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Supply Chain Mapping of Green Leafy Vegetables in Bengaluru

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Abstract

Since agriculture is the backbone of the Indian economy, much more attention is needed to sustain the industry. Vegetables are essential components of nutritional security given their short duration, high yield, nutritional capital, economic viability and the potential to generate on-farm and off-farm employment. An increase in per capita income, health awareness, urbanization, increasing working women, crop diversification towards high value vegetables for higher profits fuel vegetable cultivation in the country. The primary focus of the study was to assess the mapping and understanding of supply chain of green leafy vegetables in Bengaluru, Karnataka. The total sample size included 40 green leafy vegetable farmers / growers and 20 retailers identified through focus group discussions. An attempt to map and understand the performance of supply chain of green leafy vegetables and to enquire the monetary flow to farmers from consumers through different channels.

Keywords : Supply chain, Mapping, Understanding, Green leafy vegetables, Bengaluru

Supply chain mapping (SCM) was the process of planning, implementing and controlling the supply chain operations with a view to meeting customer requirements as effectively as possible (Maertens., 2007). SCM covers the transport and storage of raw materials, supply from manufacture to consumer, operating in process procurement and finished products (Ayieko *et al.*, 2005). It consists of integration and Co-ordination of their flows inside and between firms (Cluskey and Opourke, 2001). SCM can also be defined as the transfer of products, knowledge and resources as they pass from the supplier wholesaler - retailer - customer in cycle and it plays a key role in holding business at minimum costs and enhance productivity (Bhatnagar and Sohal, 2005). The most critical factor within the framework of SCM is the flow process (Furlanetto., 2006). The flow process is divided into three types *viz.,* material flow, information flow and money flow (Priyanka *et al.,* 2021). The material flow consists of delivering goods to a customer from a manufacturer and any requirements of the customer returns or service. The money flow ensures timely, secure and productive monetary transactions falling under the terms of credit, payment schedules etc. The information flow which transfers orders and updates the delivery status to consumers (Rahul *et al.,* 2021).

Agricultural supply chain concept relates to all organizations / cooperatives that are responsible for the production and distribution of vegetable / fruit / cereals / pulses and other farm commodities (Reddy, 2005). Agricultural commodities are used as raw materials in these chains to manufacture consumer products with maximum value addition and to supply products to customers through two or more different organizations to satisfy the requirements of the orders of customers in the field of agribusiness (Subha, 2004). Agricultural supply chain contains small and medium-sized entrepreneurs, such as farmers and producers of raw materials, agricultural inputsuppliers, agricultural output processors, farmer's cooperatives, FPO's, brokers, suppliers, distributors, wholesalers and retailers, who tend to operate independently, mainly in the last few steps of the supply chain (Marsden, 2000). SCM ensures the remunerative prices for farmers and induces them to invest more in vital inputs so that their productivity increases (Poot, *et al*., 2000). By

increasing the marketable surplus, the supply chain can effectively reduce the inefficiencies in production, processing, storage and transportation (Ricks *et al.,* 2000).

Green leafy vegetables have a special place among all the vegetables in the country for being preferred by a large number of people in a country almost every other day (Sahay and Gupta, 2005). Hence, it was necessary to improve the marketing system to accelerate development for increasing revenue from the market by producing good quality green leafy vegetables (Frankel, 2000). As a link between producer and consumer, SCM and mapping plays a very important role in stimulating production and consumption and also increasing the rate of economic development (Mair and Tehmina, 2005).

The Advantages of Supply Chain Management as follows :

1. Increasing of sales of the products
2. Dissemination of technology
3. Advanced techniques are used
4. Better information regarding product, market and technology flows
5. Knowledge and capital among supply chain partners
6. In transportation and storage, the product losses will be reduced
7. Better control of product quality and safety
8. Tracking and tracing of sources
9. Enormous investments and problems are shared by the supply chain partners
10. Efficiencies are increasing and trade volumes are increasing
11. Customer satisfaction to the products delivered

In the light of above facts, the researcher aims to analyze the mapping of green leafy vegetables and their prospects with following specific objectives.

1. To know the personal and socio-economic characteristics of farmers and retailers
2. To map and understand the supply chain of green leafy vegetables in Bengaluru
3. To assess the monetary flow to farmers
4. To understand the performance of supply chain of green leafy vegetables

METHODOLOGY

Bengaluru was chosen as the study area to learn how green leafy vegetables mapping. Many retail companies come to Bengaluru to do business, which has been massive growth in retail chains over the last five years (Somaiah, 2016). Bengaluru has been chosen as the study location, as this city has been the center of the retail revolutions and has numerous food retail chains operating for a long time. Many new retail chains have also recently opened their stores in the city and several retail chains have made Bengaluru as the focal point of their managerial operations.

Apart from Bengaluru being known as India's garden city for its climatic conditions, greenery and the presence of numerous public parks, along with Lal Bagh and Cubbon Park, the city has become a hub for heavy industries in the public sector - particularly aerospace, telecommunications, machine tools, heavy machinery, space and defense. After the liberalization of India's economy, the establishment and excellence of business software service companies (Fearne and Hughes, 1999) in Bangalore has led to growth of India's information technology industry. Bengaluru is referred to as India's Silicon Valley, which accounts for 35 per cent of technology exports from India. The city is the home to several prestigious colleges and educational institutions and has the second highest literacy rate among the nation's metropolitan cities. Thus, the people are health conscious and they are interested in purchasing green leafy vegetables from the neighborhood retail outlets.

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Valley, which accounts for 35 per cent of technology exports from India. The city is a home of prestigious colleges and educational institutions and has the second highest literacy rate among the nation's metropolitan cities. Thus the people are health aware and they are interested in purchasing green leafy vegetables those present in the retail outlets. Bengaluru is known as India's garden city for its climatic conditions, greenery and the presence of numerous public parks, along with Lal Bagh and Cubbon Park.

In order to know current supply chain management of green leafy vegetables in Bengaluru, the data was collected from 40 farmers and 30 retailers belonging to different taluks of both Bengaluru Urban and Bengaluru Rural districts were interviewed. The questions pertained to mapping, monetary flow, optimum use of current resources and bottlenecks in supply chain of green leafy vegetables.

Analytical Tools and Techniques

Tabular Analysis : the data collected was presented in tabular form to facilitate easy comparison. Simple tabular analysis was used for analysis of farmer's, retailers and consumer's socio-economic characteristics for that the data gathered through the questionnaire method. The data collected was subjected to statistical analysis.

Percentage Analysis : per cent increase and per cent decrease are measures of per cent change, which is the extent to which a variable gains or losses intensity, magnitude, extent, or value (Wermund *et al.,* 2002). The figures are arrived at by comparing the initial and final (or after) quantities according to a specific formula (Zairi, 1998). It is assumed that both the initial and the final quantities are positive (larger than 0).

Suppose a quantity has an initial value of x_1 and then increases or decreases to a final value of x_2. The percentage change, D percentage, is calculated by finding the difference $x_1 - x_2$ (subtracting the initial value from the final value), then dividing the results of results of this subtracting by x_1 (the initial value), and finally multiplying by 100 expressed as a formula.

$$D\% = \frac{100\ (x_1 - x_2)}{x_1}$$

Supply Chain Mapping : Supply chain mapping of green leafy vegetables is used to understand the supply chain management. Mapping technique is the process of developing a visual depiction of the basic structure of the chain (Ricks *et al.,* 1999). A process map illustrates the way of green leafy vegetables flow from farmers to end consumers. It is a compressed visual diagram of the data collected at different stages of supply chain analysis and supports the narrative description of the chain (Wilson, 1996). The purpose of a visual tool in the analysis process is to develop a shared understanding. Maps also help to identify information gap required for further research. To analyze the performance of supply chain in green leafy vegetables the performance index was employed.

$$\text{Performance index (PI)} = \frac{\text{No. of farmers growing green leafy vegetables in their own or purchased farm land}}{\text{total no. of farmers}}$$

RESULTS AND DISCUSSION

Personal and Socio-Economic Characteristics of Farmers and Retailers

Family size of the farmers is presented in Table 1. It shows that the majority of the farmers *i.e.,* 43.33 per cent of sample respondents are with medium size family, having four to five members, while 21.66 per cent of the respondent farmers had large family size with more than five members and 35.00 per cent of the sample respondent farmers had small family size with less than or equal to four members including the family head.

TABLE 1

Family size of the sample respondents in Bengaluru district

Family size	Category	Number	Percentage
Small	<4	21.00	35.00
Medium	4-5	26.00	43.33
Large	>5	13.00	21.66
Total		60.00	100.00

TABLE 2

Age group of the sample respondents in Bengaluru district

Age group (years)	No. of Farmers	No. of Retailers
20-30	5.00 (12.50)	0.00 (0.00)
31-40	11.00 (27.50)	6.00 (30.00)
41-50	13.00 (32.50)	13.00 (65.00)
>50	11.00 (27.50)	1.00 (5.00)
Total	40.00 (100.00)	20.00 (100.00)

(*Note*: Figures in parentheses indicate percentage to the total)

The details of age wise distribution of sample respondents of farmers and retailers are presented in Table 2. There are 60 sample respondents in that there are 40 farmers and 20 retailers. Among the farmers, 32.50 per cent were belongs to the age group of 41-50 years, 27.50 per cent of the farmers are in age group of 31-40 years, 27.50 per cent of farmers are above 50 years and while only 12.50 per cent are in age group of 20-30 years. In case of retailers, majority of them (65.00 per cent) were in age group of 41-50 years, followed by 30 per cent of the retailers are in age group of 31-40 years and while only five per cent were in age group of above 50 years.

The results on family composition of sample respondents indicated that adult male members per family were 30.92 per cent, adult female members were 30.46 per cent. whereas, the number of children accounted 38.60 per cent in the family size as showed in Table 3.

TABLE 3

Family composition of the sample respondents in Bengaluru district

Particulars	No. of Farmers	No. of Retailers	Total
Adult males	49.00 (25.65)	32.00 (29.09)	81.00 (30.92)
Adult females	54.00 (28.27)	30.00 (27.27)	84.00 (30.47)
Children's	88.00 (46.07)	52.00 (47.27)	140.00 (38.60)

(*Note*: Figures in parentheses indicate percentage to the total)

The literacy levels of sample respondents were analyzed and showed in Table 4. Among the total sample respondents 11.66 per cent studied up to primary level, 16.66 per cent of sample respondents studied up to secondary level, 33.33 per cent of sample respondents studied upto high school level, 35.00 per cent of sample respondents were graduated and above and remaining 6.66 per cent were illiterates.

TABLE 4

Educational status of the sample respondents in Bengaluru district

Particulars	No. of Farmers	No. of Retailers	Total
Illiterate	1.00 (2.50)	1.00 (5.00)	2.00 (3.33)
Primary school	4.00 (10.00)	3.00 15.00)	7.00 (11.66)
Secondary school	6.00 (15.00)	4.00 (20.00)	10.00 (16.66)
High school	14.00 (35.00)	6.00 (30.00)	20.00 (33.33)
Graduate and above	15.00 (37.50)	6.00 (30.00)	21.00 (35.00)
Total	40.00 (100.00)	20.00 (100.00)	60.00 (100.00)

(*Note*: Figures in parentheses indicate percentage to the total)

The occupational status of sample farmers producing different vegetables in the Bengaluru district, majority of them dependent on only farming (37.50 per cent), followed by 35.00 per cent of farmers were employed along with farming and remaining only 27.50 per cent of sample farmers are having own business/ profession along with farming as shown in Table 5.

TABLE 5

Occupational status of the farmers in Bengaluru district

Particulars	No. of Farmers
Only farming	15.00 (37.50)
Farming + Employee	14.00 (35.00)
Farming + Profession/business	11.00 (27.50)

(*Note*: Figures in parentheses indicate percentage to the total)

The Mysore Journal of Agricultural Sciences

The annual income of the sample respondents is shown in the Table 6. Among the total respondents including farmers and retailers, maximum number (41.66 per cent) of them were earning Rs.2,00,000 to Rs.5,00,000 followed by 21.66 per cent of sample respondents were fall under income group of >Rs.5,00,000. 18.33 per cent of sample respondents were fall under income group of Rs.1,00,000 to Rs.2,00,000, 11.66 per cent of respondents were fall under income group of <Rs.50,000 and 6.66 per cent of respondents were fall under income group of Rs.50,000 to Rs.1,00,000.

TABLE 6

Annual income of the sample respondents in Bengaluru district

Annual income (Rs.)	No. of Farmers	No. of Retailers	Total
<50,000	7.00 (17.50)	0.00 (0.00)	7.00 (11.66)
50,000-100,000	2.00 (5.00)	2.00 (10.00)	4.00 (6.66)
100,000-200,000	6.00 (15.00)	5.00 (25.00)	11.00 (18.33)
200,000-500,000	20.00 (50.00)	5.00 (25.00)	25.00 (41.66)
>500,000	5.00 (12.50)	8.00 (40.00)	13.00 (21.66)
Total	40.00	20.00	60.00

(Note: Figures in parentheses indicate percentage to the total)

To Map and understand the Supply Chain of Green Leafy Vegetables

Product flows and actors are the major components of a supply chain. The basic functions of supply chain are collection, production, wholesale, retail and consumption. The set of supply chain functions is a good starting point for constructing the supply chain diagram. Mapping of supply chain will help to develop a shared understanding of the structure

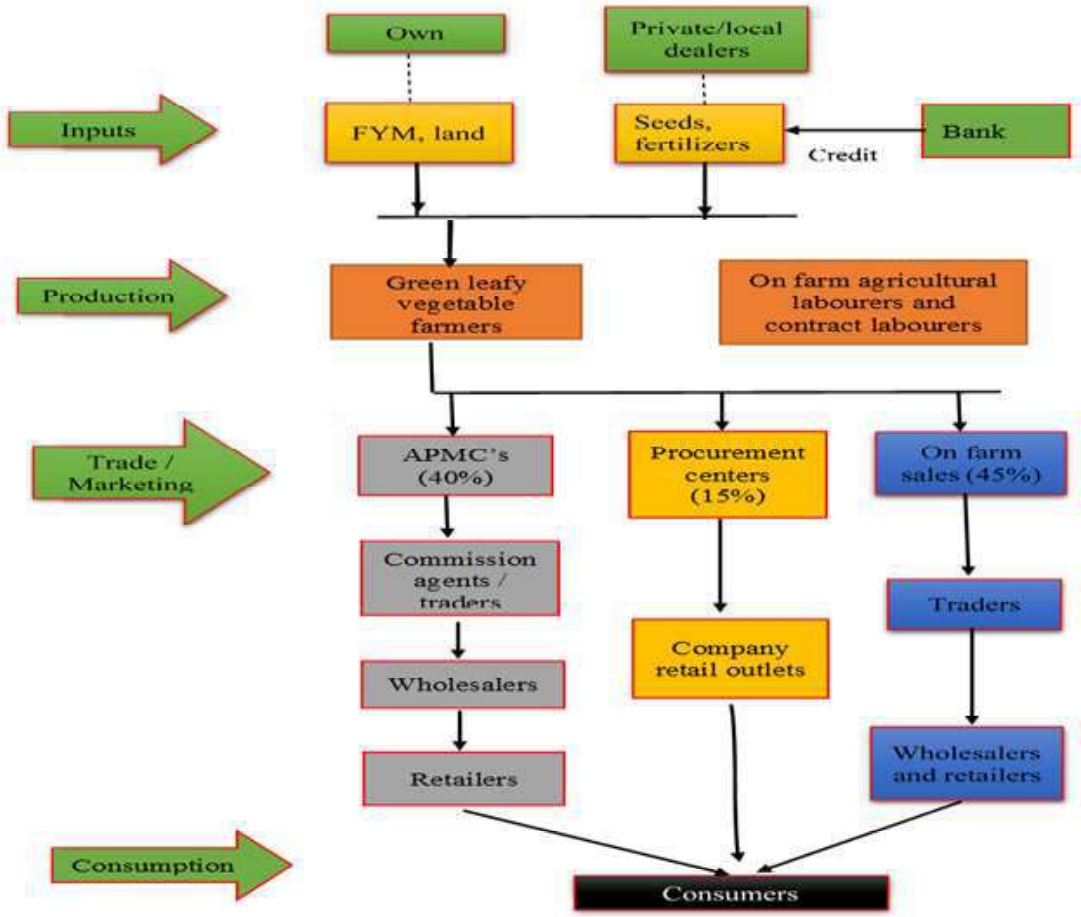

Fig. 1 : Mapping of supply chain of green leafy vegetables

and performance of the industry. Supply chains of green leafy vegetables in the study area were identified through focus group discussions and interactions with sample respondents for mapping the supply chain.

The supply chain mapping of green leafy vegetables shows the graphical representation in Fig. 1. In this supply chain mapping as it moves from inputs to consumers, passing through different stages they are, inputs, production, trade / marketing and consumption. Here the farmers having their own land and FYM and they purchase seeds and fertilizers from private / local dealers and get credit from bank these process is undertaken in inputs stage and production stage on farm agricultural labourers and contract labourers there. In trade / marketing stage the farmer sells their produce to three ways they are, first way is the farmer sells to APMC again sells to commission agents / traders next sells to wholesalers next sells to retailers next sells to consumers. Second way is the farmer sells to procurement centers next sells to company retail outlets next sells to consumers and finally third way is the on farm selling traders only take produce from farmers and sells to wholesalers and retailers and next sells to consumers.

Sales of Green Leafy Vegetables by Farmers

The sales of green leafy vegetables are shown in Table 7. Here 18 farmers (45 per cent) are selling their produce on the farm itself, 16 farmers (40 per cent) sells to APMC market and remaining six farmers (15 per cent) are selling their produce to procurement centers. Hence, most of the farmers selling their produce on the farm itself because this type reduces the farmers risk of marketing.

TABLE 7

Sales of green leafy vegetables by sample respondents in Bengaluru district

Particulars	No. of Farmers	Percentage
APMC	16.00	40.00
Procurement centers	6.00	15.00
On farm sales	18.00	45.00

Understanding the Supply Chain of Green Leafy Vegetables

In reality, customers end up paying more than customers should be paying, if the supply chain changed due to waste and various margins in the current supply structure. In India, the farmer gets about 30 per cent of what the customer pays at the retail shop.

Factors Affecting the Green Leafy Vegetables Supply Chain

Government Policies : In formulating the policies of farming, production, distribution, retailing and financing government play an important role. Allowing foreign operators for green leafy vegetables production, distribution and retailing is a decision of national importance. The decision need to be consistent along that of the supply chain and mutually reinforcing and contradictory. Further, research should be initiated to develop indigenous packaging materials, machines and more importantly protocols for storage of green leafy vegetables.

Handling and Packing : The proper handling and packaging facilities are not available in particular locations. To reduce wastage proper training and knowledge about packaging and handling needs to be provided to different intermediaries and to the growers.

i) Handling : Assemble the green leafy vegetables on the ground - in shade, informal sorting - removal of highly damaged green leafy vegetables and small size green leafy vegetables. These results into low market price, black strain on the peel green leafy vegetables and then low market price and low storage life.

ii) Packaging at farm level : In gunny bag, cloth bag, bamboo basket covered with leaves, without any packaging, wooden box, plastic crate, covering with newspaper or banana leaves these techniques lead to damage the green leafy vegetables and thus low quality and lesser price.

Transportation from farm : Rickshaw van, trucks, no control on temperature / humidity, packaging bags / boxes of different weight, size, commodity in the same carrier.

Monetary Flow to Farmers from Various Stakeholders

As furnished in Fig. 2, the monetary flow to farmers from various stakeholders. takes place either through cash, cheque, bank payment and credit / debit card payments. The mode of payment depends on the amount of money paid to the stakeholders in the chain, if the amount of money to be paid was less, then the mode of payment was through cash and if the amount paid was more, then it was through cheque or bank payment.

Performance of Supply Chain

The efficiency of supply chain refers to the extended activities of supply chain in meeting the ultimate customer requirements, including the availability of green leafy vegetables, their on-time delivery and all the capacity needed in supply chain to deliver the value in sensitive manner. From the sample survey it is found that, in their supply chain relationships almost all daily wholesalers cum commission agent, retailers and consumers have no contractual agreements. These routine wholesalers cum commission agent, retailers, and consumers play an important role in the supply chain management performance. The intensity of supply chain management is characterized by the shared confidence and faith between the parties with the unwritten contracts.

Supply chain efficiency was calculated by the model proposed with appropriate modifications. We assessed output for the two major supply chains described, that is to say, the supply chain of green leafy vegetables grown on their own farm land and the supply chain of green leafy vegetables purchased from the other farm land.

A supply chain Performance Index was developed on the basis of three dimensions of the supply chain *viz.,* efficiency, flexibility and quality. The supply chain

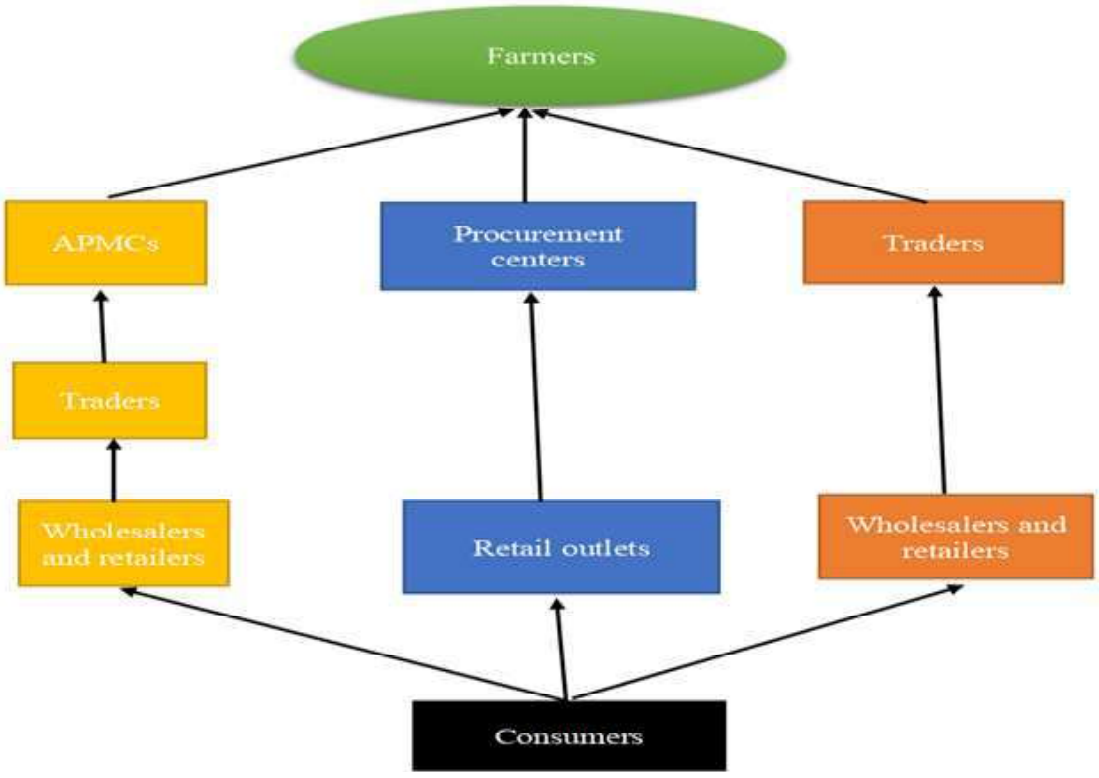

Fig. 2 : Monetary flow to farmers

TABLE 8

Performance of supply chain of green leafy vegetables

Supply chain of green leafy vegetables	Performance index (%)
Produced in their own farm land	59.00
Purchased from other farm land	41.00

Performance Index of green leafy vegetables produced in their own farm land was estimated to be 59 per cent and that of green leafy vegetables purchased from other farm land 41 per cent, which indicates that the supply chain of green leafy vegetables produced in their own farm land was slightly more efficient than supply chain of green leafy vegetables purchased from the farms of others as shown in Table 8. In other words, both these chains could be concluded as good performing ones.

Farmers of green leafy vegetables, retailers and consumer's socio-economic characteristics are need for future researchers reference and also based this future researcher can concentrate on mapping in study area with an anticipation of understanding the supply chain. The study concludes the mapping, understanding, performance of supply chain of green leafy vegetables and to know about the monetary flow to farmers from consumers through different stakeholders. This was resulted in supply chain mapping as it moves from inputs to consumers, passing through different stages they are inputs, production, trade/ marketing and consumption.

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