that clearly identifies the potential of agriculture to accelerate improvements in nutrition (examples include Gillespie *et al*, 2013; Kadiyala, 2014; Omotayo *et al*, 2016). Changes in agricultural practice over the past 50 years have increased the world's capacity to provide food for its people through increases in productivity, greater diversity of foods and less seasonal dependence. Food availability and affordability has also increased as a consequence of rising income levels and falling food prices. This has resulted in considerable changes in food consumption over the past 50 years (Kearny, 2010).

Food systems, diets, nutrient intakes and nutrition status are complex, multi-faceted phenomena which require multiple measures to understand. Food systems that diversify beyond subsistence farming and include fruits, vegetables, legumes and animal products result in improved nutritional status. Increasing understanding of nutrition and the changing nature of malnutrition have increased interest in diet quality as well as quantity especially in south Asia. Owing largely to the apparent lack of national and sub-national level data about diets and diet quality, there is little knowledge about dietary patterns, and little understanding of how agriculture, trade, food industry and health policy may be used to improve diet quality.

The global prevalence of stunting has fallen by 35% since 1990, and while there remain about one billion people in the world who lack adequate food, twice that number suffer from micronutrient deficiencies

(Black *et al* 2013; FAO 2013; UNICEF 2014). Agriculture is of fundamental importance to human nutrition, both as a direct determinant of household food consumption and through its role in livelihoods and food systems. There is a growing understanding that agricultural development provides an obvious and needed entry point for efforts to improve nutrition. At the same time, agricultural investments targeted to smallholder farmers are more likely to succeed if they address the human capital constraints due to malnutrition (FAO, 2013).

India has experienced remarkable economic growth in recent years and remains one of the fastest growing economies in the world. However, poverty and food insecurity are still areas of concern in spite of great strides on many fronts. In 2016, India ranked 97 among 118 developing countries according to the Global Hunger Index (GHI). About 15% of under-5 children still suffer from 'wasting' and 39% from stunting. According to NFHS-4 data, though 58.4% of children remain anaemic in 2015-16, there has been a substantial improvement from 2005-06 levels by 11 percentage points. Incidence of anaemia among pregnant women has gone down by about 8 percentage points between 2005-06 and 2015-16: from 57.9% in 2005-06 to 50.3% in 2015-16. About 53% of the non-pregnant women (15-49 years) suffered from anaemia in 2016 as compared to 55.2% in 2005-06. On the other side of the pendulum, incidence of obesity has almost doubled over the decade ending 2015-16: from 9.3% to 18.6% among men and from 12.6% to 20.7% among women. Thus, while the food security situation is progressively improving, access to balanced and diverse food continues to be a concern for the vulnerable populations in India (RIS, Niti Aayog, 2017). There is also evidence that provide support for the view that increases in household incomes will in turn improve the nutritional intake (JG Ryan, 1977, Bhargava 1991, Deolalikar, 1987, Behrman and Deolalikar 1990).

India continues to be a key global agricultural producer, irrespective of the declining share of agriculture in the economy (Binswanger, 2013). It has the world's largest area under cultivation for wheat, rice, and cotton, and is the world's largest producer of milk, pulses, and spices. Agricultural productivity in the country's semi-arid tropical region is constrained by water scarcity and recurring drought. In case of rural communities, especially in the harsh environment of semi-arid tropics of India, there is uncertainty in income both farm and non-farm which affects their overall well-being including nutrition. The argument then, is enhancing smallholder productivity and income in a sustainable manner, will lead to rural poverty reduction and thereby leading to enhanced food and nutrition security. With this view, the

present paper tries to understand the linkages between income, consumption expenditure pattern and its impact on the nutritional outcome of the agricultural households in the Semi-Arid Tropics (SAT) of India.

3.2. Materials and Methods

Sample and study population:

This paper uses data from Village Dynamics Studies in South Asia (VDSA)[1]. The analysis presented in this paper is based on a sample of 433 households covering individuals in the age group of 15-50 years for the period 2009-2014. These households belong to eight locations in Andhra Pradesh, Maharashtra and Telangana states of India (table 3.1).

Table 3.1: List of Villages and Sample Panel Households Selected for the Study

State	District	Climatic Characteristics	Village	Number of households
Andhra Pradesh	Prakasam	Semi-arid, assured rainfall	JC Agraharam	35
			Pamidipadu	38
Maharashtra	Akola	Semi-arid, assured rainfall	Kanzara	62
			Kinkhed	48
	Solapur	Semi-arid, transported/ canal water	Kalman	57
			Shirapur	85
Telangana	Mahbubnagar	Semi-arid, Drought prone	Aurepalle	63
			Dokur	45
Total				**433**

Source: ICRISAT VDSA data set, 2009-2014

Data used for the study:

Three types of data are extracted from the VDSA database and analysed in this paper: a. data on the socio-economic-demographic variables for the selected sample respondents and households; b. anthropometric data namely height and weight of individuals; and c. monthly consumption expenditure data. The socio-economic variables used in this paper include family size, education levels of the head of the household, per-capita income and location

---

among others. Data for all the variables was collected using a standardized questionnaire by trained investigators.

Anthropometric data (height and weight) were recorded from members of the households following the recommended methods and using standardized equipment's procured from a company named SECA[2]. Body Mass Index (BMI) was calculated for each sample respondent from the same households for 2009-2014. Using internationally accepted BMI guidelines and norms (WHO, 1995), the respondents were classified as follows:

Underweight / chronic energy deficiency   : BMI< 18.5

Normal category   : BMI between 18.5 to 24.9

Overweight   : BMI > 25.0

Data on consumption expenditure were collected through the monthly recall method from the selected households, by the resident investigators in the villages during the study period. The food and non-food consumption expenditure values were estimated using the real prices with the base year as 2009-10 equal to 100. In addition, food consumption expenditure was further classified into food groups as indicated in FAO (2013) to better understand the consumption behaviour of the households by food groups.

Descriptive statistics such as percentages and Compound Growth Rate (CGR) were estimated to illustrate the trends in income, food expenditure, non-food expenditure and nutritional status (BMI). The determinants of malnutrition (underweight and overweight) has been estimated using Tobit regression analysis. The dependent variables in the regression model considered percentage of underweight and percentage of overweight among total household's adult members (age between 15 to 50 years) using two separate models. The study includes dependent variables that range from 0 to 100, therefore using Tobit regression method has been justified.

---

[2] SECA- It is a German company that develops, produces and sells weighing scales and measuring instruments.

3.3. Results and Discussion

3.3.1. Trends in Annual Household Income (farm and non-farm)

Among the three regions, sample households belonging to the two study villages in Andhra Pradesh have higher per capita total income compared to other two regions. The total per-capita income of the respondents from villages of Maharashtra and Telangana is relatively lower compared to the Andhra Pradesh villages (Figure 3.1). This is because of the characteristics of the regions selected for the study.

Figure 3.1: Trends in Per Capita Total Income, 2009-14, VDSA Study Locations
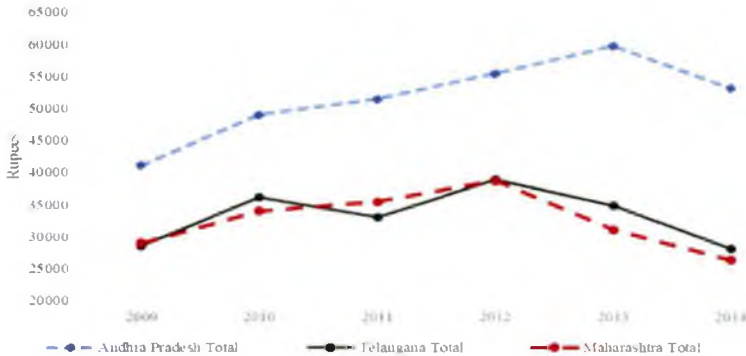
Source: ICRISAT VDSA data set, 2009-2014

Table 3.2 describes the trends in annual household income for the years 2009-2014. The analysis of the income data for the Andhra Pradesh sample households presents that both farm income (5.98 percent) and non-farm income (5.48 percent) increased leading to an overall increase in the household total income by 5.70 percent. In Telangana villages, farm income increased by 2.78 percent while non-farm income reduced by 3.27 percent overtime, indicating stagnation of household income (CGR is only -0.11%). In the Maharashtra villages, it was found that farm income decreased by 3.94 percent while non-farm income increased by 1.23 percent leading to about 2 percent decrease in overall total household income. This is an interesting observation that the villages in Maharashtra are basically agriculture based economies wherein the pathway of development in these villages has been through intensification of agriculture, thus the primary source of income was through agriculture (Walker and Ryan, 1990; Rao

KPC and Kumara Acharyulu D, 2007, Deb *et al*, 2014). The decrease in farm income in these villages calls for additional enquiry which is beyond the scope of this paper.

Table 3.2: Households wise Per-capita Income in Constant Price (2009-10=100) (in INR)

Year	Andhra Pradesh			Telangana			Maharashtra		
	Farm	Non-farm	Total	Farm	Non-farm	Total	Farm	Non-farm	Total
2009	24119	16967	41086	18337	10664	28544	18337	10664	29001
2010	25813	23125	48938	21724	12256	36093	21724	12256	33980
2011	25779	25684	51463	20881	14533	33021	20881	14533	35414
2012	30548	24816	55364	22647	15970	38863	22647	15970	38617
2013	34115	25475	59590	17573	13478	34771	17573	13478	31051
2014	29614	23425	53038	15461	10768	28033	15461	10768	26229
CGR (%)	5.98	5.48	5.70	2.78	-3.27	-0.11	-3.94	1.23	-1.94
CV (%)	13.26	13.98	12.19	14.20	16.34	12.86	14.20	16.34	13.93

Source: ICRISAT VDSA data set, 2009-2014

3.3.2. Trends in Expenditure Pattern

Table 3.3 shows the proportion of annual income allocated to food and non-food expenditure components (that are classified as education, health and other non-food expenditure) in the selected households across the three regions. The share of food expenditure with respect to total expenditure in Telangana region is lower compared with the other two study regions. Also trends in food expenditure share reveals increased share of food expenditure in Maharashtra households, while it is significantly decreased in Telangana (2.71 percent) and Andhra Pradesh (2.53 percent) households.

For a better understanding of the expenditure patterns in food and non-food categories, a further disaggregation was done for both the broad categories and presented below (table 3.3). In order to understand the trends in total non-food expenditure, it was further divided into three components: expenditure share in education; health; and all other expenditures (that includes outside eating, buying jewellery, two wheeler, spending on weddings, ceremonies, rituals and other social events) of the households. With respect to education, the descriptive statistics reveal an overall decrease in expenditure on education in all the three study regions (table 3.3). This might be due to provision of free school education called Sarva Shiksha Abhiyaan (SSA)[3] and various education scholarships targeted for social groups like backward classes or targeted towards the regions, in this case the semi-arid regions. Health is an important indicator of nutritional and overall wellbeing of an individual and therefore the share of expenditure on health care was purposively derived for a better understanding of the nutritional outcome. The results reveal that there is an increased trend in expenditure on health across all the three regions, highest being in Andhra Pradesh followed by Telangana and Maharashtra.

---

[3] Sarva Shiksha Abhiyan is an Indian Government program aimed at the universalization of elementary education

Table 3.3: Households wise Distribution of Food and Non-food Expenditure (in percentage)

Year	Andhra Pradesh				Telangana				Maharashtra			
	Food	Non-food expenditure			Food	Non-food expenditure			Food	Non-food expenditure		
		Education	Health	All others		Education	Health	All others		Education	Health	All others
2009	57.67	11.49	9.51	79.00	44.84	11.68	15.09	73.23	54.70	8.93	10.93	80.14
2010	53.22	11.91	9.46	78.63	45.69	10.10	16.18	73.73	51.32	8.69	9.95	81.35
2011	45.60	11.32	15.39	73.29	45.44	10.94	15.16	73.90	53.74	6.06	8.57	85.37
2012	48.76	10.58	15.12	74.30	43.18	10.58	21.36	68.07	54.13	6.63	9.81	83.56
2013	51.12	10.67	14.44	74.89	40.20	10.21	20.74	69.05	55.66	7.28	11.60	81.12
2014	48.71	8.18	20.27	71.55	40.34	10.31	18.51	71.17	58.13	7.18	10.57	82.25
CGR (%)	-2.53	-3.60	9.84	-1.78	-2.71	-1.09	3.95	-1.20	1.60	-2.61	0.82	0.29

Source: ICRISAT VDSA data set, 2009-2014

The food expenditure was further categorized into expenditure on various food groups to understand the quantitative and qualitative changes in dietary intake in the selected regions. Simpson's dietary diversity index was calculated to understand the diversity in the food consumption based on the food expenditure data. The analysis indicates an increase in per capita diversity of foods consumed in sample households of Telangana and Maharashtra villages. The per-capita diversity in foods expenditure significantly decreased in Andhra Pradesh households (table 3.4).

To understand the shifts in the energy density of the diets i.e., energy from carbohydrates to energy from fat source, a macro perspective followed by the micro-perspective is elucidated. Literature reveals that analysis of the food balance sheets from the Food and Agriculture Organization (FAO) show that the change in energy intake in Asian countries has been small, but there have been large changes in consumption of animal products, sugars and fats. The net effect has been a marked shift in the diet with energy from fat (both animal and vegetable) increasing each year. A similar trend is observed from the analysis of the food expenditure data of the agricultural households in the selected regions. In Andhra Pradesh households, the share of expenditure on cereals (8.31 %), eggs (1.22%) and all types of fruits (3.78%) has risen while in case of Telangana and Maharashtra households, an increasing trend of share of expenditure on eggs (14.42%; 5.40%), milk and milk products (14.59%; 4.73%), fish and meat (2.46%; 10.66%) and all types of fruits (13.14%; 4.38%) was observed during the period 2009-2014. The Simpson diversity index revealed an increase in diversity in Telangana and Maharashtra households while it has reduced in Andhra Pradesh households. This result holds significance in explaining the nutritional outcome in the following section.

In summarizing the above discussion, the findings by Behrman and Deolalikar (1987) continue to hold good even during the present survey period. The authors argue that in Telangana and Maharashtra households, food expenditures will increase more or less proportionally to income-but the marginal increments in food expenditures will not be devoted primarily to obtaining more nutrients. Perhaps with more education about the relation between nutrients and other food characteristics or with development of food varieties in which the nutritional benefits are more highly associated with the food attributes that consumers value highly at the margin, stronger associations between nutrient intakes and increases in income could be developed as opined by Behrman and Deolalikar (1987).

Table 3.4: Share of Different Food Items in Total Food Expenditure (%)

Food items	2009 to 2014					
	Andhra Pradesh		Telangana		Maharashtra	
	Average expenditure	Growth rate (%)	Average expenditure	Growth rate (%)	Average expenditure	Growth rate (%)
Cereals	34.23	8.32	30.69	-1.37	22.79	-4.16
Pulses	7.50	-8.86	5.72	2.16	10.17	-5.81
Eggs	1.26	1.22	1.13	14.42	1.16	5.40
Milk and milk products	19.95	-2.49	11.11	14.59	15.40	4.73
Oil	5.82	-0.99	7.93	6.32	12.05	-0.41
Vegetables	10.55	-3.85	14.46	-6.38	14.12	2.94
Fruits	4.14	3.78	2.16	13.14	4.53	4.38
Fish and meat	7.76	-2.68	13.09	2.46	7.86	10.66
Spices and condiments	7.04	-9.60	10.98	-10.68	4.21	3.57
Sugar and Gur	1.75	-12.18	2.73	-9.49	7.71	-8.46
Simpson diversity index	0.81	-1.57	0.83	0.37	0.86	0.22

Source: ICRISAT VDSA data set, 2009-2014

3.3.3. Changes in Nutritional Status

Table 3.5 shows the trends of the nutritional status of the households across three regions. The analysis revealed dual burden of malnutrition- an increasing trend of overweight/obesity while under nutrition continues to prevail in these households. Further analysis of the data showed that proportion of overweight individuals is increasing in Telangana (24.40%) households followed by Maharashtra (10.66%) and Andhra Pradesh (0.50%) households. Owing to this trend, the individuals in the normal category are tending to decline in Telangana and Maharashtra households. In case of underweight/under nutrition, there is a decreasing trend across all the three regions. The fact remains that on an average about 42% of the sample individuals continue to be malnourished – either under – or over-nourished. These findings clearly substantiate that despite India's economic growth, poverty and malnutrition remain at a high level.

Table 3.5: Nutritional Status of Individual Members of the Household in the Study Regions (in percentage): Using BMI as an Indicator

Year	Andhra Pradesh			Telangana			Maharashtra		
	Normal	Over weight	Under weight	Normal	Over weight	Under weight	Normal	Over weight	Under weight
2009	59.76	23.67	16.57	58.82	2.35	38.82	56.67	7.94	35.40
2010	58.58	23.08	18.34	56.72	6.72	36.57	56.95	11.36	31.69
2011	59.43	24.00	16.57	58.43	7.45	34.12	56.39	11.67	31.94
2012	58.72	23.84	17.44	55.11	7.11	37.78	55.94	11.59	32.46
2013	61.54	23.08	15.38	56.15	9.43	34.43	55.82	12.41	31.77
2014	61.68	24.55	13.77	55.74	8.94	35.32	52.40	15.32	32.28
CGR (%)	0.84	0.50	-3.92	-1.02	24.40	-1.57	-1.30	10.66	-1.24

Source: ICRISAT VDSA data set, 2009-2014

Figures 3.2a, 3.2b and 3.2c further reveal that over the years, the proportion of households with all members having normal BMI is reducing in all the study locations - Andhra Pradesh, Telangana and Maharashtra. The figures also illustrate that the underweight, overweight and normal individuals exist in the same households. These findings align with the macro-picture clearly noticed in many South Asian countries and especially India. Despite India's economic growth, poverty and malnutrition remain at a high level. About 60 million - almost half of India's child population are underweight (Gragnolati, 2006). At the same time, south Asia is rapidly moving through the nutrition transition (Popkin, 1994, Shetty, 2001, Ramachandran, 2011). Obesity rates among adults, especially among women are rising, not just in urban areas, but also in rural areas. Associated with this, there has also been a rapid expansion in the prevalence of non-communicable diseases, so that over nutrition will soon be as large (if not larger) a public health problem than under nutrition even in rural areas. Also, these two problems—of undernourished children, and over nourished adults (women)—often coexist within a household, suggesting that more than household-level constraints, access issues (access to sanitation, assets etc.,) and the intra-household issues and constraints warrant attention.

Figure 3.2a: Household Level Nutritional Status in Andhra Pradesh
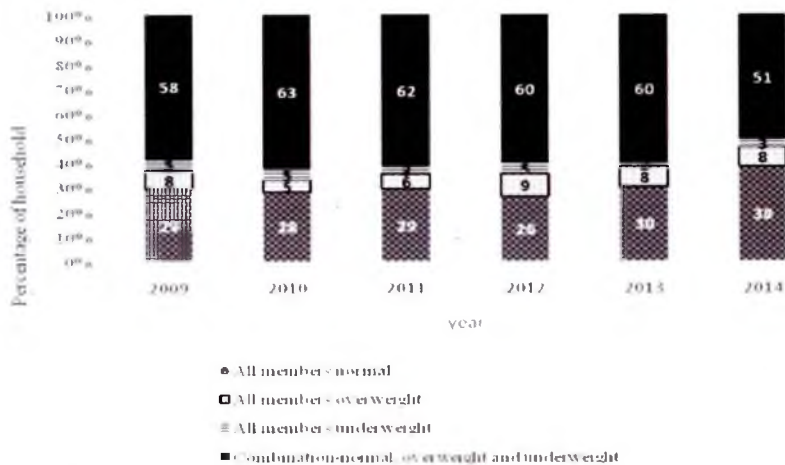
Source: ICRISAT VDSA data set, 2009-2014

Figure 3.2b: Household Level Nutritional Status in Telangana
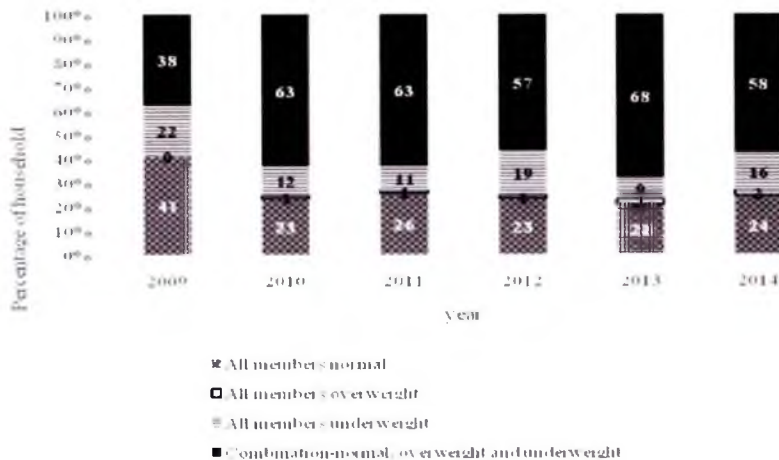
Source: ICRISAT VDSA data set, 2009-2014

Figure 3.2c: Household Level Nutritional Status in Maharashtra
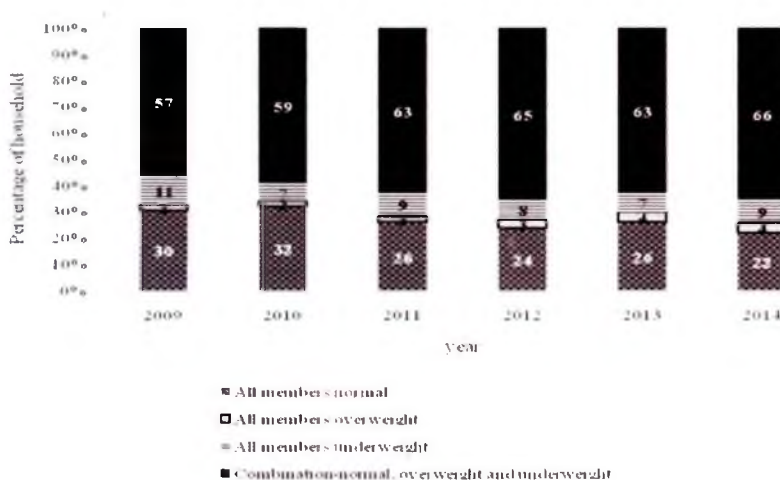
Source: ICRISAT VDSA data set, 2009-2014

3.3.4. Determinants of Household Nutritional Situation

One of the major outcome indicator which represent members as well as household nutritional status is BMI. The present study uses Tobit regression model to find out the variables that have an either a positive or a negative impact on the household's nutritional status. Percentage of underweight and percentage of overweight adult members in a household are considered as the dependent variables in the study. Two separate models have been estimated to find out the determinants of underweight and overweight among household members. Table 3.6 represent the Tobit regression output. From model-1, which estimated the determinants of underweight, it is found that education of household head had a significant role to reduce the underweight. Income is one of the important factor towards nutritional security. Analysis showed that increase in current income status led to an increase in the level of underweight individuals in the household upto a certain level. However, when the current income level of the households reaches to double or more, the percentage of underweight members reduced significantly. Further, the level of underweight individuals per household in Maharashtra and Telangana region have been significantly higher than that of Andhra Pradesh region. The determinants of overweight in the sample households have been estimated in model-2. The results revealed that increase in the education level of household head have a

positive relation to percentage of overweight in the households because it leads to increase in income and also change in their diets and eating behaviour. At current income level, increase in per capita income led to significant reduction in the percentage of overweight members in the households, whereas in case the current income level doubles, it inversely affects the nutritional status of the households. Also, increasing income across the households affect the current status of the food habits as well as the expenditure on non-food items. Also, level of overweight in the selected locations of Andhra Pradesh are significantly higher than that of Maharashtra and Telangana. Though the covariate "proportion of micronutrient to macronutrient expenditure" is not significant but then also it can be said that expenditure on food should not be concentrated on single food groups. It should be balanced and diverse to achieving better nutritional status of the household members specially to reduce under nutrition.

Table 3.6: Determinants of Malnutrition in the Study Regions – A Tobit Regression Analysis

Variables	Model-1 (Percentage of Underweight)	Model-2 (Percentage of Overweight)
Dependency Ratio	0.018	2.571
Household head years of education	-0.936***	2.770***
Per-capita income in constant price (2009-10=100)	0.013*	-0.005*
Double of per-capita income in constant price (2009-10=100)	-0.007*	0.002*
Ratio of food and non-food expenditure (%)	1.275	-10.937***
Proportion of micro-nutrient to macro nutrient expenditure	-6.800	10.255
Region dummy -Maharashtra (Reference region - Andhra Pradesh)	27.897***	-28.998***
Region dummy -Telangana (Reference region - Andhra Pradesh)	33.862***	-41.989***
Constant	7.445	-32.996***
Number of observations	2348	2348
Probability> chi²	0.000	0.000
Log likelihood	-7743.127	-4119.790

Source: ICRISAT VDSA data set, 2009-2014

Note: *** p<0.01, ** p<0.05, * p<0.1

3.4. Conclusions

The present paper attempted to understand the linkages between household income, consumption expenditure on nutritional status of farm households in the semi-arid regions of Andhra Pradesh, Telangana and Maharashtra in India. The analysis of farm and non-farm income of the agricultural households revealed a significant decrease in farm income especially in the agro-based economies of Maharashtra while it is more or less stable in Andhra Pradesh and Telangana regions. This calls for an in-depth enquiry on the cropping pattern, agricultural diversification and livelihood diversification thereby resulting in more stable household farm incomes along with non-farm incomes in the study regions.

The long-term analysis of the per-capita income among sample households showed an increasing trend, that has significant impact on household food and non-food expenditure. The analysis of household per capita income (an important determinant of malnutrition), indicates when current income tends to increase or almost doubles, the prevalence of underweight decreases in the study regions. However, as the income increases, the prevalence of overweight also increases, thereby the prevalence of malnutrition continues but in different variants. Therefore, it is concluded that enhancing the farmer's income would reduce undernourishment nonetheless results in continuation of the malnutrition in the form of overweight among the households of Semi-Arid Tropics. The paper confirms the arguments in literature that income is clearly one of the most important determinants of food insecurity and hunger but not malnutrition. Increase in household income eradicates or minimizes hunger but would not help in reducing malnutrition, as malnutrition is multi-dimensional with its linkages with socioeconomic, agro ecological and other extraneous factors that reflect the nutritional status.

Therefore, it can be concluded that policy makers in less-developed countries should view nutritional status not merely as an end in itself (Deolalikar, 1988) but also as an important and powerful means to increase labour productivity and thereby economic growth.

3.5. Future Recommendations

There are three important research recommendations from this study. The first recommendation is that a multi-dimensional approach is needed to bring out improvements in nutritional outcomes in the rural communities of India. The findings above clearly suggest that linkages between household income, agriculture and nutrition are complex, requiring

a multi-faceted and multi-sectorial approaches to tackle malnutrition problems, especially in the fragile environment – technological, socio-cultural, political, erratic climate- of the semi-arid tropics.

A second recommendation is empowering the rural communities – women, men, boys and girls – to view nutrition as important and actually understand what good nutrition means. Rural households must be empowered by enhancing their awareness and knowledge regarding human nutrition, health and sanitation. In spite of the Swachh Bharat Mission (SBM)[4], good sanitation and hygiene practices are yet to trickle down to the remote rural villages.

A third recommendation stemming out indirectly from the analysis, is importance of the home production of nutrient-rich food crops for enhancing the diversity in the diets and thereby improving the nutritional outcomes. Establishing the practice of growing homestead gardens and the importance of consuming seasonal foods such as vegetables and green leafy vegetables can influence the intake of a micronutrient-rich diet and consequently affect nutritional outcomes. This also suggests that the diversification of agriculture towards high value commodities like fruits and vegetables along with raising incomes, can improve the diversity in the diets of the rural population especially in the SAT regions and thus bring about the desired nutritional outcomes.

---

[4] Swachh Bharat Mission (SBM) is a campaign under the Ministry of Drinking Water and Sanitation in rural India that aims to clean up the streets, roads and infrastructure of India's cities, smaller towns, and rural areas. The objectives also include eliminating open defecation through the construction of household-owned and community-owned toilets and establishing an accountable mechanism of monitoring toilet use.

References

Behrman, J R and A B Deolalikar (1987). Will Developing Country Nutrition Improve with Income? A Case Study for Rural South India. *Journal of political Economy*, 95 (3): 492-507.

———————— (1990). The Intra Household Demand for Nutrients in Rural South India: Individual Estimates, Fixed Effects and Permanent Income. *Journal of human resources*, 665-696.

Bhargava, A (1991). Estimating Short and Long Run Income Elasticities of Foods and Nutrients for Rural South India. *Journal of the Royal Statistical Society*, Series A (Statistics in Society), 157-74.

Binswanger-Mkhize, H P (2013). The Stunted Structural Transformation of the Indian Economy. *Economic and Political weekly*, 48 (26-27): 5-13.

Black, R E, C G Victora, S P Walker, Z A Bhutta, P Christian, M De Onis, ... and R Uauy (2013). Maternal and Child Undernutrition and Overweight in Low-income and Middle-income Countries. *The lancet*, 382 (9890): 427-51.

Chand, R (2017). *Doubling Farmers' Income Rationale, Strategy, Prospects and Action Plan*.

Dar, W D (2011). Dryland Agriculture in Semi-arid Tropics: Constraints and Opportunities. *Indian Journal of Dryland Agricultural Research and Development*, 26 (1): 1-7.

Deb, U, C Bantilan and G V Anupama (2014). Drivers of Change: Dynamics of Rural Livelihoods and Poverty in SAT India. *Research Bulletin No. 26*.

Deolalikar, A B (1988). Nutrition and Labor Productivity in Agriculture: Estimates for Rural South India. *The Review of Economics and Statistics*, 406-13.

FAO, I (2013). *WFP: The State of Food Insecurity in the World 2013. The Multiple Dimensions of Food Security*. Rome: FAO.

Gillespie, S, L Haddad, V Mannar, P Menon, N Nisbett and Maternal and Child Nutrition Study Group (2013).The Politics of Reducing Malnutrition: Building Commitment and Accelerating Progress. *The Lancet*, 382 (9891): 552-69.

Gragnolati, M (2006). *India's Undernourished Children: A Call for Reform and Action*. World Bank Publications.

Kadiyala, S, J Harris, D Headey, S Yosef and S Gillespie (2014). Agriculture and Nutrition in India: Mapping Evidence to Pathways. *Annals of the New York Academy of Sciences*, 1331 (1): 43-56.

Kearney, J (2010). Food Consumption Trends and Drivers. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365 (1554): 2793-2807.

Omotayo, A O, B R Aremu and O P Alamu (2016). Food Utilization, Nutrition, Health and Farming Households' Income: A Critical Review of Literature. *Journal of Human Ecology*, 56 (1-2): 171-82.

Popkin, B M (1994). The Nutrition Transition in Low-income Countries: An Emerging Crisis. *Nutrition Reviews*, 52 (9): 285-98.

Ramachandran, P (2011). Nutrition Transition in India. *Bulletin of the Nutrition Foundation of India*, 32 (2): 1-8.

Rao, K P C and D Kumara Charyulu (2007). *Changes in Agriculture and Village Economies*. International Crop Research Institute for Semi Arid Tropics.

Ryan, J G (1977). Human Nutritional Needs and Crop Breeding Objectives in the Indian Semi-arid Tropics. *Indlan Journal of Agricultural Economics*, 32 (3): 78-87.

Ryan, J G and D C Spencer (2001). *Future Challenges and Opportunities for Agricultural R&D in the Semi-arid Tropics*. International Crops Research Institute for the Semi-Arid Tropics.

Sharma, M, M Garcia, A Qureshi and L R Brown (1996). *Overcoming Malnutrition: Is there an Ecoregional Dimension?* (Vol. 10). International Food Policy Research Institute.

Shetty, P S (2002). Nutrition Transition in India. *Public Health Nutrition*, 5 (1a): 175-82.

UNICEF (2014). *Committing to Child Survival: A Promise Renewed. Progress Report 2013*. New York: UNICEF.

Walker, T S and J G Ryan (1990). *Village and Household Economics in India's Semi-arid Tropics*. Johns Hopkins University Press.

WHO (1995). Physical Status: The Use and Interpretation of Anthropometry. *WHO Technical Report Series 854*. Geneva.

SOCIAL AND ECONOMIC CHANGE MONOGRAPH SERIES