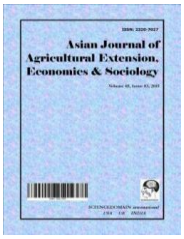

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Demand for Agro Processed Food Products: An Evidence from Indian Households

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Authors' contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

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ABSTRACT

There is an increased growth in the value addition sector which in turn leads to the development of agro-industries, it is important for all stakeholders involved in production, processing and marketing of agricultural products to understand the demand dynamics for processed food products and its determinants in Indian households making use of the National Sample Survey Organization data revealed that the per capita expenditure on processed foods had increased by over 52 per cent in both rural and urban areas in the year 2011-12 over 2004-05. Per capita income and product prices were identified as the major determinants of consumption of processed food products. The income elasticity estimates obtained through Quadratic Almost Ideal Demand System (QUAIDS) model were positive and high for most agro processed foods particularly for milk based products and fruit juice. This implies greater business opportunity for agro food processing sector in India as per capita income and population growth are on the increase. The processed food products were highly responsive to changes in their own prices as indicated by high own price elasticity. Cross price elasticity estimates led to the conclusion that the changes in the quantity demanded of the processed foods are independent of changes in the prices of the other processed products.

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1. INTRODUCTION

Food processing is one of the important agricultural marketing functions that transform the primary agricultural produce into food products for final consumption. Processing adds value for the agricultural and horticultural commodities through changing form, preservation, sorting, grading, packaging, branding, storage and transportation. For most agricultural commodities some amount of processing is necessary to change the form of the produce to palatable form. Most urban consumers prefer the foods in processed form as it reduces their time required for preparation of food items at home. Food processing has not only led to income growth but also assisted: to reduce post harvest losses of agro-products; to add value for these products; to generate employment and business opportunities; and to increase foreign exchange earnings of a country.

The growth of the processed food markets is undeniable and has dominated the diets of consumers [1,2,3,4,5,6] and [7]. The global processed food industry is valued as more than US $ 3 trillion and accounts for over three fourth of global food sales [8]. Developing countries have nearly doubled the agro-industry manufactured products in last 25 years although the developed countries have the highest agro-industrial food share [9]. India is the world's second largest food producer after China and spends more than a quarter of its expenditure on food and related products. The Indian food processing sector accounts for about 14 per cent of manufacturing GDP along with creating employment for about 13 million people directly and 35 million people indirectly, especially in rural areas [10]. Although the Indian processing sector has vast potential with strong agricultural raw material base, only two per cent of agricultural produce and 13 per cent of fruits and vegetable are processed as compared to 80 per cent and 30 per cent in United States and European countries, respectively.

The share of processed and packaged food products in total expenditure is more than 60 per cent in high income countries, whereas, it is around 20 per cent in low income countries [11] With respect to intermediate products, India and Indonesia accounted for 7 per cent and 13 per cent, respectively, in total retail sales. The increasing tendency towards processed and convenience foods consumption has been observed by [12] and [13]. These changes in the food consumption pattern from traditional food to processed and packaged food products is due to the demographic and socio-economic changes, which include increasing number of working women, rise in income, changes in relative prices of commodities, dietary changes, emergence of middle income class, changes associated with lifestyles, urbanization, improvements in transportation and storage facilities, rise of supermarkets, the ageing of the population and rising importance of single person households. Besides, tourism, international migration, prestigious thought on soft drinks, apprehensions about the health and food safety are the drivers increasing consumption of processed and packaged food products.

Although the market and demand are likely to play major roles in the development of the food processing sector, detailed information on the nature of demand and preferences of consumers regarding processed food is unavailable. Such information is useful for producers and market actors in making market oriented decisions to take advantage of growing and changing markets. Since there is an increased growth in the value addition sector which in turn leads to the development of agro-industries, it is important for all stakeholders involved in production, processing and marketing of agricultural products to understand the demand dynamics for processed food products and its determinants. The research studies in Indian context have largely focused either on raw food products individually or on group of products [14,15,16,17,18] and [19]. In this context, studying responsiveness of food consumption pattern to changes in income and prices, and identifying major determinants at household level assumes importance. The demand for processed foods is insufficiently understood in general, and in rural and urban areas of India in particular. Therefore, understanding of consumption dynamics of processed foods to the changes in income and prices is crucial for policy formulation. Keeping these facts in view, hypothesis of study is the changes does not exist in the consumption of agro processed food products at the household level and the objective of study is to capturing the changes in the consumption of agro-processed food products at the household level.

2. DATA AND METHODOLOGY

2.1 Data

The household data on dietary pattern and consumer expenditures collected by National Sample Survey Organization (NSSO) at national level, particularly pertaining to the periods 2004-05(61st round) and 2011-12 (68th round) is used for this study to capture both spatial and temporal variations in the consumption pattern of processed foods. These comprehensive National Sample Survey (NSS) data with sample size of over 100,000 households covering both rural and urban holds has high acceptance in research and policy. The data pertains to the average per capita consumption of all food and non-food commodities following the accepted classification. The total per capita expenditure was considered as a proxy for total per capita income, and therefore is used interchangeably in the study. The sample households were categorized into two groups based on the location of dwelling as rural and urban households. The processed food products included in the present analysis are: rice-based processed products (including chira[1],muri[2],khoi and lawa[3]), wheat-based processed products (including maida[4], suji[5], rawa[6], sewai[7], noodles, bread and bakery), milk based processed products (including baby foods, milk powder, curd, ghee and butter), fruit juice and shakes, papad[8], bhujia and namkeen[9], chips, pickles and fruit preserves of sauce, Jam and Jelly.

In our paper, price response of demand is obtained on the basis of unit values. Unit price for a particular food item was derived by dividing the value of food item by total quantity consumed by a particular respondent in a region. Price for the food item which is not consumed by any respondent in a region was given the average price of the corresponding region. The unit value as price for a food item have been widely applied by [20,21,22,23]. The income (total expenditure of processed food) and prices of the processed food products were deflated with poverty line of respective years to convert them into constant prices.

2.2 Model Specification: Quadratic-Almost Ideal Demand System (QUAIDS)

The Almost Ideal Demand System (AIDS) is a popular method of estimating consumer demand systems and its upgraded versions such as linear approximate AIDS (LA/AIDS) and quadratic AIDS (QUAIDS) models prevail predominantly in most of the literature. This study used QUAIDS as it allows non-linear Engel curves [24] and tests the restriction of homogeneity and symmetry through restriction of fixed parameters [25]. Since there is a chance to have zero expenditure on some of the commodities, our study followed the two-step estimation procedure given by [26] to estimate the demand elasticity of income and price. Accordingly, in the first stage, a probit function is used to capture the choices of income allocation to different kinds of processed food commodities that are available to households. In the second stage, the level of allocation of total food expenditure across processed foods is captured by using the QUAIDS demand model. The estimation procedure used in the two stages is as follows:

The first stage involves estimating a probit regression function to estimate the probability of consumption of a particular food commodity and the specific form of the function is as follows:

$$d_{ih} = \theta_0 + \sum_j \theta_{ij} \ln p_j + \theta_x \ln x_h + \theta_1 HHS_h + \theta_2 SEX_h + \theta_3 RSE_h + \theta_4 DWU_h + \mu_i \quad (1)$$

Where, d_{ih} =1 if the h^{th} household consumes the i^{th} processed product and 0 if the household does

[1] *Chira is de-husked rice which is flattened into light dry flakes. These flakes of rice swell when added to a liquid, such as water, milk or any other liquids whether hot or cold. The thicknesses of these flakes vary between almost translucently thin (the more expensive varieties) to nearly four times thicker than a normal rice grain.*

[2] *Puffed rice or Muri is prepared by parching milled parboiled rice in an earthenware vessel over a hot fire with continuous rapid string. Finally, the rice swells and retains its grain shape and becomes porous and crisp.*

[3] *Puffed paddy or Khoi is prepared by similar technique followed in Muri preparation but the rice kernel expands rapidly to ten to fifteen times its original volume and burst open through the husk.*

[4] *Maida is wholemeal flour made from soft wheat similar in texture to cake flour.*

[5] *Suji is a granular product made from endosperm of any wheat other than the Durum variety.*

[6] *Rawa is a wholemeal granular product grittier than suji. It is made from Gehun or Durum wheat*

[7] *Sewai is one kind of vermicelli made from the wheat.*

[8] *Papad is a thin Indian wafer, sometimes described as a flatbread. It is usually made from dried lentils; eaten fried or roasted. The papads are processed in different tastes utilizing natural inbuilt flavours to suit individual preference.*

[9] *Bhujia and Namkeen are popular crispy snacks and are prepared by using gram flour and spices.*

not consume the item in question. *lnp$_j$* are the prices of eight processed products, x_h is total household consumption expenditure on all processed foods, *HHS* is household size in numbers, '*SEX'* is a dummy variable for gender of household head (1 for female headed household; 0 for male headed household), *RSE* is a dummy variable for presence of regular salary earners in households (1 for the households having regular salary earners; 0 for absence of regular salary earners in the households), DWU is dummy variable for ownership of dwelling units (1 for the households having dwelling units, 0 for household not having dwelling units).

Prior to executing the probit function, the total expenditure function was regressed on its determinants and the residual error term was obtained to solve the endogeneity problem of total expenditure variable in the estimation of the QUAIDS model. The exact form of the function is as under:

$$\ln x_h = \theta_0 + \sum_j \theta_{ij} \ln p_j + \theta_1 HHS_h + \theta_2 SEX_h + \theta_3 RSE_h + \theta_4 DWU_h + \mu_i \quad (2)$$

The second step provides the estimated form of the Quadratic Almost Ideal Demand System (QUAIDS), which is represented as follows:

$$w_{ih} = \Phi(z_{ih}\hat{\theta}_i)\left\{\alpha_i + \sum_{j=1}^{n}\gamma_{ij}\ln p_j + \beta_i \ln\left[\frac{x_h}{a(p)}\right] + \frac{\lambda_i}{b(p)}\left\{\ln\left[\frac{x_h}{a(p)}\right]\right\}^2 + \tau_i \hat{e}_h\right\} + \delta_i\phi(z'_{ih}\hat{\theta}_i) + \xi_{ih} \quad (3)$$

where $w_{ih} = \frac{P_{in}q_{in}}{x}$ = the i-th food product expenditure share for consumer h; p_i = the prices of processed foods i; q_i = quantity of good i; x = monthly household income (total expenditure on all processed foods); $\hat{e}_h$ is the residual from the total expenditure regression; and $\Phi(\hat{z_{ih}}\hat{\theta}_i)$ and $\delta_i\phi(z'_{ih}\hat{\theta}_i)$ are obtained from the first-stage probit regression. The parameters of the QUAIDS model are estimated using Poi's STATA routine [27]. Adjustments are made to the original routine to include additional control variables in order to capture endogeneity and selectivity problems as appropriate.

Parameters in two levels; rural and urban were estimated separately by using Seemingly Unrelated Regression Estimation (SURE) method with symmetry and homogeneity simultaneously imposed. Budget-share equation for sauce, jam and jelly products was dropped to accommodate adding-up. The remaining seven equations were estimated by iterated, feasible, generalized non-linear least squares which is equivalent to the maximum likelihood [27]. Estimates of the dropped budget share equation (jam and jelly products) were recovered by exploiting the adding-up and homogeneity restrictions. All the analyses were done by using statistical software Stata13.1 version.

2.3 Estimation of Elasticities

Using the method adopted by [28] and [29], the expenditure elasticity is estimated as:

$$\varepsilon_{i,x} = \frac{x}{q_i}\frac{\partial q_i}{\partial x} = \frac{1}{w_i}\left\{\beta_i + \frac{2\lambda_i}{b(p)}\ln x - lxa(p)\right\} + 1 \quad (4)$$

The uncompensated own price and the cross price elasticities are estimated as:

$$\varepsilon_{i,p} = \frac{1}{w_i}\left\{\gamma_{ii} - \left\langle\left(\alpha_i + \sum_{k=1}^{n}\gamma_{kj}\ln p_k\right)\left[\beta_i + \frac{2\lambda_i}{b(p)}(\ln x - \ln a(p))\right] + \frac{\beta_i}{b(p)}\lambda_i\left[\ln x - \ln a(p)\right]^2\right\rangle\right\} - 1 \quad (5)$$

$$\varepsilon_{i,p_j} = \frac{1}{w_i}\frac{p_i}{p_j}\left\{\gamma_{ii} - \left\langle\left(\alpha_i + \sum_{k=1}^{n}\gamma_{kj}\ln p_k\right)\left[\beta_i + \frac{2\lambda_i}{b(p)}(\ln x - \ln a(p))\right] + \frac{\beta_i}{b(p)}\lambda_i\left[\ln x - \ln a(p)\right]^2\right\rangle\right\} \quad (6)$$

3. RESULTS AND DISCUSSION

3.1 Changing Trend in Consumption of Processed Foods

The share of different food commodities in total food expenditure presented in Table 1 indicates that in 2004-05, in rural households rice (19.16 per cent), liquid milk (14.41 per cent) and fruits and vegetables (14.52 per cent)together constituted nearly half (48.09 per cent)of the total food expenditure while their share decreased (42.82 per cent) in 2011-12. The expenditure share of rice was comparatively lower in urban households in both the periods as compared to rural households. The urban households spent more on liquid milk and fruits and vegetables (over 15 per cent on each). In addition, beverages formed (ranging between 4.16 to 14.6 per cent) an important item in total expenditure. In both rural and urban households, the share of

Table 1. Annual per capita expenditure on different food products in Rural and Urban households

Food commodities	Expenditure (Rs./annum) at constant prices			
	2004-05 (61st round)		2011-12 (68th round)	
	Rural	Urban	Rural	Urban
Raw rice	1291.85	1163.93	1049.16	1099.8
	(19.16)	(12.55)	(11.56)	(8.18)
Raw wheat	653.93	805.67	564.6	719.64
	(9.7)	(8.69)	(6.22)	(5.35)
Other cereals	0.88	1.04	2.28	3.48
	(0.01)	(0.01)	(0.03)	(0.03)
Liquid milk	971.57	1519.7	1275	1901.16
	(14.41)	(16.38)	(14.05)	(14.13)
Salt and Sugar	315.02	359.09	313.56	361.32
	(4.67)	(3.87)	(3.45)	(2.69)
Egg, Meat and Fish	407.74	590.26	821.52	1151.88
	(6.05)	(6.36)	(9.05)	(8.56)
Fruits & Vegetables	979.24	1420.39	1521.36	2294.52
	(14.52)	(15.31)	(16.76)	(17.06)
Spices &Condiments	232.81	272.22	600.96	764.76
	(3.45)	(2.93)	(6.62)	(5.69)
Beverages	556.15	1354.04	377.4	751.08
	(8.25)	(14.6)	(4.16)	(5.58)
Agro-processed food Products	164.19	400.76	313.08	753.48
	(2.43)	(4.32)	(3.45)	(5.6)
Other food products	1404.96	1907.81	2945.28	4732.32
	(20.84)	(20.57)	(32.44)	(35.18)
Total Food Products	6743.13	9275.95	9077.88	13450.56
	(100.00)	(100.00)	(100.00)	(100.00)

Source: Extracted from unit level data of 61st (2004-05) and 68th (2011-12) rounds of consumer expenditure survey of the NSSO

Note: Figures in the parentheses are percentage to total.

expenditure on egg, meat and fish products, fruits and vegetables and agro-processed foods increased in the year 2011-12 as compared to 2004-05.Whereas, the share of expenditure decreased for rice, wheat, liquid milk, salt and sugar and beverages during the same period.

The per capita expenditure on agro-processed food commodities increased from Rs.164 in 2004-05 to Rs. 313 in 2011-12 in rural households representing an increase of 52 per cent. In the same period in urban areas, it increased by 53 per cent. In terms of expenditure share to total food expenditure, it increased from 2.43 to 3.45 per cent in rural households and from 4.32 to 5.60 per cent in urban households. The results relating to per-capita quantity consumption of agro-processed food products in India presented in Table 2 indicates higher increase in quantity consumption of processed foods in urban households (101.08 per cent) as compared to rural households (63.94 percent) during 2004-05 and 2011-12 periods. It is interesting to note that the quantity consumption of fruit juice has more than doubled in both rural and urban households followed by sauce, jam and jelly. Alongside, the increase in consumption of the agro processed products over the years, there was a decline in the quantity consumption of rice based processed foods by 7.65 per cent, milk products by 45.88 per cent and pickles by 8.53 per cent in rural areas, whereas in urban areas the decline was observed only for milk based processed foods (11.72 per cent).

The expenditure on individual agro-processed food items presented in Table 3 indicates that during 2011-12, expenditure on processed milk based products (41.2 per cent), snack items (19.46 per cent) and wheat based products (17.2 per cent) had higher share in the total processed food expenditure in urban households. In the

rural households too, these three processed items constituted nearly 3/4th of total expenditure. In addition, rice based processed products (17.21 per cent) continued to be an important constituent of processed food in rural households. Interestingly, the expenditure on snack foods such as papad, bhujia and namkeen and chips has increased tremendously in both rural and urban regions.

3.2 Expenditure (Income) Elasticity of Processed Food Products

Expenditure elasticity enables us to identify whether the commodities are necessity, luxury, normal or inferior goods. In both rural and urban regions, income elasticity for most processed products was positive and significant indicating that all the products are normal goods. This

Table 2. Annual per capita quantity consumption on agro-processed food products in Rural and Urban households

Food commodities	Consumption (kg/capita/annum)				Rural (% change)	Urban (% change)
	2004-05 (61st round)		2011-12 (68th round)			
	Rural	Urban	Rural	Urban		
Rice based products	2.04	1.704	1.884	2.112	-7.65	23.94
Wheat based products	1.188	3.432	1.656	3.72	39.39	8.39
Milk based products	1.02	1.74	0.552	1.536	-45.88	-11.72
Fruit juice& Shake	0.048	0.288	0.12	0.636	150.00	120.83
Papad, Bhujia & namkeen	-	-	0.792	1.272	-	-
Chips	-	-	65.46	179.7	-	-
Pickles	78.96	129.612	72.228	137.976	-8.53	6.45
Sauce, Jam & Jelly	5.748	60.828	7.74	79.272	34.66	30.32
Others	3.048	4.92	0.48	1.008	-84.25	-79.51
Total	92.052	202.524	150.912	407.232	63.94	101.08

Source: Extracted from unit level data of 61st (2004-05) and 68th (2011-12) rounds of consumer expenditure survey of the NSSO

Table 3. Annual per capita consumption expenditure on agro-processed food products in Rural and Urban households

Food commodities	Expenditure (Rs./annum) at constant prices			
	2004-05 (61st Round)		2011-12 (68th Round)	
	Rural	Urban	Rural	Urban
Rice based processed products	52.61 (32.04)	46.03 (11.49)	53.88 (17.21)	63.96 (8.49)
Wheat based processed products	34.42 (20.96)	105.94 (26.43)	49.68 (15.87)	129.6 (17.2)
Milk based processed products	65.77 (40.06)	207.12 (51.68)	103.92 (33.19)	310.44 (41.2)
Fruit, Juice & Shake	1.75 (1.07)	14.93 (3.73)	6.12 (1.95)	37.92 (5.03)
Papad, Bhujia & Namkeen	0.00 (0.00)	0.00 (0.00)	79.08 (25.26)	146.64 (19.46)
Chips	0.00 (0.00)	0.00 (0.00)	10.92 (3.49)	33.24 (4.41)
Pickles	8.55 (5.21)	15.96 (3.98)	8.4 (2.68)	18.36 (2.44)
Sauce, Jam and Jelly	1.1 (0.67)	10.78 (2.69)	1.08 (0.34)	13.32 (1.77)
Total agro-processed food products	164.19 (100)	400.76 (100)	313.08 (100)	753.48 (100)

Source: Extracted from unit level data of 61st (2004-05) and 68th (2011-12) rounds of consumer expenditure survey of the NSSO.

Note: Figures in the parentheses are percentages to total.

implied that the proportion of quantity consumption of these processed food products increased more than the proportionate increase in income of the households. When, we look closely at the magnitude of the income elasticity, fruit juice and shakes exhibited high income elasticity in both rural (1.83 per cent) and urban households (4.16 per cent). This was followed by milk based food products. Consumption of wheat and rice based food products and snack items were relatively inelastic in both rural and urban households. These results show that the demand for most processed foods especially horticultural and milk based products are on the increase with the rise in income levels of both rural and urban households in India (Table 4).

3.3 Own Price Elasticity

Uncompensated own price elasticity of demand describes the percentage change in the quantity demanded for a particular product with respect to percentage change in the price of the respective product in the absence of any compensation in terms of either price or income change. As expected, in both rural and urban households, own price elasticity of demand for all processed food products was negative and statistically significant endorsing the law of demand; the demand for the processed food products decreased as their prices increased. Further, own price elasticity of all processed food products were highly elastic in both rural and urban households, implying that even a marginal change in the price level of these products would lead to more than proportionate change in their consumption (Table 5).

3.4 Cross-price Elasticity

Cross price elasticity measures the responsiveness of the demand for one commodity to the change in the price of another, indicating whether commodity is a substitute or complement. A negative cross price elasticity indicates that the two commodities are complements and positive cross price elasticity indicates that two commodities are substitutes. Two commodities are considered independent of each other if their cross price elasticity approaches towards zero. Cross price elasticity estimates for rural and urban households for most of the processed food products were inelastic, indicating that the changes in the quantity demanded of these processed foods is independent of changes in the prices of the other processed products (Tables 6 and 7). These results are logical, as the processed food products are used for different purposes in the final food preparation and their consumption.

Table 4. Expenditure (Income) elasticity of processed food products in Rural and Urban Households in India

Processed food products	Rural	Urban
Rice based	0.961*	0.197*
	(0.05)	(0.041)
Wheat based	0.877*	0.9*
	(0.046)	(0.023)
Milk based food products	1.759*	1.199*
	(0.063)	(0.023)
Fruits Juice and Shakes	1.828*	4.155*
	(0.349)	(0.293)
Papad, Bhujia and Namkeen	0.525*	0.947*
	(0.067)	(0.056)
Chips	1.288*	0.69*
	(0.177)	(0.106)
Pickles	0.523**	2.058*
	(0.239)	(0.15)
Sauce, Jam and Jelly	-1.694^{NS}	0.418^{NS}
	(1.312)	(0.612)

*Note: ** and * indicate significant at one per cent and five per cent level respectively; ^{NS} indicates non-significant*

Table 5. Own price elasticity of processed food products in Rural and Urban Households

Processed food products	Rural	Urban
Rice based	-1.679*	-1.36*
	(0.044)	(0.076)
Wheat based	-1.271*	-1.112*
	(0.044)	(0.036)
Milk based	-1.153*	-0.775*
	(0.034)	(0.024)
Fruits Juice & Shakes	-2.563*	-9.061*
	(0.396)	(0.592)
Papad, Bhujia & Namkeen	-1.256*	-1.85*
	(0.056)	(0.065)
Chips	-4.258*	-3.124*
	(0.313)	(0.2)
Pickles	-3.84*	-3.701*
	(0.617)	(0.482)
Sauce, Jam & Jelly	-10.204*	-3.003*
	(1.567)	(1.134)

*Note: * indicate significant at five per cent level and ^{NS} non-significant*

Table 6. Cross price elasticity of processed food products in Rural households

	Rice based food products	Wheat based food products	Milk based food products	Fruit juice & Shakes	Papad, Bhujia & Namkeen	Chips	Pickles	Sauce, Jam & Jelly
Rice based food products	-1.679*	0.015^{NS}	0.014*	0.04*	-0.002 ^{NS}	0.047*	0.044*	0.001 ^{NS}
	(-0.044)	(-0.029)	(-0.003)	(-0.01)	(0.01)	(-0.004)	(-0.007)	(-0.006)
Wheat based food products	0.036 ^{NS}	-1.271*	-0.022*	0.035*	0.062*	0.007**	0.016**	0.02*
	(-0.027)	(-0.044)	(-0.003)	(-0.007)	(-0.009)	(-0.003)	(-0.006)	(-0.004)
Milk based food products	-0.362**	-1.495*	-1.153*	-0.241**	0.002 NS	0.08**	-0.059 ^{NS}	-0.304*
	(-0.176)	(-0.152)	(-0.034)	(-0.125)	(-0.068)	(-0.033)	(0.076)	(-0.071)
Fruits Juice & Shakes	2.071*	1.996*	-0.062 ^{NS}	-2.563*	-0.218 ^{NS}	-0.088 ^{NS}	-0.255*	0.032 ^{NS}
	(-0.586)	(-0.493)	(0.049)	(-0.396)	(0.182)	(0.068)	(-0.139)	(-0.066)
Papad, Bhujia & Namkeen	0.249**	0.747*	0.151*	0.063 ^{NS}	-1.256*	0.001 ^{NS}	0.159*	-0.045 ^{NS}
	(-0.127)	(-0.112)	(-0.011)	(-0.044)	(-0.056)	(-0.013)	(-0.027)	(0.027)
Chips	11.446*	2.433**	-0.048 ^{NS}	-0.556**	0.443**	-4.258*	-0.321 ^{NS}	1.505*
	(-1.097)	(-0.992)	(0.117)	(-0.273)	(-0.258)	(-0.313)	(0.221)	(-0.172)
Pickles	6.194*	2.82*	-0.418*	-0.497**	2.349*	-0.222**	-3.84*	0.406**
	(-0.894)	(-0.872)	(-0.081)	(-0.291)	(0.356)	(-0.116)	(-0.617)	(-0.233)
Sauce, Jam & Jelly	-0.081 ^{NS}	25.98*	2.431**	5.76*	-28.841*	13.731*	3.881 ^{NS}	-10.204*
	(9.807)	(-9.094)	(-1.082)	(-1.963)	(-3.778)	(-1.513)	(-3.607)	(-1.567)

*Note: ** and * indicate significant at one per cent and five per cent level respectively; ^{NS} indicates non-significant; The entry in i^{th} rows and j^{th} column of each elasticity matrix represents the percentage changein the quantity of good i consumed for a 1% change in the price of good j*

Table 7. Cross price elasticity of processed food products in Urban households

	Rice based food products	Wheat based food products	Milk based food products	Fruit juice &Shakes	Papad, Bhujia & Namkeen	Chips	Pickles	Sauce, Jam & Jelly
Rice based food products	-1.36*	0.024^{NS}	0.04*	-0.228*	0.112*	0.047*	0.068*	0.034*
	(-0.076)	(-0.039)	(-0.004)	(-0.028)	(-0.012)	(-0.005)	(-0.01)	(-0.009)
Wheat based food products	0.056*	-1.112*	-0.035*	0.012 ^{NS}	0.073*	0.006*	-0.023*	0.027*
	(-0.027)	(-0.036)	(-0.003)	(-0.015)	(-0.007)	(-0.002)	(-0.004)	(-0.005)
Milk based food products	-0.305*	-1.226*	-0.775*	0.977*	-0.045 ^{NS}	-0.059*	-0.077*	-0.309*
	(-0.109)	(-0.079)	(-0.024)	(-0.096)	(0.031)	(-0.011)	(-0.019)	(-0.032)
Fruits Juice & Shakes	4.995*	2.993*	-0.137*	-9.061*	1.035*	0.384*	-0.805*	-0.095 ^{NS}
	(-0.644)	(-0.358)	(-0.034)	(-0.592)	(-0.117)	(-0.039)	(-0.098)	(0.08)
Papad, Bhujia&Namkeen	0.921*	1.022*	0.008^{NS}	0.421*	-1.85*	0.052*	0.094*	-0.077**
	(-0.134)	(-0.102)	(-0.016)	(-0.126)	(-0.065)	(-0.011)	(-0.021)	(-0.039)
Chips	9.728*	1.543**	-0.395*	2.594*	1.196*	-3.124*	0.007 ^{NS}	0.164 ^{NS}
	(-1.117)	(-0.699)	(-0.098)	(-0.506)	(-0.239)	(-0.2)	(-0.17)	(-0.163)
Pickles	3.258*	-3.865*	-0.442*	0.561 ^{NS}	0.726*	-0.071 ^{NS}	-3.701*	1.357*
	(-0.828)	(-0.592)	(-0.084)	(-0.396)	(-0.206)	(0.074)	(-0.482)	(-0.218)
Sauce, Jam & Jelly	-92.451*	0.756^{NS}	-0.418 ^{NS}	35.394*	-7.4*	-1.135**	15.497*	-3.003*
	(-6.168)	(-4.27)	(0.434)	(-4.542)	(-1.677)	(-0.498)	(-2.119)	(-1.134)

*Note: ** and * indicate significant at one per cent and five per cent level respectively; ^{NS} indicates non-significant; The entry in i^{th} rows and j^{th}, column of each elasticity matrix represents the percentage change in the quantity of good i consumed for a 1% change in the price of good j*

4. CONCLUSIONS AND POLICY IMPLICATIONS

The consumption of processed foods by the households in India has increased discernibly during 2004-05 to 2011-12 both in absolute (per capita quantity and total expenditure) and relative (share to total food expenditure) terms. The share of processed food items in total food expenditure increased from 2.43 to 3.45 per cent in rural households while in urban households it increased from 4.32 to 5.60 per cent during 2004-05 – 2011-12 period. In terms of region, the analysis of NSSO consumption data revealed that urban households consumed more quantity of processed food products as compared to the rural households. Per capita income and products prices emerged as the major determinants influencing consumption of processed foods. Income elasticity for all processed foods was positive and high particularly for milk based food products and fruit juice. This implied greater opportunity for agro food processing sector in India as the income levels of households are on the increase. The results on own price elasticity of processed food products indicated that all products were highly responsive to the changes in their own price. Cross price elasticity estimates for most of the processed food products were inelastic; indicating that the changes in the quantity demanded of these processed foods is independent of changes in the prices of the other processed products. India with a diverse agro climatic condition provides wide range of agricultural commodities as raw material throughout the year for the food processing industry which in turn will help in reducing huge post-harvest losses and increasing greater employment opportunity, especially in rural regions.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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