Application of AIDS model to analyse the farm household food demand elasticity: Evidence from panel data

V. Khed[1]; U. K.b.[2]

1: University of Agricultural Science, Bengaluru, Agricultural Economics, India, 2: University of Agricultural Science, Bengaluru, Department of Agricultural Economics, India

Corresponding author email: vijayalaxmikhed39@gmail.com

Abstract:

This study examines the responsiveness of major food commodities consumption expenditures to changes in total consumption expenditures and to changes in the price of those food commodities. The study uses LA-AIDS to derive farm household food demand elasticity using farm household panel data. The results revealed that, food consumption patterns and demand elasticities were quite different across farm size groups. The estimated income elasticities for food commodities showed that, elasticities were lowest for cereals groups and highest for high valued nutritious horticultural and livestock food products. The analysis of price and income effects based on the estimated demand system has recommended that with increase in food prices, the demand for staple food may not be affected adversely but, that of high-value food commodities is likely to be affected negatively. If increase in food commodity prices are ignored for an extended period of time, there will be adverse impact on the food diversification and resuming the cereal based consumption resulting in under-nourishment. The policy makers should take appropriate policy strategies for different farm size groups. It is better to distribute subsidized nutritive food and milch animals to achieve the food and nutritional security instead of providing financial benefit to farm households.

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JEL Codes: C33, R22

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Abstract

This study examines the responsiveness of major food item consumption expenditures to changes in total consumption expenditures and to changes in the price of those food commodities. The study uses Linear Approximation -Almost Ideal Demand System(LA-AIDS) with normalized prices to derive farm household food demand elasticity for the period 2009-2014 using VDSA, ICRISAT farm household panel data. The results revealed that, food consumption patterns and demand elasticities were quite different across farm size groups. The estimated income elasticities for food commodities showed that, elasticities were lowest for cereals groups and highest for high valued nutritious horticultural and livestock food products. The analysis of price and income effects based on the estimated demand system has recommended that with increase in food prices, the demand for staple food may not be affected adversely but, that of high-value food commodities is likely to be affected negatively. Therefore, the study suggests that if increase in food commodity prices are ignored for an extended period of time, there will be adverse impact on the food diversification and resuming the cereal based consumption resulting in under-nourishment. Therefore, the policy makers should have to take appropriate policy strategies for different farm size groups. It is better to distribute subsidized nutritive food commodities and milch animals to achieve the food and nutritional security instead of providing financial benefit to farm households.

Key words: Farm households, food demand, demand elasticity, expenditure, price and LA-AIDS.

JEL Classification: Q1, Q11,Q18, R22,N35

Introduction

Fluctuations in net farm income and aggregate rural consumption patterns can dramatically affect the well being of farm households. This has been witnessed in recent years, declining farm size, periods of low farm income and high farm debt may have contributed to a decline in the economic stability of many farm households. Knowledge of the income (expenditure) and price elasticities for farm households consumption items helps farm households anticipate inventory needs, make pricing decisions and reduce adverse impacts of declines in the agricultural economy (Carriker *et al*., 1993).

In India, according to agricultural census 2010-11 the agriculture and allied activities engaged 54.6 percent of the country's workforce compared to 69 per cent in 1983, while its share in the gross domestic product (GDP) declined from 40 per cent to 17 per cent during this period. Further, the Indian agriculture is dominated by small landholdings and the average size of landholding has shrunk to 1.15 ha in 2010-11 from 1.84 ha in 1980-81 (Annual report-2016-17, Government of India). Given these trends, there arises a basic question: how far farm households consumption and food security would survive on such tiny pieces of land?. Despite, the rising per capita household income and changes in the prices of food commodities tend to induce greater changes in the composition of food consumption. During food inflation, the most frequent strategy of households is the substitution of low priced food commodities to high priced food commodities with close nutritional content. Nevertheless, the results of this strategy in most cases are inefficient to maintain healthy diet, which lead to malnutrition. At present, malnutrition is a major public health disaster in India with 32.7 per cent of the population suffering from it and Karnataka state is no exception (Umanath *et al*., 2015). Karnataka state is one of the emerging economies of India. It is the 7^{th} largest Gross Domestic Product (GDP) producing state in India with 5.5 per cent to the national GDP. Despite the declining share of agriculture sector in Gross State Domestic Product(GSDP), it remains main source of livelihood for majority of population in the state. Karnataka state with ten agro-climatic zones, finds diversity in regional agricultural production. These agro-climatic zones of the state produces food grains, millets, oil seeds, fishery, livestock and horticultural commodities. However, it is disheartening to note that though state has made significant progress in agriculture, industry and service sectors, the state is lagging behind to achieve similar drive in food security front. Prevalence of underweight

children, high mortality rate under five years of age and percentage of stunted children under three years of age are more in Karnataka compared to other south Indian states (NFHS III, 2005-06).

Against this background, we examined farm households consumption pattern in the context of rural Karnataka with an exclusive focus on consumption of food items by farm households using panel data. There are number of studies by considering farm households food consumption and expenditure patterns for different income groups of households or for a specific category households (Kumar *et al*., 2011, Umanath *et al*., 2015 and Umanath *et al*., 2016). Nonetheless, studies on farm households consumption are limited (Carriker *et al.*, 1993). Very few studies have analysed consumption pattern and demand elasticity in circumstance of households by using panel households data (Kang, 1983) through AIDS (Almost Ideal Demand System) model. The shortage of data has conditioned very much the empirical work in demand analysis. The almost exclusive focus on cross-section data for estimating demand systems could be explained by the limited availability of panel databases or the difficulty for handling panel data from an econometric point of view. But households are heterogeneous and panel data provide a useful source for testing consumption behaviour (Calvet and Comon, 2000).The estimation of food demand in the context of farm households is not there for the country in general and for rural households in particular. The use of farm households panel data in describing households food demand in farm households is a first attempt. The use of panel data allows for controlling individual households heterogeneity and provides a good estimation of both cross-sectional and temporal variation of food demand. These analyses provide complete and fully specified food demand systems, effectively including all households expenditures on all food groups in an attempt to develop a comprehensive view of farm households food choice. The major constraint in this empirical analysis was that, the assumption of farm households are homogeneous among the farm size category and explanatory variables are non-stochastic. The data were pooled and conventional LA-AIDS (Linear Approximation- Almost Ideal Demand System) was applied. The purpose of this study is to describe farm households food consumption pattern and how households alter expenditures for individual consumption items as the total consumption expenditure level and prices change by computing demand elasticity across different farm size groups. This objective is met by estimating expenditure , own-price and cross price elasticities for food consumption food consisting of seven food expenditure categories for

a sample of Karnataka farmers over the period of 2009-2014 panel farm households data through LA-AIDS model.

Data and Methodology

Data

This study is based on households level panel data collected by International Crop Research Institute for Semi-Arid Tropics (ICRISAT) under the Village Dynamics Studies in south Asia (VDSA)[1] project. These data are comprehensive households, individual and plot level records collected from selected villages on a continuous basis over several years. During data collection, the resident investigators re-interview the participating farm households several times per year so as to capture the dynamics of the farm households, including their expenditure, income, consumption, investment and farming practices. For the estimation of food demand elasticity, data sets from 2009 - 2014 were used to capture the cross-sectional and temporal price variation. From these data sets, we extracted and used the data for Karnataka State separately. The farm households come from different rainfall zones representing varied infrastructural and socio-economic conditions. The data referred to the average per capita consumption of all the food commodities in the sample farm households. The per capita expenditure was considered as a proxy for income and therefore, these have been used interchangeably in this paper. For the analysis purpose, we have classified commodity groups into cereals, pulses, edible oils, milk and milk products, vegetables & fruits, egg & meats and others. Quantum of calorie intake by the farm households were calculated by multiplying total consumption of a particular food item with conversion factors given by Gopalan *et al*., (2014).

Based on their land ownership status, farm households is divided into five farm size groups: Marginal (Up to 1 ha), Small (1.01 to 2.0 ha), Semi-medium (2.01 to 4.0 ha), Medium

[1] The VLS are longitudinal surveys initiated by ICRISAT in 1975 in 10 semi-arid tropical Indian villages. The surveys continued for the next 10 years, before formally closing in 1985 in response to budgetary pressure. The surveys were re-opened in 2002 in the initial six villages, starting with low frequency rounds and with higher frequency interviews since 2005–06. Subsequently in 2008, the programme was redesigned under the title, 'Village Dynamics in South Asia (VDSA), extending the activities to Karnataka and other parts of India and Bangladesh. This initiative was funded by the Bill and Melinda Gates Foundation (BMGF) and implemented in India in collaboration with Indian Council of Agricultural Research (ICAR), State Agricultural Universities (SAUs) and other local organizations. The VLS data however cannot be treated as representative data for districts, states or the agro-climatic region within which the villages are located due to the relatively small sample coverage.

(4.01 to 10.0 ha) and Large (10.01 ha and above). These definitions are used by the Government of India (Agriculture Census 2010-11). Distribution of the farm households according to the farm size groups is presented in Figure 1. Among the farm households, majority of the households were of marginal farm size (48.55 % of total sample) followed by small farm size (22.40 %) and semi-medium farm size (14.69 %). Only 4.59 percent of the households were of large farm size group while 9.80 percent were medium farm size category. The percentage change in land holding across years reveals that, there is decrease in percentage of marginal farmers and increase in other farm size groups. This is mainly because, marginal farmers are moving from agriculture to non-agricultural activities for sustained income generation as fluctuations in price of agricultural commodities is leading to instability in total income.

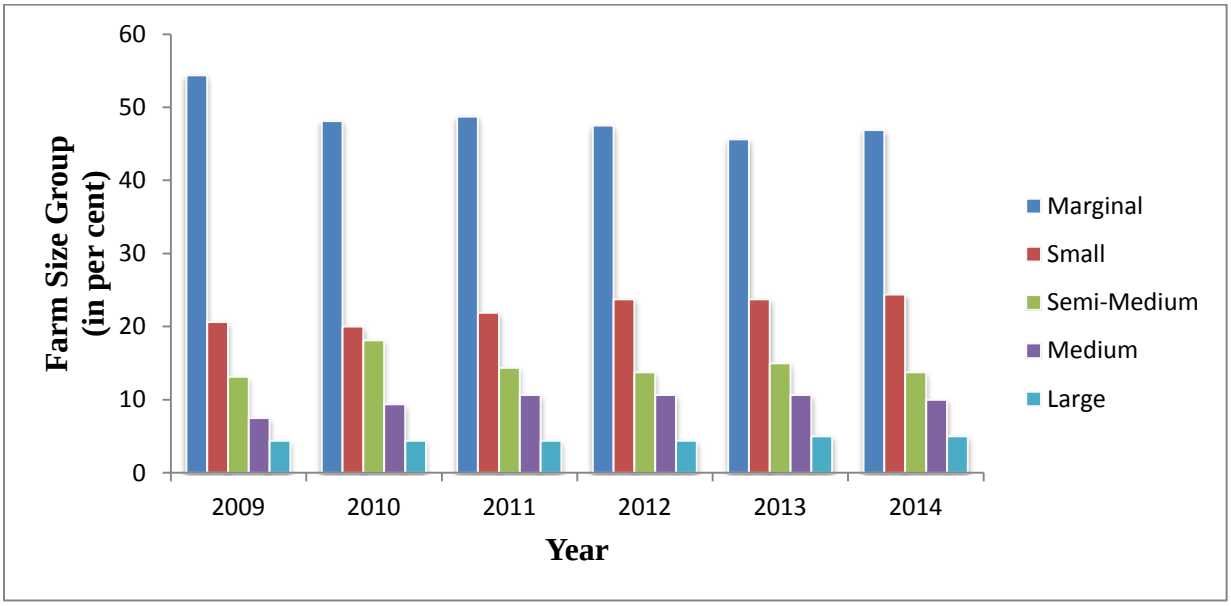

Figure 1. Distribution of the households according to farm size groups

Model specification

The econometric AIDS model has used for testing the households consumption behaviour and demand elasticities and its linear approximation (LAAIDS) was applied in examining the income, own price and cross-price food demand elasticities for major food commodities across different farm size groups. The Almost Ideal Demand System (AIDS) proposed by Deaton and Muellbauer (1980) is probably the most popular demand system in empirical demand analysis. Although the AIDS model is more than 25 years old, this functional form is still widely used (Chambwera and Folmer 2007; Kumar *et al*., 2011 and Umanath *et al*., 2015) because it unifies almost all theoretical and empirical desirable properties. For instance, the linear approximation

of the AIDS (LA-AIDS) using the Stone price index, which is applied in most empirical studies (Carriker *et al.*, 1993 and Guta, 2012). The LA-AIDS model with normalized price was estimated separately for each of the seven food groups. Panel data model were fitted using pooled OLS (Ordinary Least Square) estimations.

The AIDS model is based on a constrained utility- maximizing household expenditure function of the form:

$$\log m(u, p)=\alpha_0+\sum_{k=1}^{n} \alpha_k \log p_k + \frac{1}{2} \sum_{k=1}^{n} \sum_{j=1}^{n} \gamma_{kj} \log p_j + \mu\beta_0 \pi_{k=1}^{n} p_k^{\beta k} \quad \text{..... (1)}$$

where α_k, β_o, β_k, and γ_{kj} are parameters and u is the utility level achieved from expenditure level m given prices P_k. The demand equations, in budget share form, derived from (1) are,

$$w_i=\alpha_i+\sum_{j=1}^{n} \log p_j + \beta_i \log \left(\frac{m}{p}\right) \qquad i=1, 2, ...n \quad \text{..... (2)}$$

where α_i, γ_{ij}, and β_i are parameters; p_j and m are as defined earlier; and P is a general price index defined as:

$$\log P=\alpha_0+\sum_{k=1}^{n} \alpha_k \log p_k + \frac{1}{2} \sum_{k=1}^{n} \sum_{j=1}^{n} \gamma_{kj} \log p_k \log p_j \quad \text{..... (3)}$$

Theory-based conditions of adding up, homogeneity and symmetry may be statistically imposed on equation (2) as:

Adding Up

$$\sum_{i=1}^{n} \alpha_i = 1, \sum_{i=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \beta_i = 0 \quad \text{..... (4a)}$$

Homogeneity

$$\sum_{j=1}^{n} \gamma_{ij} = 0 \quad \text{..... (4b)}$$

Symmetry

$$\gamma_{ij} = \gamma_{ji} \; for \; i \neq j \quad \text{..... (4c)}$$

One advantage of the AIDS model is that the homogeneity and symmetry restrictions are easily imposed and tested.

Essentially, the intercept term in equation (2) is composed of a "true" intercept and a weighted average hybrid index of household demographic attributes (Deaton and Muellbauer, 1980). Use of aggregate time series data to estimate an AIDS model often requires the exclusion of variables for demographic characteristics; such specifications assume that all households have the same tastes. Use of primary data permits the decomposition of the intercept term (Carriker *at el.*, 1993) and is accomplished by re-specifying α_i in equation (2) as:

$$\alpha_i= \alpha_i^*+ \sum_{q=1}^{S} a_{iq} d_q \qquad i=1,2,3.....n \quad \text{..... (5)}$$

where α_i* is the "true" intercept, a_{iq} are parameters and d_q are binary variables representing demographic attributes of the household. Equation (5) implies that demographic characters are incorporated into the analysis through a process known as demographic translating. Substituting (5) into (2) gives

$$w_i=\alpha_i^*+\sum_{q=1}^{S} a_{iq}d_q + \sum_{j=1}^{n} \gamma_{ij} log p_j + \beta_i log(\frac{m}{p}) \quad \text{..... (6)}$$

The resulting adding-up conditions consistent with Equation (4a) are now:

$$\sum_{i=1}^{n} \alpha_i^* = 1,\ \sum_{i=1}^{n} a_{iq} = 0, \sum_{i=1}^{n} \gamma_{ij} = 0, \sum_{i=1}^{n} \beta_i = 0 \quad \text{..... (7)}$$

The general price index defined by Stone (Deaton and Muellbauer 1980) is commonly used in place of P from equation (3), and is specified as:

$$\log P^*_t=\sum_{i=1}^{n} \bar{w}_{it}(log p_{it}) \quad \text{..... (8)}$$

where P_t is a general price index in year t, w is the mean household budget share for expenditure item i in year t, and p_{it} is the price index for budget item i in year t. Green and Alston (1990) showed that when the price index in equation (8) is used in the AIDS model, resulting in the linear approximate AIDS model (LA-AIDS) and α_i*, β_i and γ_{ij} are the coefficients of the LA-AIDS. The analyses were done by free statistical software "R" using the add-on packages "micEconAids".

Result and Discussion

Farm households food consumption and calorie intake

Engels' Law on food demand appears to be fully operational in India, as it is evident from the declining income elasticities for food with rise in income (Kumar *et al*., 2011) and land holding size. In the past few decades, economists had closely followed the trend in cereals consumption and demonstrated that the per capita consumption and demand had leveled-off (Kumar, 1998 and Deaton & Jean, 2009). It is widely believed that though food security has been achieved at the national level but food security continues to be vulnerable at households level. However, agriculture is backbone of India and 54.6 percent of households dependent on agriculture for their livelihood. Farm households are more vulnerable with respect to food grain consumption as food grain production is more fluctuated due to changes in biotic and abiotic factors than the non-farm households. Therefore, a study on changes in food consumption and expenditure pattern at farm households level have great significance. The consumption pattern, obviously different from that of the non-farm households, since farm households are the net seller of food commodities and any changes in production will affect their consumption. This

section provides empirical evidences on the nature and extent of changes in consumption patterns and demand elasticity of farm households across different income groups in Karnataka.

Food consumption pattern of farm households

The consumption pattern of farm households significantly differ from non-farm households (Lee and Keith, 1971) because in case of farm households, the consumption of particular food item depends on production of that particular food item on his land than his income level. Since most of farm households are semi-commercial. Basically, farm households produce crops to meet his basic consumption requirement rather than market oriented production. Whereas in non-farm households consumption of particular food item depends on his income level. Therefore, the per capita consumption of major food commodities across different farm groups is computed and presented in Table 1. The per capita consumption of all food commodities except coarse cereals and meat, fish & egg items was found higher in large farm households in all the years except in rice. These differences exist on account of self production of food items. The per capita consumption of coarse cereals has declined substantially over the years. The consumption of high value cereals like rice has increased in marginal and small farm households but it has decreased in semi-medium, medium and large farm households. Whereas consumption of wheat has increased in all the farm size groups. It is due to increased per capita income as well as easy availability of these grains from the public distribution system and also higher productivity of crops in all farm size groups. Nevertheless, total cereal consumption has declined in semi-medium, medium and large farm households by 2.55, 3.71 and 5.55 percent, respectively due to consumption of diversified horticultural and livestock products. But consumption of total cereals has increased in case of marginal and small farm households by 2.55 and 3.82 percent, respectively due to easy accessibility from PDS. Similarly, there was decreasing trend in case of pulses across farm size groups due to increased real price of pulses and also adverse climatic condition. The rate of decline in consumption of pulses ranges from 33.88 to 14.33 percent. The per capita consumption of edible oil, vegetable & fruits, milk & milk products and meat, fish & egg in all farm size groups has increased. In addition, this increase was quite substantial in lower classes of farm households. Consumption of milk & milk products was higher in large farm size households whereas, meat, fish & egg was high in marginal and small farm size households. Since, most of the large and medium farm size households are vegetarians, their consumption solely dependent on plant products.

Table 1. Annual per capita consumption of major food commodities by farm size groups

(kg/person)

Food commodity	Farm size groups	2009	2010	2011	2012	2013	2014	% change 2009-14
Rice	Marginal	46.89	52.79	52.87	54.86	55.68	58.74	25.27
	Small	49.32	51.66	52.65	52.54	56.63	58.44	18.49
	Semi-Medium	49.83	45.50	43.01	42.14	41.64	41.99	-15.73
	Medium	50.39	47.93	47.37	45.33	43.02	42.80	-15.06
	Large	53.10	52.75	49.37	49.39	47.86	46.73	-12.00
Wheat	Marginal	25.28	20.65	23.72	24.38	27.36	29.01	14.75
	Small	26.05	26.12	27.42	28.59	29.82	31.98	22.76
	Semi-Medium	32.69	36.02	34.49	37.85	39.18	42.25	29.24
	Medium	43.45	45.97	46.11	46.38	47.96	49.60	14.15
	Large	57.75	59.83	61.34	61.54	62.89	63.37	9.73
Coarse cereals[2]	Marginal	61.76	53.29	48.47	48.05	46.61	49.60	-19.69
	Small	58.42	58.02	50.07	50.80	48.64	48.48	-17.01
	Semi-Medium	57.19	56.14	54.78	55.67	53.47	51.91	-9.23
	Medium	52.17	52.16	51.66	49.02	49.52	48.20	-7.61
	Large	49.47	49.52	43.92	43.24	42.07	41.32	-16.47
Total cereals[3]	Marginal	133.93	126.73	125.06	127.29	129.65	137.35	2.55
	Small	133.79	135.80	130.14	131.93	135.09	138.90	3.82
	Semi-Medium	139.71	137.66	132.28	135.66	134.29	136.15	-2.55
	Medium	146.01	146.06	145.14	140.73	140.50	140.60	-3.71
	Large	160.32	162.10	154.63	154.17	152.82	151.42	-5.55
Pulses	Marginal	17.71	13.14	11.94	12.31	13.38	11.71	-33.88
	Small	18.90	16.74	15.64	15.44	14.61	13.79	-27.04
	Semi-Medium	19.55	18.93	16.23	15.89	15.39	14.79	-24.35
	Medium	23.03	22.94	20.55	20.35	18.11	18.43	-19.97
	Large	30.50	29.95	28.83	27.95	27.23	26.16	-14.23
Edible oils	Marginal	7.38	6.72	7.46	7.37	7.43	8.05	9.08
	Small	7.77	7.39	7.01	8.39	8.54	8.77	12.87
	Semi-Medium	8.84	9.47	8.93	9.07	9.43	10.23	15.72
	Medium	9.45	10.39	11.69	12.15	10.46	11.88	25.71
	Large	11.28	10.24	11.33	12.46	13.12	14.44	28.01
Vegetables & fruits	Marginal	32.53	34.09	31.20	36.75	39.18	44.07	35.47
	Small	43.16	44.32	45.43	49.07	50.06	53.12	23.08
	Semi-Medium	45.04	49.08	49.52	53.18	57.33	61.80	37.21
	Medium	51.28	55.76	56.62	56.83	63.14	68.62	33.81
	Large	62.31	64.11	66.28	59.98	67.19	73.01	17.17
Milk & Milk products	Marginal	29.68	34.20	23.34	27.21	25.08	38.33	29.14
	Small	32.70	40.39	28.96	28.96	29.92	39.76	21.59
	Semi-Medium	34.26	32.26	28.77	36.95	38.62	41.31	20.58
	Medium	69.86	77.28	76.18	65.42	68.58	78.05	11.72
	Large	72.44	64.77	74.44	78.71	82.47	89.97	24.20
Meat, fish & eggs	Marginal	3.15	3.29	3.47	3.75	3.97	4.08	29.52
	Small	3.60	3.82	3.31	3.19	3.84	4.47	24.17
	Semi-Medium	2.41	2.95	2.32	2.88	3.38	2.91	20.75
	Medium	2.55	2.95	2.56	2.07	2.95	2.84	11.37
	Large	2.16	2.18	2.22	2.29	2.42	2.39	10.65

[2] Coarse cereals includes sorghum, maize, finger millet, pearl millet

[3] Total cereals includes rice, wheat and coarse cereals

Food expenditure pattern of farm households

Farm households expenditure on food commodities were computed and presented in Table 2. Across different food groups, cereals dominated in budget allocation in the total food expenditure of all the farm size groups. It was as high as 52 percent in marginal farm households followed by small (50.33 %), semi-medium (49.87 %), medium (44.58 %) and large (42.68 %). It was found that cereals tend to receive maximum share with respect to expenditure on food commodities across farm size groups with a consistent decline across the years. The decline of 17.20 percent was observed in marginal farm households followed by semi-medium (16.84 %), small (16.39 %), large (13.57 %) and medium (11.87 %) farm size groups. The share of vegetables and fruits in total food expenditure has shown maximum change in total food expenditure across farm size groups. And the important observation is that, particularly across marginal, small and semi-medium farm size groups, it was 29.71, 33.73 and 30.04 percent, respectively. Similarly budgetary allocation to edible oils has shown the second maximum rise, after vegetables and fruits, particularly across marginal, small and semi-medium farm size groups, it is 22.11 percent for marginal and 24.96 per cent for small and 26.94 per cent for semi-medium farm households. In the total food expenditure, the share of milk has shown a considerable rise; it was maximum for marginal (34.52 %), small (25.81 %) and semi-medium (20.83 %) groups. Contrastingly, the rise in budgetary allocation to milk was nominal by medium (6.00 %) and large (5.80 %) farm households. The budgetary allocation to meat, fish and eggs in total food expenditure has depicted a consistent rise across all the farm size groups. The share of total food expenditure on other food commodities has revealed an increasing direction across different farm size groups.

There was significant decline in budget allocation to pulse across all farm size groups. The decline was observed to the extent of 8.42 per cent to 26.71 per cent across farm size groups. From the result it is clear that, the reduction (11.87 % - 17.20 %) in the budget allocation to cereals was been diverted to high value nutritive products like vegetables & fruits, milk & milk products and meat, fish and eggs across all farm size groups. This reveals that increasing nutritional consciousness of the farm households as well as their urge to divert consumption from traditional cereal based consumption to more nutritious food items. This bent was visible for marginal, small and semi-medium farm households than the medium and large farm households.

Table 2. Food expenditure share of major food commodities by farm size groups

(in per cent)

Food commodity	Land holding size	2009	2010	2011	2012	2013	2014	% change 2009-14
Cereals	Marginal	52.74	50.17	46.67	46.64	43.77	43.67	-17.20
	Small	50.33	48.69	47.56	46.11	43.21	42.08	-16.39
	Semi-Medium	49.87	47.39	46.16	44.69	42.63	41.47	-16.84
	Medium	44.58	43.30	42.66	42.33	39.53	39.29	-11.87
	Large	42.68	41.29	40.71	39.67	39.33	36.89	-13.57
Pulses	Marginal	5.48	5.87	5.14	5. 11	4.65	4.86	-11.31
	Small	5.69	5.95	5.45	5.15	4.38	4.17	-26.71
	Semi-Medium	5.73	5.13	5.05	4.63	4.70	4.64	-19.02
	Medium	6.24	6.15	5.84	5.68	5.51	5.43	-12.98
	Large	6.41	6.22	6.19	6.11	5.84	5.87	-8.42
Edible oils	Marginal	6.65	6.87	7.16	8.07	7.85	8.12	22.11
	Small	6.97	7.01	6.78	7.72	7.77	8.71	24.96
	Semi-Medium	6.57	7.21	7.59	7.79	7.96	8.32	26.64
	Medium	7.67	7.60	7.80	8.12	8.13	8.73	13.82
	Large	7.29	7.49	8.32	8.42	7.58	8.17	12.07
Vegetables & fruits	Marginal	9.74	9.62	9.41	13.12	13.26	11.66	29.71
	Small	9.31	10.61	10.76	11.66	12.29	12.45	33.73
	Semi-Medium	10.12	11.24	11.44	12.90	14.04	13.16	30.04
	Medium	10.49	12.82	12.06	10.63	13.04	13.02	24.12
	Large	10.73	12.80	12.58	10.55	11.74	13.52	26.00
Milk & Milk products	Marginal	5.33	6.45	7.60	8.37	8.95	7.17	34.52
	Small	9.36	8.17	9.15	9.14	10.24	10.84	25.81
	Semi-Medium	9.59	12.52	11.26	11. 35	11.35	11.53	20.23
	Medium	12.66	13.08	15.66	14.03	13.35	13.42	6.00
	Large	13.63	14.65	15.76	13.90	14.02	14.42	5.80
Meat, fish & eggs	Marginal	8.72	9.79	12.01	11.73	8.94	11.91	36.58
	Small	6.01	7.43	7.31	7.33	8.82	8.33	38.60
	Semi-Medium	4.86	3.97	4.31	4.73	4.71	6.05	24.49
	Medium	4.87	3.83	2.61	4.77	5.99	5.41	11.09
	Large	4.91	3.71	2.88	5.47	5.31	5.44	10.79
Others	Marginal	11.34	11.23	12.01	12.07	12.58	12.61	11.20
	Small	12.33	12.14	12.99	12.89	13.29	13.42	8.84
	Semi-Medium	13.26	12.54	14.19	14.31	14.61	14.83	11.84
	Medium	13.49	13.22	13.37	14.44	14.45	14.70	8.97
	Large	14.35	13.84	13.56	15.88	16.18	15.69	9.34

Calorie intake of farm households

The estimates of per capita calorie intake of farm households for different farm size groups are presented in Figure 2. The per capita intake of calorie seems to have direct relationship with farm size. The per capita intake of calorie in absolute term was high in large farm size households. Nevertheless, the per capita calorie intake has declined over a period of time across all farm size groups except among marginal, small and semi-medium farm households due to consumption of animal products along with plant products. The rate of decline was 2.46-4.24 percent. The per capita intake of calorie increased substantially among farm households by marginal (1611kcal to 1765), small (1626lcal to 1776kcal) and semi-medium (1751kcal to 1831kcal).

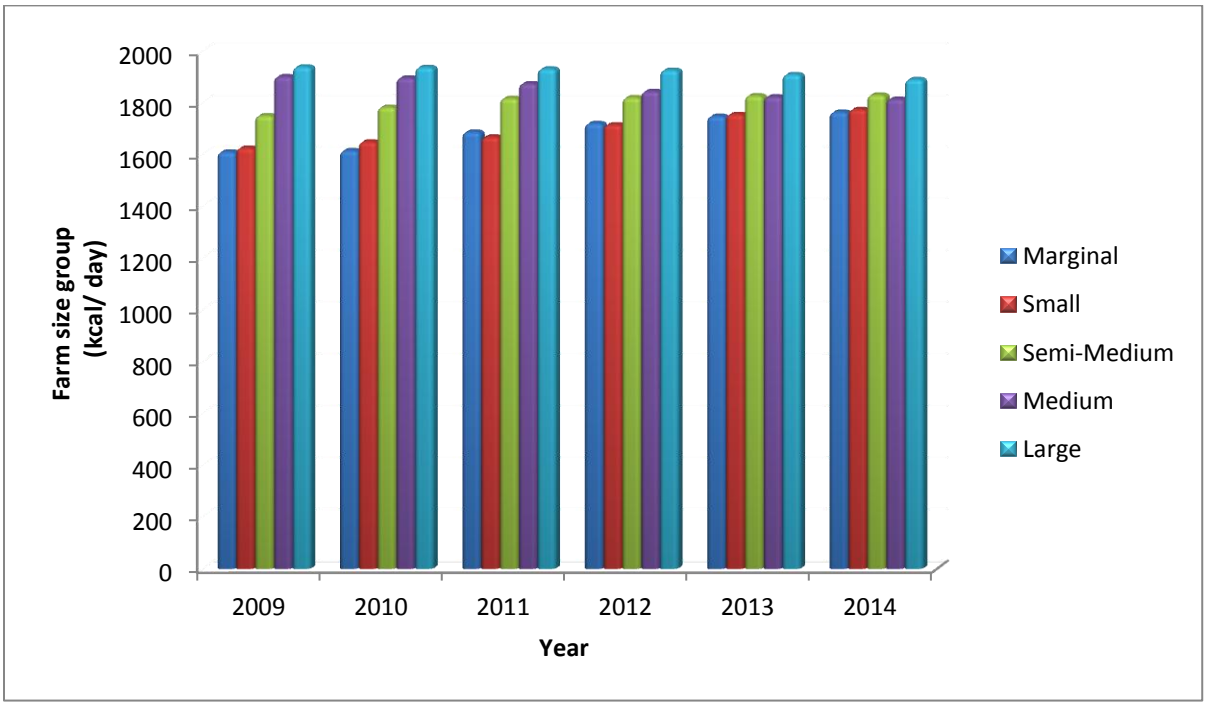

Figure 2. Trends in per capita calorie intake across farm size groups

Food demand elasticities

Food demand elasticity at disaggregate level vary widely across farm size groups as influenced by production environment and changes in taste (Kumar *et a*l., 2014). To compute the demand elasticities of farm households for different food groups (like cereals, pulses, edible oils, milk& milk products, meat, fish & egg, vegetables & fruits and others). LA-AIDS model was

used. The income, price and cross price elasticities for major food groups across farm size groups were derived and given in Table 3.

Income elasticity[4] of food demand

Income elasticity refers to percentage change in the quantity consumed of a particular commodity with respect to per cent change in the income of the households. Through the income elasticity, we can identify whether the food commodities are normal or inferior or necessity or luxurious to the normal farm households. Income elasticity of food commodities across different income groups are presented in Table 3. These were found to be in accordance with a-priori expectations. Except meat, fish & egg, all the food commodities were normal goods as the income elasticities of these food commodities were positive and decrease with increased farm size. The income elasticities of food were higher for marginal farm households than the large farm households. The income elasticities were high for milk & milk products (0.17) followed by vegetables & fruits (0.11), pulses (0.08), edible oils (0.05), meat, fish & egg (0.04) and cereals (0.03). However, the magnitude of response to income change was low and close to zero among all the farm size groups, since farm households are producers of major food commodities and also spend increased income on their non-food expenditure. The result suggest that, with inclusive growth government should plan programmes to supply physical quantity of food through PDS and Anganwadi's, rather than financial support.

Own price elasticity of food demand

Own price elasticity refers to the percentage change in quantity consumed by a households with respect to change in the prices of the food commodities. As per economic theory, the sign of the own price elasticity is expected to be negative. Table 3. shows the un-compensated own price elasticity of demand for major food groups across farm size groups. As expected, own price elasticity for food commodities found negative and inelastic across farm size groups. Across food commodities and farm size groups, own price elasticity was high for high valued items than the cereals. With raise in price of food items, the consumption of high nutritive value food items will be affected. Across farm size groups, own price elasticity of milk & milk products and vegetables & fruits shows inelastic with comparatively high negative value.

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[4] Negative income elasticity of demand- inferior goods
Positive income elasticity of demand -normal goods
Income elasticity of demand of a commodity is less than 1- necessity good
Income elasticity of demand is greater than 1- luxury good

T**able 3. Income and price elasticities of food commodities based on LA-AIDS model**

Food commodities	Farm size groups					
	Marginal	Small	Semi-Medium	Medium	Large	Over all
Income (Expenditure) elasticities of food						
Cereals	0.10	0.11	0.08	0.06	0.08	0.03
Pulses	0.11	0.09	0.07	0.08	0.05	0.08
Edible oils	0.06	0.07	0.04	0.05	0.04	0.05
Vegetables & fruits	0.17	0.15	0.16	0.18	0.20	0.11
Milk & Milk products	0.18	0.19	0.21	0.23	0.26	0.17
Meat, fish & eggs	0.07	0.05	0.03	0.04	-0.09	0.04
Others	0.12	0.13	0.11	0.14	0.17	0.09
Uncompensated own price elasticities of food						
Cereals	-0.06	-0.07	-0.07	-0.07	-0.07	-0.06
Pulses	-0.17	-0.18	-0.14	-0.16	-0.13	-0.13
Edible oils	-0.15	-0.15	-0.12	-0.13	-0.10	-0.12
Vegetables & fruits	-0.10	-0.11	-0.13	-0.12	-0.15	-0.11
Milk & Milk products	-0.16	-0.18	-0.14	-0.15	-0.13	-0.14
Meat, fish & eggs	-0.06	-0.05	-0.03	-0.04	-0.02	-0.05
Others	-0.17	-0.17	-0.16	-0.15	-0.17	-0.17

Cross price elasticity[5] of food demand

Cross price elasticity measure the percentage changes in the quantity consumption of food commodities with respect to changes in the prices of the other commodities. Through the cross price elasticity, the relationship among the food commodities can be identified i.e., whether the commodities are substitutes or complements or independent of each other. Cross price elasticity for food commodities of farm households are given in Table 4. The interpretation of cross price elasticity is ambiguous as the cross price elasticities were inelastic i.e., the responsiveness of quantity of consumption of the food commodities was very less to the changes in the prices of the other food commodities. However, majority of food commodities were complementary to each other.

[5] Negative cross-price elasticity denotes two products- Complements products
Positive cross-price elasticity denotes two products - Substitute products
Zero cross-price elasticity denotes two products- independent products

T**able 4. Cross price elasticity of food commodities based on LA-AIDS model**

Food commodities	Cereals	Pulses	Edible oils	Vegetables & fruits	Milk & Milk	Meat, fish & eggs	Others
Cereals	-0.15	-0.02	-0.01	-0.02	-0.02	-0.01	-0.06
Pulses	-0.02	-0.10	-0.01	-0.01	-0.01	-0.02	-0.03
Edible oils	-0.01	-0.01	-0.06	-0.01	-0.01	-0.02	-0.03
Vegetables & fruits	-0.02	-0.02	-0.01	-0.01	-0.01	-0.11	-0.03
Milk & Milk products	-0.02	-0.01	-0.01	-0.09	-0.01	-0.01	-0.01
Meat, fish & eggs	-0.01	-0.01	-0.01	-0.01	-0.05	-0.05	-0.01
Others	-0.06	-0.03	-0.01	-0.02	-0.01	-0.03	-0.17

Conclusions

The study has assessed the farm households consumption pattern and food demand elasticities across farm size groups in Karnataka by using farm households panel data from VDSA, ICRISAT for the period 2009-2014. The study revealed that, food consumption patterns and demand elasticities across farm size groups was quite different. The land holding size of farm households had influenced positively the consumption of all food commodities due to self-production of food commodities. Comparing to large and medium farm households, food consumption pattern of marginal, small and semi-medium farm households was more responsive to the changes in the price of major food commodities as estimated price elasticities. It was also observe that, consumers have been found to reallocating their budgetary allocation from cereals based food towards high-value commodities like fruits and vegetables, milk, fish, meat and meat products, etc.

From the policy point of view, policy makers should have to take appropriate strategies for different farm size groups. It is better to distribute subsidized nutritive food commodities and milch animals to achieve the food and nutritional security instead of providing financial benefit to farm households. Further study revealed that, most of the farm households are vegetarian, so necessary efforts such as crop diversification, rearing milch animals should be strengthened to increase micro nutrient sources like pulses based products and dairy products. Moreover, it gives

additional and regular income to the farm households that reduce inequality in food consumption expenditure among farm households.

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