

Role of Farmers in Supply Chain Management of Horticultural Products

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Abstract

The horticultural crop in the country presently covers 13.6 million hectares of land i.e., 7 per cent of the gross cropped area and contributes 18-20 per cent of the gross value of India's agricultural output. However, the post harvest loss in fruits and vegetables is estimated to be around 35-40 per cent of the production. This necessitates effective and efficient Supply Chain Management (SCM). Various initiatives are attempting to strengthen the supply chain and provide benefits to the farmers. This study examines the role of farmers in supply chain management of horticultural products. The study examined the farmer's role in planning for production of horticultural crops and SCM, procurement of material, credit arrangement, production management, post harvest management of vegetables and fruits, processing, information management and marketing. Results reveal that majority of the farmers had medium level of participation in planning and procurement of material. Majority of the farmers had high participation in production management and no participation in credit arrangement, post harvest management, processing and marketing through SCM models.

Introduction

The production and productivity of horticultural crops have augmented manifold and the production of fruits and vegetables has tripled in the last 50 years. The horticultural crop in the country presently covers 13.6 million hectares of land i.e., 7 per cent of the gross cropped area and contributes 18-20 per cent of the gross value of India's agricultural output. India ranks first in the world in the combined production of fruits and vegetables. The production of fruits and vegetables during 2006-07 as per the data available with the National Horticultural Board (NHB) is 58.92 and 116.03 million tones, respectively.

India is the largest producer of mango and banana in the world and occupies the second position for onion. However, the post harvest loss in fruits and vegetables is estimated to be around 35-40 per cent of the production. Infrastructure facilities for post harvest handling like pre-cooling, refrigerated transport, grading, packing, cold storage etc. are not adequate and result in considerable post harvest losses in horticultural

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produce. Due to inadequate linkages with markets and lack of processing facilities, farmers do not get a good price for fruits and vegetables. The presence of a large number of intermediaries and absence of linkages lead to loss of value both for farmers and consumers. The farmer's share in consumer rupee varies from 40-60 per cent in the case of vegetables. Further, the degree of perishability, variety and quality, and various market imperfections, market infrastructure etc. also influence the marketing costs and price levels of fruits and vegetables. This necessitates effective and efficient supply chain management.

Supply Chain Management refers to the management of the entire set of production, distribution, and marketing processes by which a consumer is supplied with a desired product. (Gadre et al, 2002). Globally, consumer concerns on food safety and product quality assurance have led to the implementation of new food safety systems, but implementing these quality assurance systems is resource demanding, time consuming and expensive for farmers. To provide safe and quality products, farmers need to adopt modern practices and technologies. The supply chain needs to build a long term relation between retailers and farmers for procurement and providing extension services regarding use of inputs, production technology; information on harvesting, prices, pre-cooling, grading, sorting, packaging and on-farm sorting. A number of big corporate houses like Reliance, ITC, Aditya Birla group, Godrej and Bharati have entered into the retail marketing of fresh fruits and vegetables. These new initiatives are attempting to strengthen the supply chain and provide benefits to the farmers. The farmer has played different roles in crop production. Majority of the farm men participated in land preparation, manure and fertilizer application, irrigation and application of chemicals to control pests and diseases, harvesting and marketing of the produce. Farm women have participated in leveling of the field, sowing, transplanting, weeding and intercultural operations, protection of crop from birds and sometimes harvesting.

This study examines the role of farmers in supply chain management of horticultural products.

Materials and Methods

The study was conducted in the state of Andhra Pradesh which is one of the important agricultural states in the country. Andhra Pradesh is divided into three regions; namely, Telangana, Rayalaseema and Coastal Andhra. Three districts, one from each region, namely Ranga Reddy, Cuddapah and East Godavari were purposively selected, based on the highest area and production of horticultural crops. A complete list of mandals having more number of existing models of Supply Chain

Management (SCM) was prepared for the selected districts. One mandal from each district having highest number of SCM models was selected purposively. The mandals selected were, Kakinada from East Godavari, Cudapah from Cudapah and Bala nagar from Ranga Reddy district. Three retail outlets i.e. Food World, Reliance Fresh and More Super Market were selected for the study. Besides these, Rythu Bazaar (Farmers' Market) was also selected for the study. Two vegetables and two fruits were selected for the study. Tomato and onion from Ranga Reddy district, banana from East Godavari and mango from Cuddapah district were selected for the study based on the highest area and production in the selected districts.

A list of farmers who are supplying their produce to each of the existing models of SCM was collected. From the list, 10 banana growing farmers, 10 tomato cultivating farmers, 10 mango orchard farmers and 10 onion cultivating farmers were selected randomly from each outlet. Equal numbers of banana, tomato and mango farmers were selected randomly from the Rythu Bazaar. In all, 40 banana growing farmers, 30 onion cultivating farmers, 40 tomato cultivating farmers and 40 mango orchard farmers were selected for the study. Thus a total of 150 farmers were selected from existing models of SCM at Mandal level by following proportionate random sampling.

Development of Index for Role of Farmers in SCM of Horticultural Products

A list of indicators was prepared, from the available literature and interactions with experts, of the farmer's role in Supply Chain Management. The components were scrutinized for their amenability for operationalisation, measurement and possibility of eliciting data from farmers. The list thus prepared was submitted to judges for relevancy to the indicators. The judges were from the cadre of Assistant Professors and above in the area of Agricultural Extension and Horticulture. They were asked to indicate their responses on a 3 point relevancy continuum viz., most relevant, relevant and irrelevant.

The judges responded to the relevancy coefficient of i^{th} component worked by the following formula.

$$R_{ci} = \frac{\text{Total score all the judges on } i^{th} \text{ component}}{\text{Maximum score on the continuum} \times \text{Total number of judges}}$$

Those components with the relevancy coefficient of 0.7 and above were selected.

Measurement of the Indicators of Farmer's role in Supply Chain Management of Horticultural Products

S.No.	Category	Score range
1.	Less role in Supply Chain Management	Below (Mean - S.D)
2.	Medium role in Supply Chain Management	Between (Mean±S.D)
3.	High role in Supply Chain Management	Above (Mean + S.D)

Selected indicators were administered to the farmer to know their role in Supply Chain Management. Each indicator was measured to obtain the farmer's role in SCM by using the index formula. Selected indicators are : 1.Planning for production of horticultural crops and SCM, 2.Procurement of material, 3.Credit arrangement, 4.Production management, 5.Post harvest management of vegetables and fruits, 6.Processing, 7.Information management and 8.Marketing. For measuring these identified eight indicators, statements were prepared for computation of index to know the role of the farmers. The number of statements prepared were 8, 6, 4, 15, 10, 14, 8 and 3 respectively.

Each of the statements has a 5 point continuum scale with a scoring pattern of 5,4,3,2 and 1 and weightages were given according to the responses. Index for each parameter has been worked out by using the following formula:

$$\text{Indicator index} = \frac{\text{Actual score obtained}}{\text{Maximum possible score}} \times 100$$

Computation of Farmer Role index: The scores obtained for each respondent for all the eight indicators were totaled to get the farmer role index by using this formula.

$$\text{Farmer role Index} = \frac{\text{Actual score obtained}}{\text{Maximum possible score}} \times 100$$

S.No.	Category	Score range
1.	Less role in Supply Chain Management	Below (Mean - S.D)
2.	Medium role in Supply Chain Management	Between (Mean±S.D)
3.	High role in Supply Chain Management	Above (Mean + S.D)

Categorization: After obtaining the scores, the respondents were categorized into three groups based on mean and S.D. as may be seen below.

Results and Discussion

To elicit the farmer's role in supply chain management of horticultural products, different indicators were developed. Eight indicators with their sub indicators were given to the farmers to know their participation in Supply chain management of horticultural products. After obtaining the responses, frequency and percentage were calculated to know the participation of the farmer against different indicators. Farmer participation for each indicator was different and their participation is given in the following tables.

Role of Farmers in Planning for Production of Crops

Table 1 reveals that all the banana farmers are participating in the planning for division of area for the crop, followed by procurement of material, labor requirement and planning for different crop varieties as farmers had good knowledge about these practices and these are the activities mostly carried out by them and according to the required quantity and quality of products supplied to the outlet.

Farmers divided the area and cultivated different crop varieties and also knew about the wages at their locations and required material for crop production. Supply Chain (SC) agents influenced farmers in activities related to planning as majority of the Supply Chain agents went to the farmers and set up agreements with them and provided better price for their produce. To satisfy consumer needs, farmers adopted the practices suggested by the SC agents in planning, so that they could get a better price for their produce.

With regard to tomato farmers, majority of them participated in the planning for division of area for the crop, followed by labor requirement and planning for different crop varieties due to their age, education and farming experience. Tomato is a highly perishable crop, hence, in order to reduce the product loss, the farmer should plan for more marketing channels. SC agents influenced tomato farmers in planning for market demanded crops, suitable SCM for marketing of produce, selection of effective marketing channel, different crop varieties and time of sowing. They provided the information about consumer requirements, current market, demanded crops and varieties. To satisfy the consumer, SC agent should provide recommendations to the farmer while planning. Farmers not only get market access but also get advice on market demand – what variety to grow, how much and when.

Table.1 Distribution of Farmers according to their role in Planning for Production of Crops

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
1	Planning for production of crops												
a)	Market Demanded Crops	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (33.33)	20 (66.67)	-	10 (25.00)	30 (75.00)	-
b)	Division of Area for the Crop	40 (100.00)	-	-	40 (100.00)	-	-	30 (100.00)	-	-	31 (82.50)	-	9 (17.50)
c)	Different Crop Varieties	21 (52.50)	14 (35.00)	5 (12.50)	26 (65.00)	14 (35.00)	-	13 (43.33)	17 (56.67)	-	21 (52.50)	14 (35.00)	5 (12.50)
d)	Procurement of material	38 (95.00)	-	2 (5.00)	-	40 (100.00)	-	2 (6.67)	20 (66.67)	6 (20.00)	39 (97.50)	-	1 (2.50)
e)	Labour requirement	25 (62.50)	8 (20.00)	7 (17.50)	40 (100.00)	-	-	21 (70.00)	5 (16.67)	4 (13.33)	33 (82.50)	-	7 (17.50)
f)	Time of sowing	15 (37.50)	13 (32.50)	12 (30.00)	17 (42.50)	11 (27.50)	12 (30.00)	10 (33.33)	8 (26.67)	12 (40.00)	21 (52.50)	11 (27.50)	8 (20.00)
g)	Suitable Supply chain for marketing of produce	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	16 (53.33)	14 (46.67)	-	10 (25.00)	30 (75.00)	-
h)	Selection of effective marketing channel	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (33.33)	20 (66.67)	-	10 (25.00)	30 (75.00)	-

Figures in parentheses indicate percentage

Onion farmers are participating in the planning as they have the ability to divide the area for production and had farming experience, extension contact and media exposure. SC agents influenced onion farmers in planning for market demanded crops, suitable SCM for marketing of produce, selection of effective marketing channel, different crop varieties and time of sowing. To get better price farmers must follow the suggestions made by the SC agents and adopt recommended practices. Farmers are planning with the help of SC agents who provide the required information to the farmers for planning.

Mango farmers had large land holdings and they had farming experience and education to divide the area and procure the material. Farmers mostly get the information from the neighbors and involve the family members in planning. Farmers are getting information about the required quantity and quality of produce to the outlet twice a week from the collection center. SC agents influenced mango farmers in planning for market demanded crops, suitable SCM for marketing of produce, selection of effective marketing channel, different crop varieties and time of sowing. This was because SC agents went to the farmer and set up agreements with them to provide the information about the outlets and marketing channel.

These findings are in line with the findings of Mitra (2008), Ranganna et al (2009) and Sreenivasa *et al.* (2009).

Role of Farmers in Procurement of Material

All the banana farmers are participating in procurement of herbicides, implements, FYM/ organic manure and fertilizers (Table 2). The remaining materials were procured by the family members and neighbors. This might be due to the fact that, earlier, mostly farmers procured the material from input dealers but through SCM farmers procure material from Hariyali Kisan Bazaars which are located at district level. Some times SC agents assist them in procuring the material from other places.

All the tomato farmers procured the FYM/ organic manure, pesticides/ insecticides and implements for crop production. This might be due to the fact that farmers procured these materials from rural hubs which were located around the city. SC agents are not providing the material but they provide subsidies to get the implements and material.

All the onion farmers procured FYM/ organic manure followed by implements, seeds, pesticides and fertilizers with the help of SC agents. SC agents provided information about the place for procurement of material and also advised the farmer

Table.2 Distribution of Farmers according to their Role in Procurement of Material

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
2	Procurement of material												
a)	Seeds	2 (5.00)	30 (80.00)	8 (20.00)	10 (25.00)	30 (85.00)	-	10 (33.33)	20 (66.67)	-	10 (25.00)	30 (85.00)	-
b)	FYM/ organic manure	26 (85.00)	-	14 (35.00)	40 (100.00)	-	-	30 (100.00)	-	-	31 (82.50)	-	9 (17.50)
c)	Fertilizers	18 (40.00)	24 (60.00)	-	26 (65.00)	14 (35.00)	-	13 (43.33)	17 (56.67)	-	21 (52.50)	14 (35.00)	5 (12.50)
d)	Pesticides / insecticides	19 (47.50)	-	21 (52.50)	-	40 (100.00)	-	2 (6.67)	20 (66.67)	6 (20.00)	39 (97.50)	-	1 (2.50)
e)	Implements	28 (70.00)	-	12 (30.00)	40 (100.00)	-	-	21 (70.00)	5 (16.67)	4 (13.33)	33 (82.50)	-	7 (17.50)
f)	Herbicides	40 (100.00)	-	-	17 (42.50)	11 (27.50)	12 (30.00)	10 (33.33)	8 (26.67)	12 (40.00)	21 (52.50)	11 (27.50)	8 (20.00)

Figures in parentheses indicate percentages

Table.3 Distribution of Farmers according to their Role in Credit Arrangement

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
3	Credit arrangement												
a)	Credit information	-	31 (77.50)	9 (22.50)	3 (7.50)	30 (75.00)	7 (17.50)	3 (10.00)	19 (63.33)	8 (26.67)	1 (2.50)	29 (72.50)	10 (25.00)
b)	Arrangement of credit	30 (75.00)	-	10 (25.00)	-	30 (75.00)	10 (25.00)	-	20 (66.67)	10 (33.33)	4 (10.00)	30 (75.00)	6 (15.00)
c)	Providing short term loans	3 (7.50)	27 (67.50)	10 (25.00)	3 (7.50)	27 (67.50)	10 (25.00)	3 (10.00)	17 (56.67)	10 (33.33)	3 (7.50)	27 (67.50)	10 (25.00)
d)	Providing long term loans	11 (27.50)	14 (35.00)	15 (37.50)	18 (40.00)	14 (35.00)	10 (25.00)	8 (53.33)	15 (50.00)	9 (30.00)	16 (40.00)	14 (35.00)	10 (25.00)
e)	Crop Insurance	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (33.33)	20 (66.67)	-	10 (25.00)	30 (75.00)	-
f)	Health insurance	0 (22.50)	23 (57.50)	8 (20.00)	-	35 (87.50)	5 (12.50)	-	16 (60.00)	12 (40.00)	6 (15.00)	27 (67.50)	7 (17.50)
g)	Veterinary care	-	10 (25.00)	-	-	-	-	-	-	-	-	-	-

Figures in parentheses indicate percentages

about the recommended doses to be applied for crop production. Farmers mostly had high level participation in procurement of insecticides and pesticides as in order to control the pests and diseases, farmers obtained suitable and powerful pesticides at any cost to get a better quality of produce.

In case of mango farmers, majority of them participated in procurement of pesticides/ insecticides, seeds for crop production, FYM/ organic manure and implements and fertilizers. Farmers procured the material from the input dealers and some of them got the assistance of SC agents to procure the material. To get better quality and quantity of products, farmers procured pesticides/ insecticides on a timely basis and also participated more in these activities.

Role of Farmers in Credit Arrangement

Seventy five per cent of the banana farmers are arranging credit, some times from neighbors as may be seen in Table 3. Farmers had health insurance for their family and some members obtained insurance from outlet members. Farmers got the agricultural inputs, financial services, veterinary health care and educational facilities through the Rural Business Hubs which act as procurement centers of Reliance Retail. Hence the role of the farmer was medium and the role of supply chain agents was more.

Through SCM, farmers are getting the information regarding credit facilities from SC agents. Farmers get loans from outlet members with low interest at the required time because they set up agreements with outlets to sell their produce. Hence, farmers get the required amount whenever they require the credit for their children's education or marriages. They get a loan up to Rs.1 lakh from outlet members.

Regarding tomato farmers, majority of the tomato farmers participated in the arrangement of credit, arranging long term loans themselves for crop production and health insurance. SC agents are providing credit information to the farmers followed by providing short term loans and long term loans. Farmer's education and farming experience helps to save money for crop production and planning the budget accordingly. Through SCM, farmers get short term and long term loans from outlet members due to their agreement with the outlets.

Majority of the onion farmers are participating in credit arrangement and SC agents are providing credit information and long term loans. The possible reason may be that farmers store the seed for crop production and also maintain the credit according to their budget and save the amount from other crops like rice, pulses etc. SC agents provide the information about credit regarding how to maintain the budget and where to get loans at low interest etc.

Majority of the mango farmers are participating in arrangement of credit and SC agents are providing credit information followed by short term loans and long term loans. This might be due to the farmer's extension contact, large land holding and planning ability which help them to arrange the credit themselves. Mostly SC outlets provide long term and short term loans to the farmers for their crop and family needs.

Role of Farmers in Production Management

As may be seen in Table 4, all the banana farmers are participating in ploughing, time of planting, weeding and inter cultivation, preparation for spraying, spraying and harvesting with hands, size of pits, irrigation, inter cropping, after care, fertilizer application, recommended spacing and method of propagation. The possible reason might be that production practices were mostly performed by farmers alone, some activities were performed along with family members and some activities carried out by labor. Farm women mainly participated in planting in pits, weeding, manure application and fertilizer application with the help of farm men.

All the tomato farmers are participating in production activities such as ploughing, compost application, fertilizer application, preparation of spraying, spraying, nursery bed preparation, sowing of seeds, transplanting of seedlings, dusting, lay out of the field, compost application after lay out of the field, weeding and inter cultivation, irrigation and harvesting with hands. The possible reason may be that farmers cultivate the crop by following the recommended practices. In order to follow the SCM practices, farmer's age, education, farming experience, extension contact are important factors in crop cultivation.

All the onion farmers are participating in ploughing, compost application after ploughing, compost application after sowing, nursery bed preparation, irrigation, weeding, and preparation of spraying, fertilizer application, transplanting of seedlings, sowing of seeds and spraying. These activities were mostly carried out by farmers. SC agents or vendors provide specific practices to the farmers for better crop production and higher yield. Farmers are following production practices as per SC agent's recommendations to produce the required quantity and quality of produce for outlets.

Table.4 Distribution of Farmers according to their Role in Production Management

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
4	Production management												
a)	Soil testing	40 (100.00)	-	-	40 (100.00)	-	-	30 (100.00)	-	-	40 (100.00)	-	-
b)	Ploughing	40 (100.00)	-	-	40 (100.00)	-	-	30 (100.00)	-	-	40 (100.00)	-	-
c)	Lay out of the field	-	-	-	27 (67.50)	-	13 (32.50)	20 (66.67)	-	10 (33.33)	27 (67.50)	-	13 (32.50)
d)	Compost application	-	-	-	27 (67.50)	-	13 (32.50)	30 (100.00)	-	-	40 (100.00)	-	-
e)	Method of propagation	27 (67.50)	-	13 (32.50)	-	-	-	-	-	-	-	-	-
f)	Time of planting	40 (100.00)	-	-	-	-	-	-	-	-	40 (100.00)	-	-
g)	Size of pits	38 (95.00)	-	2 (5.00)	-	-	-	-	-	-	24 (60.00)	-	16 (40.00)
h)	Recommended spacing	29 (72.50)	-	11 (27.50)	-	-	-	-	-	-	27 (67.50)	-	13 (32.50)
i)	Compost application	21 (52.50)	-	19 (47.50)	40 (100.00)	-	-	30 (100.00)	-	-	-	-	-
j)	Fertilizer application	32 (77.50)	-	8 (20.00)	40 (100.00)	-	-	22 (73.33)	-	8 (26.67)	29 (72.50)	-	11 (27.50)

Table.5 Distribution of Farmers according to their Role in Post harvest Management of Horticultural Products

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
5	Post harvest management	-	-	-	-	-	-	-	-	-	-	-	-
a.	De greening	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
b.	Assembling	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
c.	Sorting	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
d.	Grading	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
e.	Grading based on shape	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
f.	Size	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
g.	Color	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
h.	Manual grading	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
i.	Hand packing	10 (25.00)	-	-	10 (25.00)	-	-	-	30 (100.00)	-	10 (25.00)	-	-
j.	Machine packing	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
k.	Material used	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (25.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-

All the mango farmers are participating in production operations like ploughing, compost application, time of planting, inter cropping followed by irrigation, spraying and dusting, weeding, fertilizer application, lay out of the field, recommended spacing. The results show that majority of mango farmers performed all production activities by adopting SCM practices to provide required quality and quantity to the outlets and earn better profits. SC agents had no role in these activities but provided SCM practices to farmers for better crop cultivation.

These findings are supported by the findings of Anil Kumar and Arora (1999), Sangeeta (2004), Sunil Kumar (2006), Sudharshan Naidu (2007) and Everaarts and Putter (2009).

Role of Farmers in Post Harvest Management

It is clearly seen from Table 5 that, 25 per cent of the SCM farmers followed post harvest management whereas 75 per cent of SC agents or labor at outlets participated in post harvest management practices like de greening, assembling, sorting, grading manually, based on shape, size and color, machine packing, materials used for packing. The place for packing was the central processing center. For all products, post harvest management practices were carried out by the outlet members.

Through Reliance Fresh, farmers sold their produce at collection centers after harvesting and obtained the price for their produce. From the center, the vendor transported the produce to the central processing center where sorting, grading, packing was done according to the requirement of consumers. Thus through SCM, post harvest management practices were mostly carried out by labor of the central processing center. Farmers had no participation in these activities.

Through More outlet, tomato, onion and banana farmers sold their produce to the vendors at farm level and vendors procured the produce and transported the same to the central processing center where sorting, grading and packing was done. Thus there was no farmer participation in post harvest management.

Through Food World, tomato and banana farmers sold their produce to the vendors and vendors transported the produce to the central processing center where sorting, grading and packing was done. Onion and mango produce was sold at the wholesale market, and in the market, the vendor sold the produce and transported it to the central processing center where sorting, grading and packing was done.

On the other hand, at the Rythu Bazaar, farmers are not following post harvest management practices at the field level and are loading their produce at Rythu Bazaar without packing and grading.

Regarding processing, majority of the SC agents participated in drying and labeling of the selected products at the central processing center. Outlet members are labeling their products with their brand names along with quantity and weightage of the produce.

The findings are supported by the findings of Anil Kumar and Arora (1999), Sunil Kumar (2006), Sudharshan Naidu (2007) and Everaarts and Putter (2009).

Role of Farmers in Information Management

Regarding information management, SC agents are providing information on demanded crops, seed varieties, post harvest management practices, marketing information, product promotion strategies, price fixing followed by package of practices and plant protection measures to banana, tomato, onion and mango farmers. The possible reason may be that farmers had less knowledge about SCM and to satisfy the consumer requirements farmer must be aware of the present market information. Farmers get the information from the SC agents about SCM.

Tomato farmers are getting information from the SC agents on demanded crops, seed varieties, post harvest management practices, marketing information, and product promotion strategies, price fixing followed by package of practices and plant protection measures. To satisfy the consumer needs, better quality and quantity, low wastage of produce, better price, farmers get the required information from the SC agents.

Mango farmers got the information from SC agents on demanded crops, seed varieties, post harvest management practices, marketing information, and product promotion strategies, price fixing followed by package of practices and plant protection measures. To get a better crop with less wastage, higher price, and better crop production, a farmer must get the information from SC agents about SCM.

Role of Farmers in Marketing

With regard to marketing, farmers participated in marketing of their produce through the Rythu Bazaar and had high level of participation in marketing of their produce through the same. After harvesting, farmers sold their produce at the Rythu Bazaar. Majority of the SC agents marketed banana, tomato, onion and mango through outlets. The activities conducted by SC agents in marketing of all products included cold storage of the produce, transportation of produce from the farm to the outlet, selecting the place for sale of produce, immediate payment to the farmers and channels used for marketing. The possible reason may be that after packing, vendors transport the packed produce to the outlets through tempos. Marketing was done by outlet members. Farmers had no participation in marketing of their produce through outlets.

The findings are in line with the findings of Quaddas *et al* (1999) Anil Kumar and Arora (1999), Sackey *et al* (2001) and Hicks (2002).

Table.6 Distribution of Farmers according to their Role in Information Management

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
I.	Place of packing: Farm building/ processing center	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
6a.	Processing Drying	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (75.00)	-
b.	Packing & labeling	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
7a.	Information management Information about demanded crops	-	30 (75.00)	10 (25.00)	-	30 (75.00)	10 (25.00)	-	30 (100.00)	-	-	30 (75.00)	10 (25.00)
b.	Seed varieties	-	30 (75.00)	10 (25.00)	-	30 (75.00)	10 (25.00)	-	30 (100.00)	-	10 (25.00)	20 (50.00)	10 (25.00)
c.	Plant protection measures	19 (47.50)	21 (52.50)	-	19 (47.50)	17 (42.50)	4 (10.00)	30 (75.00)	-	-	10 (25.00)	30 (75.00)	-
d.	Package of practices	-	13 (32.50)	27 (67.50)	21 (52.50)	9 (22.50)	-	10 (33.33)	20 (66.67)	-	10 (25.00)	30 (75.00)	-
e.	Post harvest management practices	10 (25.00)	30 (75.00)	-	9 (22.50)	28 (70.00)	3 (7.50)	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
f.	Marketing information	-	30 (75.00)	10 (25.00)	-	30 (75.00)	10 (25.00)	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
g.	Product promotion strategies	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
h.	Price fixing	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-

Figures in parentheses indicate percentages

Table.7 Distribution of Farmers according to their Role in Marketing of Horticultural Products

S.No	Indicators	Banana (n=40)			Tomato (n=40)			Onion (n=30)			Mango (n=40)		
		Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others	Farmers	SC agents	Others
8	Marketing												
a.	Cold storage	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (33.33)	20 (66.67)	-	10 (25.00)	30 (75.00)	-
b.	Mode of transport: bicycle	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (33.33)	30 (100.00)	-	10 (25.00)	30 (75.00)	-
c.	Mini auto	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
d.	Produce transportation from farm to road through vehicle	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (100.00)	-	10 (25.00)	30 (75.00)	-
e.	Transport of produce from road to market	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (100.00)	-	10 (25.00)	30 (75.00)	-
f.	Place for sale of produce Rythu Bazaar	10 (25.00)	-	-	10 (25.00)	-	-	-	-	-	10 (25.00)	-	-
g.	Retail outlet	-	30 (75.00)	-	-	30 (75.00)	-	-	20 (66.67)	-	-	20 (50.00)	-
h.	Wholesaler	-	-	-	-	-	-	10 (33.33)	-	-	10 (25.00)	-	-
i.	Immediate payment	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-	-	30 (100.00)	-	10 (25.00)	30 (75.00)	-
j.	Channels used: retail outlets	-	30 (75.00)	-	-	30 (75.00)	-	-	30 (100.00)	-	-	30 (75.00)	-
k.	Wholesalers	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (25.00)	-	10 (25.00)	30 (75.00)	-	10 (25.00)	30 (75.00)	-

Figures in parentheses indicate percentages

Conclusion

Supply chain plays a key role in production of quality produce and providing remunerative prices to the farmers. The model shows the way for small and marginal farmers with quality concerns to face open markets. There is every scope for consumers to get fresh produce and it has become the main channel, through which consumer preferences are reaching the producers. Therefore more number of SCM models need to be extended at mandal and village levels which may bring most of the farmers and consumers under one roof.

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