Food processing industry in India: Opportunities and constraints for Fruits and vegetable processing sector

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Abstract
India produces 82 mm tones of vegetable (10.9% of global production), and 47 mm tones of fruits (8.4% of global production). However, the level of processing of fruits and vegetable in India is about 2%. This, low level of processing resulting 35% wastage of total fruits and vegetable production of the country that accounts for approximately Rs. 35000 crore per annum. Since 1976, significant increases in the installed capacity have been found, as the number of fruits and vegetable-processing units has been increasing. This has gone up further after 1991. However, the level of capacity utilization remains below 50% of total installed capacity. It may be because of the meager demand of processed fruits and vegetable. Studies on cross-country consumption pattern show that consumption structure of consumers are changing with the increase in their income levels. They shift their consumption from normal food like cereals' to high value food like fruits and vegetable, meat, fish, and processed food. In order to examine this in Indian context, an attempt has been made in this study to calculate the Engel elasticity of demand for vegetable, fresh fruits, dried fruits and processed food by using data on per capita monthly consumer expenditure from NSSO 55th round.

1.0 Introduction

As per the latest available data from GOI 2003, the size of food processing industry in India is about US$ 70 billion. The average growth rate of food processing industry during the period 1998-99 to 2003-04 has been 7.15% (outcome budget, MFPI, 08-09). Food processing industry has an important place in the Indian economy. This Industry contributed 6.3% to India's GDP in 2003 (IBEF, 2006). The industry employs 1.6 million workers directly (annual report, 2006-07, MFPI).

It may be noted that the Indian food processing industry is a large sector and it covers various activities such as agriculture, horticulture, plantation, animal husbandry and fisheries. It also includes other industries that use agriculture inputs for manufacturing of edible products. Further, the ministry of food processing industry GOI (MFPI 2006-07) has classified the entire processed food in six product heads: Fruits and vegetable processing, Dairy, Grain processing, Meat and poultry processing, Fisheries, Consumer food including packaged food, beverages and packaged drinking water.
As defined by ministry of food processing industry, the product head fruits and vegetable processing consists of five products- dried and persevered vegetable, mango pulp, pickle and chutney and other processed fruits and pulses. Processing for fruits & vegetable is categorized as primary processing – sorting, grading, packaging of fresh fruits & vegetable, and secondary processing – conversion into value added products like juice, concentrates, pickles, jams, chutneys, squashes, etc.

The production of fruits and vegetables varies among different states. For example Maharashtra accounts for the largest share (21%) of country's total fruits production where as West Bengal accounts for the largest share (20%) of total vegetable production of the country.

With the second largest arable land in the world and advantage of diverse agro- climatic zones across its geographical spread, India is the second largest producer of fruits & vegetable in the world accounting for almost 10% of global fruits & vegetable production (annual report, 2006-07, MFPI). India produces 82 mm tones of vegetable (10.9% of global production), and 47 mm tones of fruits (8.4% of global production).
India had the second rank in total world production of onion, vegetable and melon and fruits, whereas in potato production India had third rank in the year 2003. However, the level of fruits and vegetable processing is very low in India. According to the annual report of ministry of food processing industry 2006-07, the level of fruits and vegetable processing is just around 2% of the total production of fruits and vegetable. This is resulting in a massive wastage of fruits and vegetable production. According to the working group report on food processing sector MFPI (Nov.2006) wastage was 35% of total production and it accounts for almost Rs.33000 crore per annum loss for the Indian economy.

A comparison of India's secondary level fruits and vegetable processing with some other countries of the world gives the picture of backwardness of Indian fruits and vegetable processing sector. Secondary level processing in the case of fruits & vegetable is merely 1.3% in India, while the figure for the USA, Germany, Poland, Australia, and Netherlands are 80%, 33%, 31%, 25%, and 12% respectively (Rabo India, 2005). As the new technologies and information about fruits and vegetable farming have been easily accessible to the farmers, the production of fruits & vegetable are likely to increase further. Area under fruits and vegetable production was 6690 thousand hectares in 1990-91, which has increased to 9396 thousand hectares in 2004-05 (Ministry of agriculture). Therefore, the rapid growth of fruits and vegetable processing sector has become a need for the country.

The present study is organized in five sections. Section 1 contains introduction followed by objectives of the study in section 2. Review of Literature is provided in section 3. Section 4 indicates the gaps in the literature on Indian fruits and vegetable processing sector. Section 5 contains the data and methodology used in the study. Section 6 contains estimation of Engel elasticity of demand for vegetable, fresh fruit, dry fruit and processed food separately for each item and separately for rural and urban India based on the NSSO data for the period 1999-2000.

2.0 Objectives

First attempt has been made for finding the appropriate Engel function for calculating the Engel elasticity of demand for fresh fruits, dry fruits, vegetables and processed food. Then these elasticities have been analyzed to trace the demand side opportunity for Indian food processing industry especially for fruits and vegetables processing.

3.0 Review of literature

1. Gale and Huang, 2007 have studied that how the rising incomes of Chinese consumers affect the structure of food expenditure. They examined the impact of rising income on the structure of food expenditure. They have calculated the Engel elasticity of demand for a detailed set of food categories like grains, vegetable, fruits, beverages etc. by using the data on mean values of income, expenditure and amount consumed/purchased. They used the following equation, which allows the income elasticity of demand to vary with income levels:

Where, the dependent variable q_{ij} represents the per capita quantity of the i^{th} food consumed by the j^{th} household. The independent variable x_j represents the per capita income of j^{th} household, and u_{ij} is a random disturbance term. The parameters α_i, β_i, and γ_i are to be estimated. The study analyzed income and food consumption data from China's national household income and expenditure surveys for 2002 and 2003. The study found that a disproportionate share of China's income growth accrues to high-income households and these households are purchasing mainly greater value added food items in food consumption rather than increased quantity. High-income consumers devote expenditures to higher quality food: better cuts of meat, processed and packaged food, meals away from home, and food that is safer, more convenient, or healthier. income. Income elasticities of demand for the products like meat, dry fruits, and processed food are higher for low-income consumer than for high-income consumers.

Based on the above findings, the authors have concluded that rapid income growth is changing the structure of Chinese food expenditure, a development that has important implications for China's agricultural and food sector and for international trade in agricultural products. As household incomes rise, consumers demand not only a greater quantity of food, but also higher quality. The demand for quantity diminishes, as income rises, and the top tier of Chinese households appear to have reached a saturation point in quantity consumed of most food items.

Limitations of the model:

i. $1/x_j$ and $\ln x_j$ are likely to be highly related and hence the problem of multicolinearity and it has not been addressed to in the model.

ii. For calculating the Engel elasticity of demand by this model, they are not using the individual household data. This could be another limitation of the study.

2. To develop a better understanding of global food trends Regmi Anita et. al, 2001 did a cross country food demand analysis by quantifying the relationship between food demand, composition of food and income levels. Study analyses that low-income countries spend a greater portion (47 percent) of their total expenditures on food compared with richer countries, which on average spend 13 percent of their

total budget on food. In general, lower income countries spend a greater proportion of their budget on necessities such as food, while richer countries spend a greater proportion on luxuries. With income elasticity of demand below one, food, beverages and tobacco, and clothing and footwear appear to be necessities in all countries, while education, gross rent, fuel and power, house operations, medical care, recreation, transport and other groups are all luxuries. It also finds that poorer countries exhibit a greater responsiveness, as given by the income elasticity of demand to changes in income levels compared with wealthier countries. In the low and middle-income countries, income elasticity of demand for meat, fruits and vegetable, etc., are higher than that of the high-income countries which indicates that the demand for these products in low and middle income countries will increase faster than the high income countries, if income levels increase.

3. Pollack Susan L, (2001) has discussed that how the consumption of fruits and vegetable change as the nations become wealthier. The author has examined the hypothesis that increasing level of nation's prosperity has positive impact on the consumption of fruits and vegetable (fresh and processed). To examine the above, she has used the data on global fruits and vegetable supply in low, middle and high-income countries, Per capita U.S. fruits and vegetable consumption for the period 1977 to 1998 and imports as a share of fresh fruits and vegetable consumption in USA for the same period. The data have been taken from economic research service USDA, and FAO. The study shows that fruits and vegetable consumption is positively correlated with income levels and per capita consumption of fruits and vegetable being the highest in high-income countries. In high-income countries, access to wider section of products is available because of increased variety of domestic production and imports through trade. Convenience is an increasingly important factor for consumers when selecting fruits and vegetable. As a result, most Americans consume produce in the processed forms. In 1997-99, about 52 percent of vegetable consumption was canned, frozen, or dried products and about 43 percent of fruit was consumed as juice. While there are, many vegetable processed, tomatoes accounted for about 70 percent of canned consumption and potatoes accounted for about 70 percent of frozen consumption.
She concluded that as incomes continue to grow in developing countries, demand for fruit and vegetable is expected to increase. She also pointed out that "with increased globalization and the associated changes in lifestyles, demand for produce in developing countries will likely to be shaped by the same factors that have affected U.S. demand for these products. As in the United States, availability, affordability, convenience and health concerns will influence the consumption pattern of fruit and vegetable across the world".

4. The importance of fruits and vegetable processing sector in the Indian economy and its future prospects was firstly addressed by Sinha and Sinha, 1992. Objective of their study was to trace the future prospects of fruits and vegetable processing sector. They concluded that the vegetable processing sector has a bright future. To arrive at this conclusion, they used the descriptive analysis of time series data on the number of FPO licensees, installed capacity and capacity utilization for the period 1976 to 1990. The required data was obtained from various sources like, ministry of food processing industry, statistics of fruits and vegetable processing in India and annual survey for industries for working factories. They also observed that there are fluctuations in the percentage of capacity utilization. For example it was 25.4% in 1976, increased to 40.8% in 1985, and again came down to 33.9% in the year 1989 (Table 1a in the appendix). There are substantial increases in the installed capacity and in the number of licensed units. The installed capacity increased from 2.27 lakh tones in 1976 to 7.08 lakh tones in 1989 whereas the number of licensed units increased from 1331 in 1976 to 3498 in 1988 (Table 1a in the appendix). The authors had pointed out that there is immense growth potential for the vegetable processing sector since less than 5% of total fruits and vegetable production is utilized for processing. India had 7.6% share in the total World's fruits production and 10% share in the World's vegetable production, which were the symbols of large raw material base for the sector.
Although the authors have discussed the market limitation for the fruits and vegetable processing sector and have suggested the need for a convergence between the felt needs of the consumers and the product mix of the industry. However, authors have not given any clear analysis about the demand side of the sector. They have discussed mainly the opportunities and constraints of the fruits and vegetable processing sector from the supply side.

5. MS Sidhu (2005) analyzes the post reform growth of the fruits and vegetable processing sector. The study examines the hypothesis that the reforms had favorable impact on the fruits and vegetable processing sector. The study made by the descriptive analysis of the time series data on the installed capacity and the percentage of capacity utilization by Fruit and Vegetable processing industry, number of licensed units, (for the period 1991 to 2001) and investment in fruits and vegetable processing sector

from July 1991 to Dec. 2000. The data have been obtained from annual report 2000-01, ministry of food processing industry. Apart from this, the data for monthly private consumption expenditure from NSSO 27th and 55th rounds and data on estimated number of households by income groups from TSL (2001) statistical outline of India has also been used in the study. The study found a substantial increase in the installed capacity. It increased to 21.1 lakh tones in 2001 from that of 8.94 lakh tones in 1991 (Appendix table 1a) but Capacity utilization remains below 50% of total installed capacity in fruits and vegetable sector (Appendix table 1a).

The author has concluded that the growth of fruits and vegetable processing sector in the post-reform period is due to various fiscal relief and policy initiatives. Like de-licensing of food processing industries, declaring a number of them as high priority industries, permitting foreign equity investment up to 51 per cent of the paid up capital as also removing restrictions under the MRTP Act. In spite of all these policy initiatives, the capacity utilization of the industry has remained below 50 per cent in the post-reform period. Moreover, it is a big challenge to attract huge private investment in a processing industry, already facing the problem of meager demand. Therefore, as long as there is low purchasing power, it is difficult to build a heavyweight fruits and vegetable processing industry in the country. The author has explained the lack domestic demand for processed fruits and vegetable in India by comparing the low per capita income in India with the high per capita income and high domestic demand for processed food in developed countries. Of course, the argument made in this paper cannot be denied completely but to get a better picture of the demand side it is important to have the Engel elasticity of demand for processed fruits and vegetable.

4.0 Gaps in the literature on Indian Fruits and vegetable processing sector

The existing literature on Indian fruits and vegetable processing sector is mostly supply side oriented. There is little discussion on the importance of the demand side of the sector. The literature is lacking on the demand issues like how the consumption pattern of Indian consumers is changing or is there any shift-taking place in the consumption basket from normal foods to high value foods in India. Because of this, it is not possible to provide accurate projection of future demand for processed fruits and vegetable. However, at international level, studies have been conducted on the demand side of the fruits and vegetable processing industry.

5.0 Data and Methodology

Data:

Engle elasticity of demand is required to study the consumption pattern and to assess the likely changes in future demand for the vegetable, fresh fruits, dry fruits and processed food. Theoretically Engel elasticity of demand gives the percentage change in the quantity demanded for any commodity given a percentage change in the income. But because of the unavailability of quantity data economists have been using expenditure data for calculating and by calculating the expenditure elasticities we try to find the income and expected demand relationship for any commodity. The same approach has been taken in the present study. What this study says the Engel elasticity is basically the expenditure elasticity of demand. Engel elasticity can also provide the projection of the future demand for vegetable, fresh fruits, dry fruits and processed food. Therefore, in the present study Engel elasticity of demand has been calculated by using the data on:

The data on consumption expenditure reported in different NSS reports are in the form of per capita monthly expenditure classes at current prices. There are twelve expenditure classes having different percent population in each class interval. To take care of the unequal distribution of population in different expenditure classes we have reconstructed it to form ten population groups (deciles) by arranging the households in the increasing order of per capita consumer expenditure and then making ten equal groups. We have taken this deciles-wise monthly per capita consumer expenditure for calculating the elasticities. Expenditure class wise data for monthly per capita total consumer expenditure, per capita consumer expenditure on vegetable, fresh fruit, dried fruit, beverages, tea and coffee have been computed from different NSSO reports.

Data for processed food: product head beverages as defined by NSSO includes all beverages including tea, coffee and various commercially produced beverages, biscuits and confectionery, salted refreshments, sweets, pickles, sauce, jams and jellies, and cooked meals obtained on payment. In the present study, the consumption expenditure on tea and coffee has already been subtracted from total consumer expenditure in this product head. Therefore, the remaining consumer expenditure consists of mainly the expenditure on processed food.

- Expenditure values for dry fruits and fresh fruits both in the rural as well as in urban areas have been deflated by using respective percentage of households consuming those items in order to arrive at consumption per household of the consuming households.
- In the case of vegetable, almost all the households are reporting the consumption therefore, it has not been deflated for the percentage of households consuming.
- In case of processed food, the information for number of households consuming is not available. Therefore, we cannot get the consumption per household's data.

Methodology

Log linear form of regression model has been used to calculate the Engel elasticity of demand. The model is given below.

Where,

Y_i is the consumer expenditure on a particular item in the i- th decile,

X_i is the total consumer expenditure in i-th decile.

$$\ln Y_i = \alpha + \beta \ln X_i + u_i$$

Using this model, the Engel elasticity for vegetable, fresh fruit, dry fruit, and processed food have been calculated. Monthly per capita total consumer expenditure is used as the independent variable in each case. Whereas, dependent variables are the monthly per capita consumer expenditure on vegetable, fresh fruits, dry fruits and processed food in respective cases.

Engel elasticity of demand is the slope coefficient of regression model mentioned above.

$\beta = (dy/y) / (dx/x)$ This is the elasticity: $(dy / dx) * (x / y)$

The reason for using the log linear form in this study is after plotting the values on scatter diagram the closer linear relationship has been found between the variables in the case when, log values of both the variables have been plotted. The deciles-wise average consumer expenditure on variables such as fresh fruits, dry fruits and processed food has been deflated by the respective proportion of households consuming these items.

6.0 Estimation of Engel elasticity

The study estimates the Engel elasticities of demand for fresh fruits, dry fruits, vegetables and processed food. Since the present study is mainly to trace the opportunities for fruits and vegetables processing in India so, it would be fine enough to have the elasticities for processed fruits and vegetables. But data separately for processed fruits and vegetables is not available therefore Engel elasticities for processed food have been calculated.

Results of regression model **Rural Areas**

Table: 1a

Table: 1b **Urban Areas**

In both rural and urban areas the Engel elasticity of demand for fresh fruits, dry fruits, and processed food are greater than one which classifies these food items as luxurious food items.

After calculating the elasticities for all households (HHs) in the each decile we have calculated the elasticities only for consuming households. Because data reveals that the percentage of households consuming for the food products like fresh fruits, and dry fruits are less than 50% in lower deciles. Elasticities for consuming HHs will reveal the true picture of expected demand for these food items. Logic behind this argument is simple that if say for example prices get change for these items then HHs consuming these products will be affected immediately of course one cannot deny the impact of price change even on non consuming HHs but that will take some time. In case of vegetables percentage of HHs consuming in every deciles are more than 90% therefore elasticities for all HHs or consuming HHs are more or less similar, in case of processed food data foe percentage of HHs consuming is not available, therefore for these two items Engel elasticities for consuming HHs have not been calculated.

Table: 2a Elasticities foe consuming HHs. Rural Areas

Table: 2 b Elasticities foe consuming HHs. Urban Areas

Findings

Results of the regression model have been presented in appendix tables 1a, 1b, 2a, and 2b. Table 1a presents the results for vegetables, fresh fruits, dry fruits, and processed food for all households in rural areas. Tables 2a present the results for fresh fruits and dry fruits for households reporting consumption

of fresh fruits and dry fruits in rural area. Similarly, table 1b presents the results for vegetables, fresh fruits, dry fruits, and processed food for all households in urban areas. Table 2b present the results for fresh fruits and dry fruits for households reporting consumption of fresh fruits and dry fruits in urban area. The important findings from tables 1a, 1b, 2a, and 2b are as follows:

- Engel elasticity of demand for vegetable in the rural area is 0.675 and it is 0.635 in the urban area. Engel elasticities of demand for vegetable in both the rural and urban areas are less than one and it implies the necessity nature of vegetable.

- Engel elasticity of demand for both fresh and dried fruits in both the rural and the urban areas is more than one, which means these are the luxurious products.

- Engel's elasticity of demand of 1.680 and 1.593 for processed foods in the rural and urban areas respectively shows the luxurious nature of these commodities. The greater Engel elasticity of demand for processed food in rural area than the urban area implies that processed foods are more luxurious in rural areas in comparison to urban areas.
- Engel elasticity of demand for both fresh and dried fruits in rural as well as in urban areas are less in case, if we are taking the value of consumption per consuming households of fresh and dry fruits as the dependent variables.

Conclusions

The future prospects of Indian fruits and vegetable processing sector is full of opportunities in the demand side. Because, the Engel elasticity of demand for the processed food is greater than one and it indicates that percentage increase in the demand for processed food will be higher than the percentage increase in the income. Table 3 below shows that compounded annual growth rate of consumption expenditures in rural area is 1.16% and in urban area, it is 1.35% over the period 1993-94 to 2004-05. This increasing trend in consumer expenditure is due to the increasing trend in the income of the Indian consumers. The increasing per capita total consumer expenditure will lead to a higher per capita consumer expenditure on high valued food items like fresh and dry fruits, and processed food and hence demand for these products will increase.

Table: 3 Compound annual growth rate of consumer expenditure in rural and urban areas:
Table: 1a: Growth of the Indian Fruits and vegetable processing sector (In lakh tones).

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Annexure

Table: 1a results of regression model Rural Areas

Dependent variable	Coefficient of constant	Coefficient of MPCE	R^2
Vegetables	-.748 (0.210)	0.675* (0.035)	0.980
Fresh fruits	-9.252* (0.319)	1.785* (0.052)	0.993
Dry fruits	-11.432* (0.739)	1.885* (0.121)	0.968
Processed food	-8.190* (0.225)	1.680* (0.037)	0.996

*significant at 1% level of significance
Figures in brackets are the stander error of coefficients
Source: Calculated from NSSO 55th round (1999-00).

Table: 1b Urban Areas

Dependent variable	Coefficient of constant	Coefficient of MPCE	R^2
Vegetables	-0.460 (0.237)	0.635* (0.036)	0.975
Fresh fruits	-6.718* (0.404)	1.401* (0.061)	0.985
Dry fruits	-9.808* (0.277)	1.633* (0.042)	0.995
Processed food	-7.466* (0.231)	1.593* (0.035)	0.996

*significant at 1% level of significance
Figures in brackets are the stander error of coefficients
Source: Calculated from NSSO 55th round (1999-00).

Table: 2a Elasticities foe consuming HHs. Rural Areas

Dependent variable	Coefficient of constant	Coefficient of MPCE	R^2
Fresh fruits	-6.267* (0.206)	1.371* (0.034)	0.995
Dry fruits	-6.083* (0.773)	1.275* (0.127)	0.927

*significant at 1% level of significance
Figures in brackets are the stander error of coefficients
Source: Calculated from NSSO 55th round (1999-00).

Table: 2 b Elasticities foe consuming HHs. Urban Areas

Dependent variable	Coefficient of constant	Coefficient of MPCE	R^2
Fresh fruits	-5.289* (0.235)	1.216* (0.036)	0.993
Dry fruits	-4.995* (0.240)	1.093* (0.036)	.991

*significant at 1% level of significance
Figures in brackets are the stander error of coefficients
Source: Calculated from NSSO 55th round (1999-00).

Table: 3 Compound annual growth rate of consumer expenditure in rural and urban areas:

Percentile group	Rural 1993-94 (Rs.)	Rural 2004-05 (Rs.)	Rural CAGR (%)	Urban 1993-94 (Rs.)	Urban 2004-05 (Rs.)	Urban CAGR (%)
0% - 10%	115.5	129.5	1.05	154.5	163.5	0.52
10% - 20%	153	169	0.91	211	223	0.50
20% - 30%	178	195	0.83	248	269	0.74
30% - 40%	200	221	0.91	287	316	0.88
40% - 50%	222	246	0.94	332	368	0.94
50% - 60%	249	275	0.91	381	433	1.17
60% - 70%	282	310	0.86	448	512	1.22
70% - 80%	325	359	0.91	543	619	1.20
80% - 90%	398	442	0.96	698	804	1.29
90% -100%	686	843	1.89	1283	1612.5	2.10
All classes	281	319	1.16	458	531	1.35

Source: computed from NSSO reports

Table: 1a: Growth of the Indian Fruits and vegetable processing sector (In lakh tones).

Year	Installed capacity	Production	% of capacity utilization	No. of licensed Units
1976	2.27	0.55	25.4	1331
1980	2.75	0.69	25.3	2026
1981	2.75	0.9	32.7	2394
1982	3	1.36	45.5	2611
1983	3.3	1.19	36.3	2809
1984	3.79	1.31	34.6	3009
1985	4.05	1.79	40.8	3100
1986	4.47	1.61	36.1	3343
1987	5.56	1.86	33.5	3498
1988	5.99	2.1	35.1	NA
1989	7.08	2.4	33.9	NA

1990	NA	NA	NA	3846
1992	9.5	3.6	37.89	4057
1993	11.08	4.69	42.33	4132
1994	12.6	5.59	44.37	4270
1995	14.02	6.78	48.36	4368
1996	17.5	8.5	48.57	4674
1997	19.1	9.6	50.26	4932
1998	20.4	9.1	44.6	5112
1999	20.8	9.4	45.19	5198
2000	21	9.8	46.67	5293
2001	21.1	9.9	46.92	NA

Source: Computed from Sinha and Sinha, 1992 and Sidhu, 2005.