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Agro-Processing Industry and Farmers' Linkages: Pattern and Impact on Enhancing Farmers' Income in Tamil Nadu

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Abstract

Linking production to processing is one of the strategies outlined by the government to double the farmers' income by 2022. In this context, this study examines the role of processing industry in enhancing farmer's income. More specifically, the study has assessed (i) evolution of processing industry cluster and its enabling factors, (ii) farmers-processing industry linkage mechanisms and their impact on farmers' income, and (iii) farmers' preference for marketing outlets and its key determinants. This study is based on the comprehensive survey conducted across various stakeholders such as mango processors, commission agents, traders, and farmers of Krishnagiri cluster of Tamil Nadu in 2016-17. The study has found a rapid growth in the number of processing firms in the study region during 2000s. The growth was fuelled by export demand, assured supply of raw material and Government's policy incentives. On an average, the cost of mango cultivation was ₹ 1.56 lakh/ha and cost of production was ₹ 8.29/kg and farmers received net income of ₹1.34 lakh/ha. The cost of processing of mango was estimated to be ₹ 7/kg. More than 90 per cent of the farmers were linked with the processors either directly or through local contractors and an oral agreement was the common form of institutional mechanism. Overall, the study has shown that those farmers those who were linked with the processing industry could gain on an average additional income of about 49 per cent in comparison to the farmers those who were located in the non-processing industry region.

Key words: Agro-processing, farmer-processor linkage, farmer's income, value addition, Tamil Nadu

JEL Classification: Q10, Q13 and Q18

Introduction

In India, agriculture development strategies have traditionally been seen from the perspectives of attaining self-sufficiency in production and food security. The majority of the programmes and schemes essentially concentrated on the area expansion and yield improvements with little focus on farmers' income (Deshpande *et al.*, 2004, Sen and Bhatia, 2004). India succeeded in achieving the target of self-sufficiency in foodgrain production. However, it has not addressed the problem farm distress, as the farm income does not always follow the increase in output(Chand, 2017). The viability of agriculture sector is highly dependent on income received by the farmers and it is high time to understand the severity of prevailing farm distress and address those concerns to sustain the Indian agriculture (Chand, 2016). In this milieu, the paradigm shift in focus on agriculture policies from production to income have evolved recently and the Government of India has set the target of doubling farmers' income by 2022. Consequently,

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series of policy initiatives are being taken on the key issues such as irrigation, seeds, soil nutrient management, crop insurance, post-harvest losses, agricultural marketing etc. (NCAER, 2017). Out of the seven identified key issues, the issue of agriculture marketing and value addition and their role in farmers' income has been chosen for the present study.

It was reported that in India domestic value chains are fairly well developed only for commodities like milk, coffee, and food grains and the potential benefits from value chain development in fruits are not yet tapped fully (Srinivasan, 2012). In fruits, the entire value chain is laden with the issues of post-harvest losses and wastages due to long and fragmented chain, dependency on intermediaries, poor road infrastructure, inefficient mandi system, inadequate cold chain infrastructure, high cost of packaging, and weak link in supply chain (Negi and Anand, 2015; Murthy, 2009). It was suggested that large-scale promotion of secondary value addition in the fruits sector such as, establishment of processing unit cluster in major production zones and opening of export markets, would effectively reduce post-harvest losses, boost the economic growth and benefit the farmers through trickling down process (FICCI, 2010). In addition, in the context of increase in per-capita income and changing life-styles, the domestic demand for processed foods expected to increase many fold, which strongly back the embracing of food-processing. The recent studies on dietary diversity have also noted that the consumers are moving away from the cereal-centric consumption towards more diversified diet including processed foods (Kumar *et al.,* 2016; Halder and Pati, 2012; Venkatesh *et al.*, 2016 and Sangeetha *et al.*, 2017; Birthal *et al..,* 2005; Madhvapaty and Dasgupta, 2015). Studies also pointed out the farmers'benefits in linkage with high -value agriculture and value addition market through income gains by assured market for large volume and price, accessibility to export market. (Minot, 2008; Narayanan, 2014; Gouk, 2012; Shepherd, 2007).

In this background, it is important to know the emergence of processing industry cluster and the enabling environment which promoted its development. The institutional mechanism, which links farmers with processors and the role of various economic agents in the setup also needs to be explored. The empirical evidences on benefits accrued to the farmers and their perception on linkage with processors assume greater significance to develop suitable policy options and strategies to replicate similar linkage patterns in other locations. Keeping these issues in mind, this study was undertaken with the objective of exploring the linkages between farmers and processors and benefits accrued to the farmers with a case study of mango processing industry in Tamil Nadu.

Data and Methodology

The study has used both primary and secondary data. The information related mango area and production across the states was collected from *Area and Production Statistics* of Ministry of Agriculture and Farmers' Welfare (http://aps.dac.gov.in), mandi wise mango price were extracted from Agmarknet (http://www.agmarknet.nic.in/) and pulp export data were compiled from the Ministry of Commerce and Industry (http://apeda.gov.in/). Further, the list of major mango pulp processing plants was gathered from (http://agritech.tnau.ac.in), and basic characteristics from (https://pin-code.org.in/) and mango pulp processors association. Krishnagiri cluster (Krishnagiri and Dharmapuri districts) of Tamil Nadu was purposively selected for conducting the primary survey, as it is one amongst the two main clusters of mango pulp production in the country, the other cluster being the Chittoor district of Andhra Pradesh. These two clusters produce about 65 per cent of the total mango pulp production of the country.

Maharashtra and Gujarat are the other states where a significant fraction of mango processing units could be spotted (http://apeda.gov.in/). Further, Tamil Nadu is the largest exporter of mango pulp, with an export of 0.998 lakh tonnes (78% share in all India) valuing ₹ 564 crores (71% in all India) in 2015-16. In order to have a holistic understanding of mango processing and marketing activities ongoing in the selected Krishnagiri cluster, a comprehensive survey was conducted in 2016-17 among the various stakeholders involved in processing as well as fresh fruit marketing such as processors (12), commission agents (10), traders (5) and retailers (10). All the mango processors in the list were contacted over the phone for survey and 12 of them, who responded positively to our request and were available during our survey, were interviewed. A farm level survey was also conducted among 120 mango growers from the selected district to study the farm

and processing industry linkages and their impact on farm income.

The cost and returns of mango pulp processing industry were worked out taking different elements of fixed and variable costs into account. The benefit-cost ratio (BCR) was used to assess profitability in the processing industry. The cost of cultivation of mango was computed after considering establishment costs and maintenance costs. Establishment cost was taken as the cost incurred by the farmer to establish the crop till it reached the age of economic bearing. It included the cost on land preparation, planting materials, fertilizers, plant protection measures, labour charges, depreciation, interest on fixed capital and imputed value of land rent. Establishment cost was amortized using the formula (1).

Amortized cost of establishment of crop =

$$\mathbf{C}\times[(1+i)^{t\,x\,i}] \div [(1+i)^{t-1}] \qquad \ldots(1)$$

where, C is the total establishment costs; 'ī' is the interest rate and 't' is the average economic life of tree.The maintenance cost comprises the cost incurred in managing the crop once it reaches the age of economic bearing. This is similar to the cost components used for the annual crops. The total cost was arrived by adding variable and fixed cost components. The fixed cost component included amortized establishment cost, which separates it from the cost concepts used in case of annual crops. In order to minimise the effect of heterogeneity in age of mango plantations on cost and returns, the representative sample farms were grouped according to age and weighted averages were used to arrive at cost and returns. As Totapuri is the lone variety which was used for processing in this cluster, the analysis in this study is restricted to this variety (henceforth mango indicates only Totapuri mango).

Measuring the impact of mango processing industries on farm income, one of the targets set for our study, was however challenging due to the absence of suitable counterfactuals *per se*. This is because all the farmers sold mangoes to the processing industry, however, it was very difficult to find farmers selling exclusively to processors or any other channel. Therefore, with and without approach of impact assessment was not suitable for our analysis. On the other hand, most of the farmers used to grade their products and sold across the channels. In general, the best quality (uniform maturity and colour, bigger in size and without external damage) mango was sold to fresh market, while low quality produce were sold to processing industry. Therefore, direct comparison of price across the channels in the same locality was also ruled out, as it will be misleading. Consequently, to see the impact of farmer-processor linkage, three different reference mandi prices of same variety for the same period (April to July, 2016) were used as counterfactuals. First, within the Tamil Nadu, the average mandi prices of Dindigul district was selected, as it is one of the major mango (Totapuri) growing district in the state and there was no processing industries cluster. Second, the average modal mandi prices of neighbouring state Karnataka was taken as it is one of the major Toatpuri growing region in the country, however there was no processing industries cluster in the state. Another adjoining state Andhra Pradesh was chosen as counterfactual, as it has both high production and processing of Totapuri mango in the country. In addition, with less restrictive assumption of homogenous cost of production in both the selected cluster and reference states, the study estimate the impact of value addition on farm income. Further, in order to identify the factors such as assured market, premium price, prompt payment, input supply, etc., which is determined farmers' preference amongst the marketing channels, five point Likert scale was used.

Results and Discussion

Evolution of Mango Pulp Processing Industry in Krishnagiri Cluster

An attempt has been made in this study to analyse the phases in growth of mango pulp processing industries in Krishnagiri cluster, and its major driving forces, based on the personal interview with the processors and officials from pulp processors association. The entrepreneurs of Krishnagiri district identified the potential of mango pulp processing industry in the late-1980s, when a few pulp processing plants were established (Figure 1). Following the success of these industries, people who got enough working experience from such industries, relatives of those industry owners and big mango farmers gradually entered into this business. However, the number of processing plants started growing significantly only after the year 1993, owing to the opening up of global

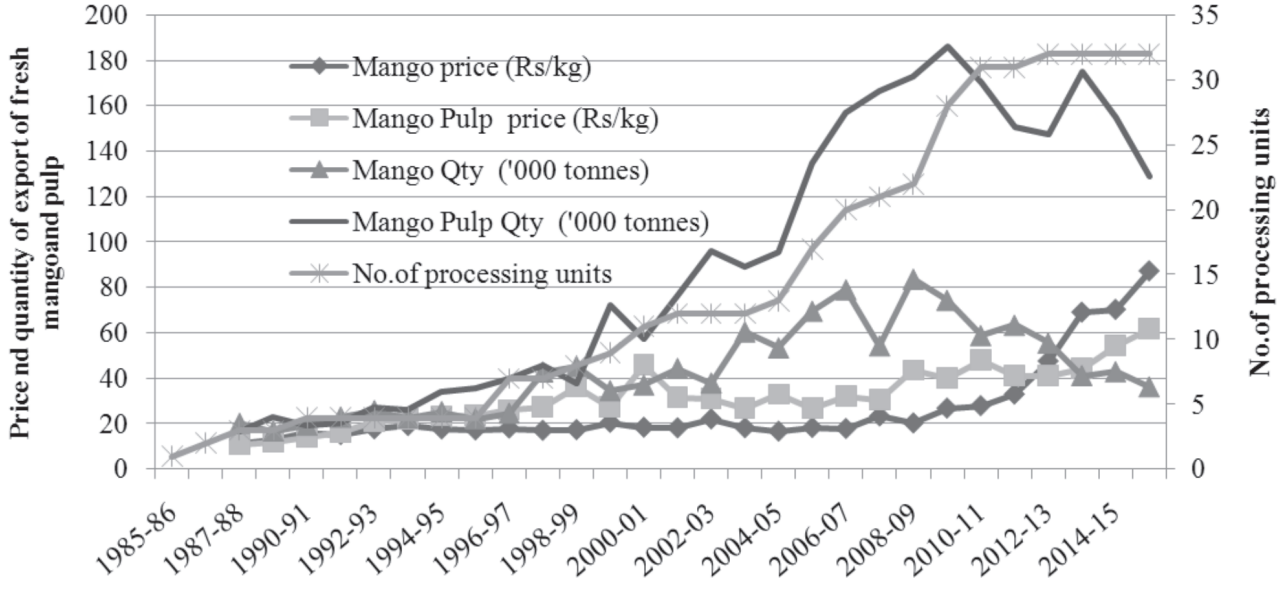

Figure 1. Growth of processing units in Krishnagiri cluster of TamilNadu and trend in export of fresh mango and mango pulp from India

markets and the substantial demand from foreign market for mango pulp. The number of plants grew gradually in the early 1990s and a sudden spurt occurred in the growth of processing units in early 2000s. During the period of our survey, there were 34 processing units in operation; out of which 63 per cent of plants were smaller ones with an operational capacity of 200 tonnes /day. About 25 per cent of the plants in the region fell in the middle category, with a capacity of 400 tonnes/ day. Though, larger plants with a capacity of 600 tonnes/ day also operated in the area, they were lesser in number (11%). On an average, the plants in this region operate for about 45-60 days during mid-May to early-July, depending upon the pulp order from the exporters and domestic markets, and supply of raw material (mango production in the region). The pulp recovery of the industries in the cluster was about 50-55 percent, and they produced about 1.8 lakh tonnes of mango pulp in 2016-17 consuming about 3.5 lakh tonnes of raw mango. Similarly, Reddy and Kumar (2010) have also reported a spurt in number of mango pulp processing industries between 1980 and 2000 in the Chittoor district of Andhra Pradesh.

Growth Drivers of Industry

The major driving forces for the mango pulp processing industry in the cluster were export demand (Figure 1) that commensurated with the increased supply of raw material due to acreage expansion

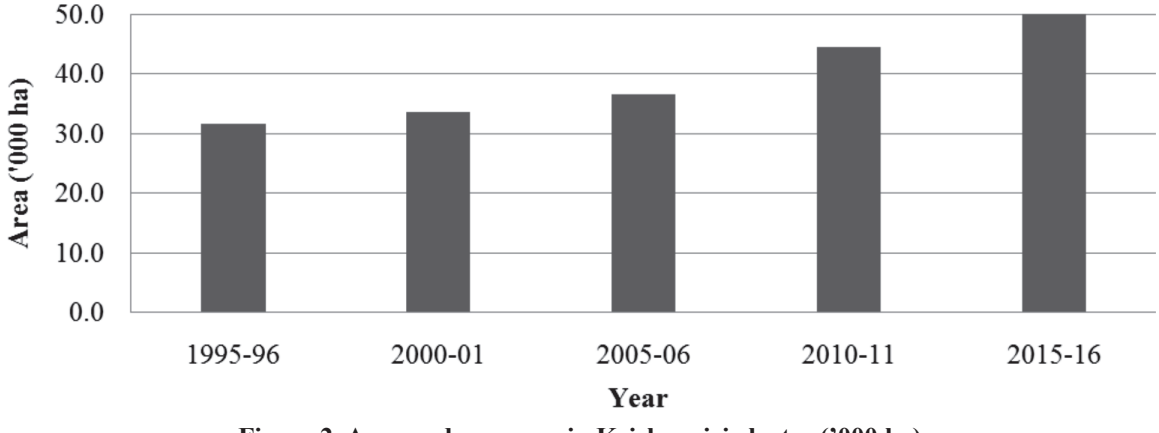

Figure 2. Area under mango in Krishnagiri cluster ('000 ha)

(Figure 2), and prevalence of favourable policy climate such as assistance from National Horticulture Board (NHB) schemes, accessibility to institutional credit and prompt licensing of processing units by the authorities. In addition, launching of National Horticulture Mission in 2005-06 also augmented the growth of processing industries in this region. Under this scheme, subsidies were provided not only for area expansion of mango, but also for establishing new processing units and/ or renovation of the existing units as credit linked back-ended subsidy.

It was evident from the survey that majority (62%) of the respondents (processors) had availed subsidy benefits from the government schemes. The effect of these support policies was visible clearly in the spectacular growth registered by the mango pulp export in comparison to the export of fresh mango (which also showed healthy growth, even though lesser than growth of pulp export). Fresh mango export increased from 17 lakh tonnes in 1987-88 to 36 lakh tonnes in 2015-16, while that of pulp has increased from 17 to 129 lakh tonnes during the same period. The growth pattern indicates that the pulp processing industry registered a modest growth in 1990s, followed by a robust growth in 2000s. However, from 2010 onwards, the exports of both the products registered a fluctuating trend in the same directions, and more importantly, exemplary growth was recorded in mango pulp. This result clearly establishes evidences for the export-led growth in processing industry. Further, Krishnagiri cluster was more suitable for growing 'Totapuri' variety, which is the best pulping quality variety and also the cheapest available raw material for pulp manufacturing. This facilitated the uninterrupted supply of raw materials to processing units. With response to increased demand for mango, farmers in the region expanded area under mango from 32,000 ha in 1995-96 to 54,000 ha in 2015-16 (Figure 2).This cluster now holds a share of 40 per cent in area, and about 25 per cent in production (2.15 lakh tonnes) of mango in Tamil Nadu in the year 2015-16.

Structural Change in Mango Pulp Industry

As per the respondents, the highest number of processing units (65 units) operated in the year 2010, but later many of these plants were either merged or shut down, resulting in a total of 34 operational units in the cluster. Nevertheless, the total processing

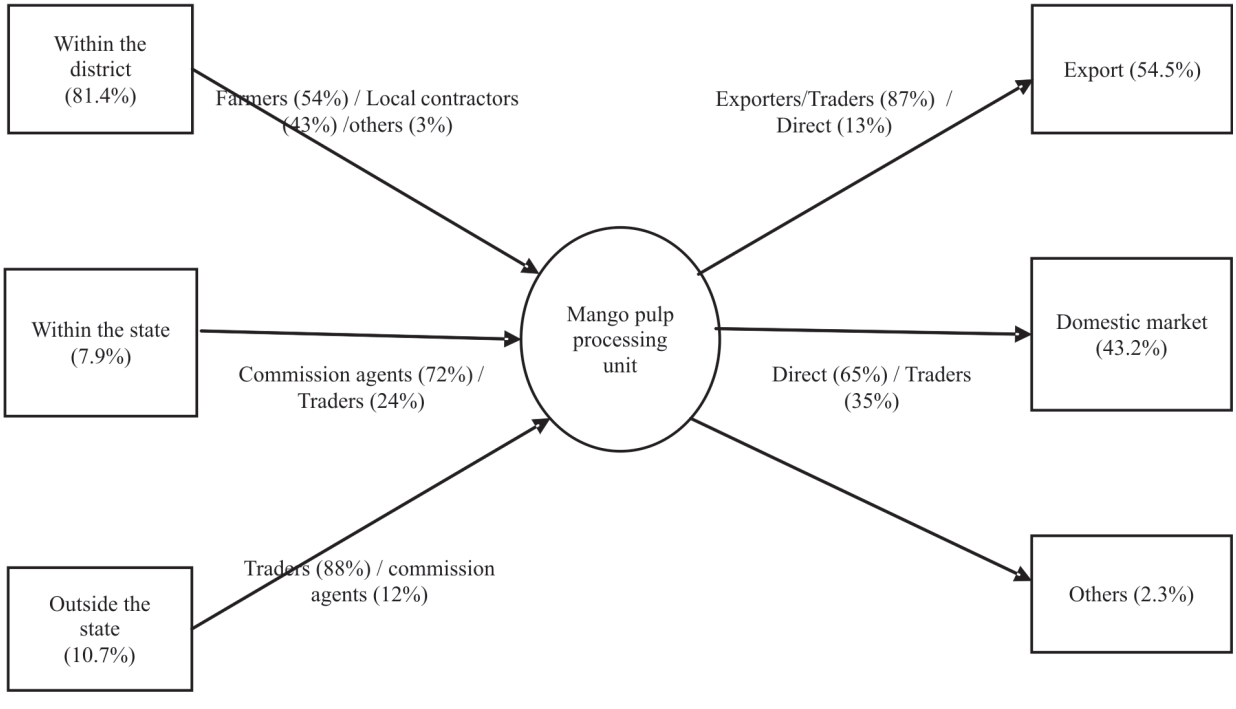

Figure 3. Forward and backward linkages established by the mango pulp processing industry
Source: Prepared by authors based on field survey, 2016-17
Note: Figures within the parentheses indicate percentage share in total volume of transactions

capacity of the cluster has not declined as processing plants have emerged with high capacity (200-600 tonnes/day) along with modern technologies. The major structural change in processing industry was observed after the year 2010. It was informed by the processors that pulp packaging materials like cans and tins were not preferred by the importers due to its non-reusable nature. This led to a sharp decline in export demand in early-2010s (Figure 1). This decline in export demand for pulp resulted in heavy inventory or stock (more than 40-50% of production) of mango pulp in many of the units and these units suffered huge financial losses. Thus, a necessity arose for restructuring of the existing traditional processing units (with relatively smaller capacity of about 100 tonnes per day), which were not able to withstand this shock, and lacking in modern technologies such as artificial ripening chamber, automatic destoner, aseptic plants and modern packaging with barrels. Such units ultimately exited from the industry.

Processing Industry-Farmer Linkages (Backward)

The mango pulp processing units had established linkages with different stakeholders to operate effectively in the input and output markets in the study area. The various pathways and role of different stakeholders in backward linkage of industry with the farmers in procurement of raw material (mango) and forward linkage with consumers in selling the mango pulp are depicted in Figure 3. The major share of raw materials (fresh mango) was procured from within the district (81.4%) (Figure 3). This supply was channelled through the backward linkage established with the farmers directly (54%) and with the local contractors (43%), as well as other marketing channel players like commission agents and traders (3%). In addition to the supply from within the district, the industry was also supplemented with fresh mango from other districts of Tamil Nadu. The commission agents were the major players (72%) in this backward linkage, followed by traders (28%). The processing units even procured raw material for pulp making from outside Tamil Nadu (10.7%). For this type of supply, they depended mainly on the traders (88%) and commission agents (12%).

Processing Industry-Market Linkages (Forward)

Mango pulp manufactured in the units of the region was sold in both in the domestic (43.2%) as well as international markets (54.5%). For selling in both these markets, the industry has established key forward linkages with the relevant players. For exporting the pulp, the linkages were mainly made with the exporters (87%). Some of the units also enter directly to the foreign markets by taking up the exporting activity themselves (13%). Selling in the domestic markets (mainly comprises of mango juice and drink manufactures) was mainly undertaken by the units themselves (65%) and about 35 per cent of the domestic sales was also enabled through traders. Interestingly, a small share of about 2.3 per cent of the total pulp produced was also sold directly to the consumers through company owned retail shops and nearby local retailers within in the cluster.

Linkages and Institutional Mechanisms

There were both formal and informal agreements functioning among the various stakeholders involved in the mango pulp processing industry. The planning for procurement of mangoes by the processing units is initiated in advance to the season. The role of local contractors is crucial for assuring minimum raw material supply to the plants by developing good rapport with the farmers. Each unit employed about 2-3 local contractors for a season and they were paid an amount of 1.5 -2 lakhs/season by the processing units. Apart from this, on an average each industry has a direct contact with about 150 farmers of the region, and this relationship was built over a long period of successful business with them. The industry provided advance payments to the farmers to the tune of 20-25 per cent of expected value of supply through local contractors with zero interest and with oral agreements. Further, institutional credit was also facilitated by the processors by linking banks and farmers, where, processors acted as the guarantors for extending loans up to 75 per cent of the cost of production through written agreements. However, institutional credit was not preferred by the farmers as it involves more procedures and formalities and interest also needs to be paid to the bank. Commission agents and traders operated at a margin of 1.5- 2.0 per cent of value of trade from the processors and without owning the product. However, traders purchased at a little lesser price from the farmers and sold to the processors and their margin was around 2-4 per cent. After the sale of mango to the processing industry, the amount is directly deposited into the farmer's bank account within a week after adjusting

for any loan or advance payments. Similar to the backward linkages, processors also maintained good rapport with agents in the forward linkages such as pulp exporters, traders and domestic juice makers. The processors got orders from these agents before start of the season, and they were to plan their processing and marketing strategies accordingly. The processors also received financial support for working capital in the form of loan through bank at an interest rate of 12 per cent, in addition to the advances received from some of the multi-national companies. In general, the linkages mostly operated on the basis of trust among the stakeholders and oral contracts were more prevalent than written agreements in the study area.

Economics of Mango Pulp Processing

The details regarding the costs involved in and the returns generated from the mango pulp processing (value addition) are presented in the Table 1. It is to be noted that although 12 processors participated in the survey, the information on costs and returns was accessed from only 7 units and all the economic analysis pertains to these units only. On an average, the total costs incurred for this value addition activity by a processing unit was ₹ 3962 lakh per year. This total cost is incurred under the two broad heads of annual fixed cost (8%) and annual variable or running cost (92%). Among the fixed costs, the interest on fixed investments, maintenance cost of processing unit and buildings and salary of permanent staff were the components with higher shares. Similarly, among the variable costs, the cost of fruits was the highest expenditure (77%), followed by interest on working capital (10%), packaging materials and packing charges, and labour charges.

The costs and returns of sample mango processing units are given in Table 2. On an average a processing plant produced about 11000 tonnes of mango pulp, and cost of mango pulp production was estimated to be ₹ 36/kg. The processing units earned a net income of about ₹7.68 crores per year and B:C ratio was found to be 1.19. The BCR was within the range of earlier studies reported by Reddy and Kumar (2010) (B:C ratio of 1.07) and Karthick *et al.* (2013) (B:C ratio of 1.41) for mango processing units, respectively for Andhra Pradesh and Tamil Nadu. The average pulp price was ₹ 45/kg, however it ranged from ₹ 35 to 50/ kg. In general, about 70-80 per cent of the production was sold in the current season and remaining 20-30 per cent will be sold gradually over the period which influences the pulp price. The decomposition of mango pulp price showed the major component of pulp price as raw material cost (64%) which indicates nothing but farmers share in mango pulp price. The cost of processing was about 16 per cent and processors' received a margin of about 20 per cent.

Table 1. Average cost of pulp processing units in the study area in 2016-17

Particulars	Value (in ₹ lakh)	Share (%)
(I) Annual fixed cost		
Salary of permanent staff	66.0	1.7
Maintenance cost of processing unit and buildings	67.7	1.7
Miscellaneous cost	22.4	0.6
Land rental value	16.0	0.4
Depreciation on machineries and buildings	27.8	0.7
Interest on fixed investment	94.2	2.4
Interest on fixed cost	35.3	0.9
Sub-total (I)	329.3	8.3
(II) Annual variable cost or running cost		
Cost of fruits	3067.3	77.4
Cost of additives	3.2	0.1
Labour charges	74.4	1.9
Cost of electricity, fuel and water	7.8	0.2
Packaging materials and packing charges	83.6	2.1
Transport Charges	5.8	0.1
Marketing and advertising charges	1.5	0.0
Interest on working capital	389.2	9.8
Sub-total (II)	3632.8	91.7
Total annual processing cost (I and II)	3962.1	100

Source: Authors' estimates based on field survey, 2016-17

Profile of Mango Farms and Cost of Cultivation of Mango in Krishnagiri District

The profile of mango farms is depicted in Table 3. The sample farms (120) were classified based on their operational holdings and majority (55%) of the farms belonged to the medium size category, followed by small (30%) and large (16%) farms. These sample farmers together cultivated mango under a total area of 421.31 ha. Similarly, the sample farms were grouped

Table 2. Economics of pulp processing and farmers' share in pulp price in 2016-17

Particulars	Value	Share (%)
Average annual pulp production (tonnes/ plant)	11000	
Cost of production of mango pulp (₹ lakhs /tonne)	0.36	
Average annual gross income (₹ lakhs /plant)	4730	
Averagenet income (₹ lakhs / plant)	768	
Benefit cost ratio	1.19	
Average price of the pulp (₹/kg)	45.00	
i. Average cost of production of pulp (₹/kg)	36.02	80.04
a. Farmers share in mango pulp price (raw material cost) (₹ /kg)	29.00	64.44
b. Cost of processing (value addition) (₹/kg)	7.02	15.60
ii. Profit margin of processor (₹/kg)	8.98	19.96

Source: Authors' estimates based on field survey, 2016-17

into three categories, based on the age of the orchards. Most of the orchards in the region were aged more than 20 years (48%), followed by orchards ageing between 11 and 20 years (38%), and orchards of less than 10 years (14%).

The economics of cultivation of mango is presented in Table 4. The cost of cultivation of mango was about ₹ 1.55 lakh/ ha, of which fixed cost was having a share 53 per cent and the rest were operational costs. Among the various components of costs, amortised share of establishment cost (18%) was the largest, followed by the interest on fixed capital (12%) and harvesting (12%). All other cost components were shared less than 10 per cent. It may be mentioned that the buyers (both processor and non-processor outlets) charged about 25-50 kg value of mango per tonne of produce as wastage (2.5-5%) based on the size and quality. The wastage cost along with transportation cost was estimated to be about 8 per cent of the total cost. The imputed rental value of land and depreciation on equipment were the other major items. The average yield of the Totapuri variety in the region was 19.98 t /ha, and the yield increased as the age of orchards increased. On an average, the cost of production of mango worked out to be ₹8.29 per kg and farmer earned a net income of ₹ 1.34 lakh/ha. A healthy benefit-cost ratio of 1.86 was found in the study area.

Table 3. Classification of mango orchards in Krishnagiri Districts based on size of operational holdings (ha) and age of mango orchards (years)

Particulars	Farms		Area	
	Number	Share in total (%)	Size (ha)	Share in total (%)
Operational holdings				
Small (< 2ha)	36	30	35.6	8.46
Medium (2-4 ha)	65	55	189.8	45.05
Large (> 4ha)	19	16	195.9	46.49
Total	120	100	421.31	100
Age of mango orchards				
< 10 years	17	14	49.79	12
11 -20 years	45	38	153.74	36
>20 years	58	48	217.82	52
Total	120	100	421.35	100

Source: Authors' estimates based on field survey, 2016-17

Farmer-Market Linkages

Mapping of farmers' linkage to the market through various marketing agents in the study area is shown in Figure 4. Different forms of linkages were established by the farmers with markets and it was found that farmers did not adopt one-channel approach; rather multi-channel linkage was common in this region. The total mango production of sample farmers was estimated along with share of various marketing channels. Figure 4 reveals that processing industry was the major destination for the farmers in the study area with a share of about 94 per cent of the total mango sold. The transaction in this channel ensued between farmers and processors either directly or through local

Table 4. Economics of mango cultivation in Krishnagiri district

Particulars	Amount (₹/ha)	Share (%)
I. Operational cost		
Land preparation and ploughing	14,377	9.18
Manures	5,593	3.57
Irrigation	6,077	3.88
Plant protection	6,349	4.06
Maintenance	11,232	7.18
Harvesting	18,977	12.12
Transportation and wastage	11,986	7.66
Interest on working capital	8,951	5.72
Subtotal (I)	83,542	53.37
II. Fixed costs		
Land rent	11,062	7.07
Depreciation on machinery and equipment	12,872	8.22
Interest on fixed capital	19,308	12.33
Land revenue tax	804	0.51
Amortized share of establishment cost	28,948	18.49
Subtotal (II)	72,993	46.63
Total costs (I+II)	1,55,580	100.00
Yield (t/ha)	19.98	
Cost of production (₹/kg)	8.29	
Gross returns (₹/ha)	2,89,590	
Net returns (₹/ha)	1,34,009	
BCR	1.86	

Source: Authors' estimates based on field survey, 2016-17

contractors. The rest of the outputs were sold to commission agents (3%), traders (2%) and exporters (1%). Subsequently, the commission agents and traders sold the outputs to three outlets such as processors, wholesalers (operating in local mandi) or line market brokers (mainly dealing with interstate transactions). Exporters sold the fresh mango as well as mango pulp mostly in the countries like Saudi Arabia, UAE and EU. The mango pulp was further processed by the juice manufactures to make mango drink or mango juice which then reached the end consumers.

Impact of Processing Industry on Farm Income

Table 5 seeks to explore the price and net income received by the mango growers of the Krishnagiri district across various marketing channels. It also demonstrates the income gain to the farmers in the presence of processing industry. The marketing channels offered varying prices to the farmers. The highest price was offered by the exporters, followed by commission agents, traders, and processors. Within the Krishnagiri cluster, despite offering highest price, exporters shared least in total mango produce in the study area, as exports require to meet the stringent quality conditions in terms of size, colour, maturity and no damage, etc. In contrast, the processors were able to attract the bulk of the mango produced in the region (95%), in spite of offering the least price.

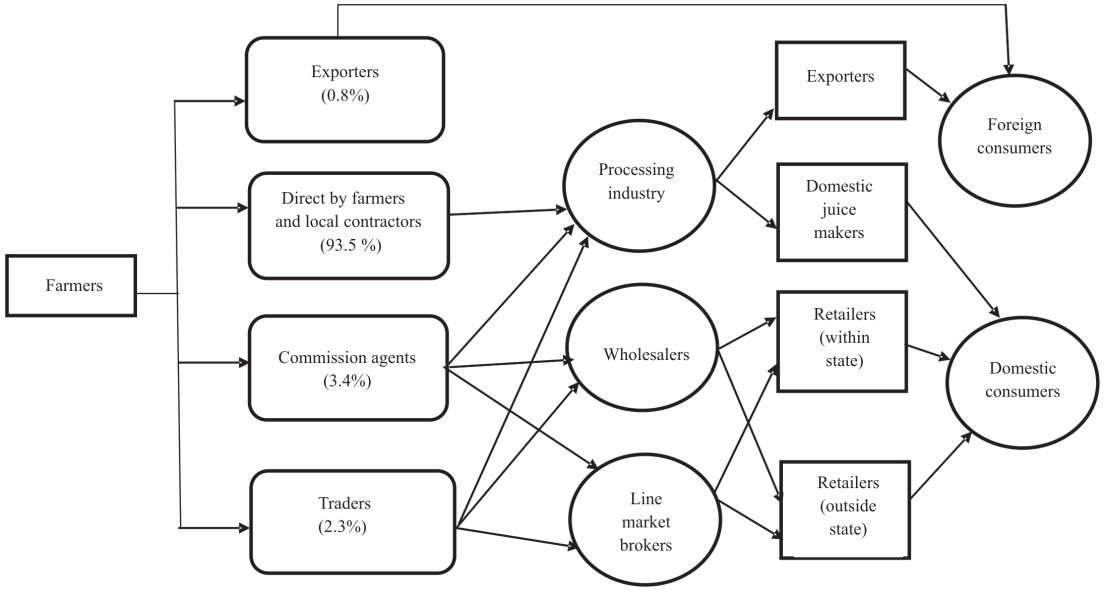

Figure 4.Linkage structure of farmers and market in Krishnagiri district
Source: Prepared by authors based on field survey, 2016-17
Note: Figures within the parentheses indicate percentage share in volume of transactions

Although, having price advantage over processors, the commission agents and traders handled small shares of mango produce. The reasons of farmers' preference for various marketing channel is discussed in detail in the next section. One of the marketing efficiency indicator shows that farmers' share in consumer rupee was highest for the processor outlets (63%), followed by non-processor outlets such as commission agents (55%) and traders (49%).

As farmers followed a 'mixed market linkage' approach rather than 'pure processor linkage' approach, a comparative analysis of the price received by the farmers in the processing industry cluster and no processing industry cluster was carried out with the assumption of homogeneous cost across the farms. The results clearly indicate that where there is no processing industry cluster, the farmers received the lowest price as in Karnataka (₹ 11.87/kg) and Dindigul (₹ 12.50/kg). However, in Andhra Pradesh where there is a well established processing industry cluster, the price was more or less equal (₹ 13.76/kg) and income gain was also very low (6%). Interestingly, the study recorded a substantial gain in net income of those farmers who were linked with processors (₹ 5.81/kg) as compared to the farmers in counterfactual markets such as Dindigul (₹ 4.21/kg) and Karnataka (₹ 3.58/kg). The study has empirically evidenced that with the emergence of processing industry cluster, the farmers' net income would increase — as high as 62 per cent in Karnataka and 38 per cent in Dindigul. On an average, the processing industry could effectively enhance the farmer's income by 49 per cent in these two localities.

Farmers' Perception about Various Marketing Channels

Despite lowest prices, a large part of the total mango production of the region was sold to the processors. To elucidate the reasons for this, Likert scale measures was used to analyse the respondent's attitude towards various attributes of marketing channels. The score ranged between 1 and 5 and the most important factor scored the value 5, and the least important had value 1. The results of analysis of decision-making behaviour of farmers in selection of marketing channels are presented in Table 6. A perusal of Table 6 clearly indicates that processor channel (4.2) scored more than non- processor channel (1.96). The reason for such wide variations in the scores was

Table 5. Income received by the farmers across different marketing channels

Marketing channel	Price received by the farmers (₹/kg)	Net returns (₹/kg)	Share in total mango sold (%)	Retail price (₹/kg)	Farmers' share in consumer price (%)
Within the Krishnagiri cluster					
Processor	14.10	5.81	93.51	45.00	62.65
Commission agent	21.58	13.29	3.40	39.00	55.33
Trader	19.27	10.98	2.30	39.00	49.41
Exporter	32.77	24.48	0.80		
Reference market					
Andhra Pradesh (A state with processing industry cluster)	13.76 (2.44)	5.47 (6.14)			
Dindigul district (Within a state no processing industry cluster)	12.50 (12.77)	4.21 (37.87)			
Karnataka (A state with no processing industry cluster)	11.87 (18.75)	3.58 (62.10)			
Average of Dindigul and Karnataka (Only no processing industry cluster)	12.19 (15.68)	3.90 (49.00)			

Note: Figures within the parentheses indicate percentage change in price and net income compared to the sample cluster
Source: Authors' estimates based on field survey, 2016-17

explored. The marketing channel attributes were classified into three major categories viz., income, input supply and convenience factors, which demonstrate the farmers' preference towards the processor channel. With the exception of price, all other non-price attributes scored significantly higher in the processor outlets than non-processor outlets. There were several reasons for the popularity of processing units as a prospective market for the farmers, another reason was that farmers were able to market large volumes of product in a assured market, even without worrying about the quality of the produce. And ability to sell directly to the processors with negligible or no brokerage charges was also an added advantage in the processor channel.

The support during waiting period at the time of bumper production and subsequent market glut was very crucial and important. The processor with sufficient infrastructure handled such a massive volume in a short period and provided much needed stability to the market. Some of the respondents recalled the nightmare of waiting in the truck at mandi and distress sale of their produce at throwaway prices, before the emergence of processing industry in this region (during 1990s). Also, the wastage costs of mango in this processor outlet as low in comparison to the others (50-100 kg /tonne). Apart from this, many of the farmers had taken loan assistance for their operating cost through tie-up with pulp industry, before start of season. The difference among the scores was least for distance and prompt payment. Most of the processing units are located in and around the mango production centres and it is evenly distributed across the mango belt. Hence, farmers felt it convenient to select this channel as most preferred one. Some of the processors provided fruit fly traps and crates to the farmers, as a strategy to build a strong linkage with the farmers. In the non-processor channel, better prices were realised only when, mango lots were of either better quality due to its uniform size, maturity, and colour, or were of bigger size. These results suggest that although the prices were high in non-processor channels, wide fluctuations in price, absence of assured market, and quality restrictions in these channels eroded the price gains. Thus, due to these key benefits, the processing industry was able to flourish and operate profitably in the region. Such benefits of farmer processor linkages were also recorded by the previous studies (Minot, 2008; Narayanan, 2014; Gouk, 2012; Shepherd, 2007).

Table 6. Farmers' perception about various marketing channels

Factors	Average score	
	Processor channel	Non-processors channel
Income related		
Assured market for any quantity	5.00	1.19
Prompt payment	4.72	2.51
Lesser brokerage	4.85	1.68
Price	1.89	4.82
Input supply related		
Technical guidance	4.78	1.08
Credit supply at a cheaper interest rate	4.88	1.33
Subsidy/Insurance facilitation	3.48	1
Convenience related		
Support during waiting period	4.51	1.1
No rejection on quality basis or less wastage	4.02	1.36
Distance	4.11	3.48
Mean score	4.22	1.96

Source: Authors' estimates based on field survey, 2016-17

Summary and Conclusions

The purpose of this study was to assess the linkage mechanisms and institutional arrangements between farmers and markets and also to quantify the extent of income gains across the marketing channel, particularly in the processor and non-processor outlets. Discussions with processors revealed that export demand was the accelerator for the processing industry growth and export trend confirmed it. In addition, various government schemes under National Horticulture Board and Mission not only incentivised entrepreneurs to venture into the processing sector, but also helped in mango area expansion, which augmented the growth of processing industry. The majority (97%) of the farmers integrated with processors either directly or through local contractors (one who is employed by the processors and does not receive any commission from the farmers). However, traders and commission agents played a major role in linking processors and farmers, particularly those who were from outside the cluster

area and other states. Although formal institutional arrangements were practised in this study area, the linkages mostly operated on the basis of trust among the stakeholders and oral contract was the major instrument.

The cost of mango pulp processing was found to be ₹ 7/kg and processor margin was about 20 per cent of the mango pulp price. The processors' annual net profit was ₹ 7.68 crore /year and B:C ratio was 1.19. The cost of cultivation of mango was estimated to be ₹ 1.56 lakh/ ha and cost production of mango was ₹ 8.29/kg and farmers received net income ₹ 1.34 lakh / ha and B:C ratio was 1.86. The farmers' received the highest price through exporter channel (₹ 33/kg) and least price in processor outlet (₹14.10/kg) within the Krishnagiri processing industry cluster. However, farmers located in non-processing industry areas, received on an average ₹ 11.76-12.50/kg. It underscores the price gain in farmers' linkage with processors. On the other hand, farmers' share in consumer rupee was highest in processor outlets (62%), while in other channels it was about 49-55 per cent. Despite low price, the farmers sold about 94 per cent of their produce to the processor outlets in the study area. It is because, price advantage received in non-processor outlet was crowded out by other attributes such as high variations in price, unassured market and stringent quality requirements.

Farmers in the selected processing industry followed 'mixed marketing linkage' than 'pure market linkage'. Therefore, to find out the impact of processing industry on farmers' income, the average modal price received by the farmers in other mango growing districts within the state and other neighbouring states was taken as the counterfactual and assumed homogenous costs conditions at farms across the regions. The empirical evidence suggests that with the emergence of processing industry in major mango-growing areas, the farmers' income would increase to the extent of 49 per cent. In the face of increasing demand for processed foods, the government should identify the production centres (particularly for perishable commodities) for promotion of processing industries to reap the twin benefits of meeting the demand for processed foods and also enhancing the farmers' income.

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