

ISSUES AND CHALLENGES IN THE SUPPLY CHAIN OF FRUITS & VEGETABLES SECTOR IN INDIA: A REVIEW

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ABSTRACT

Purpose- *The entire supply chain of Fruits and Vegetables in India is laden with various issues and challenges. To list the possible challenges and suggest a way forward, there is a need to study the supply chain of Fruits and Vegetables sector in India. So the purpose of this paper is to discuss the supply chain of fruits and vegetables sector in India and explain the issues which are affecting it. Authors also suggested the corresponding mitigation strategies to overcome the identified issues and challenges.*

Design/methodology/approach- *Descriptive research has been used for this study. The supply chain of Fruits and Vegetables sector has been explained and attempt has been made towards identifying the issues affecting the supply chain of the sector. The present study undertakes a thorough review of basic and contemporary literature available and tries to explain the factors affecting the supply chain of Fruits and Vegetables sector in India.*

The literature has been divided into various themes according to the issues in the supply chain and an investigation has been attempted to identify various factors affecting the supply chain.

Findings- *The study found that Cold Chain Facilities; Fragmented Supply Chain; Linkages and Integration between the partners; Taxation Issue; Infrastructure Facilities; Cost of Packaging Material; Technology and Techniques; Farmer's Knowledge and Awareness; Quality and Safety standards; Processing and Value Addition; Supply Chain inefficiency; Farmers income; Supply chain losses and wastage of fresh produce; Transportation facilities; Demand and market information etc. are the factors which constitutes serious challenges for Fruits and Vegetables sector and are affecting the overall growth of the agricultural development of India.*

Research limitations/implications- *The authors have focuses only on Fruits and Vegetables sector, authors may look at other sector like food processing unit, cold chain and other perishable items such as meat, dairy industry, chocolate, beverages etc.*

Practical implications- *Overcoming these issues and challenges will benefit the decision makers and various stakeholders like the farmers, state government, transporters and food processing unit to understand the current status, issues and challenges for better planning and management in the field of fruits and vegetables supply chain.*

Originality/value- *Most of the prior literature have been focused on the general issues like cold chain, marketing efficiency etc. of fruit and vegetables supply chain. There exists a need of having review on supply chain specifically in F&V sector, identifying all the factors affecting it and suggest mitigation strategies. This review fills this gap in the literature of supply chain management of Fruits and Vegetables sector.*

Keywords: *Fruits & Vegetables, Supply Chain Management, Inefficiency, Infrastructure, Wastage.*

1. INTRODUCTION

The Fruits and Vegetables (F&V) sector has been a driving force in stimulating a healthy growth trend in Indian agriculture. Given the rising share of high value commodities in the total value of agricultural output and their growth potential, this segment is likely to drive agricultural growth in the years to come (ASSOCHAM, 2013). It plays a unique role in India's economy by improving the income of the rural people. Cultivation of these crops is labor intensive and as such they generate lot of employment opportunities for the rural population.

F&V sector is perhaps the most profitable venture of all farming activities as it provides ample employment opportunities and scope to raise the income of the farming community. It also has tremendous potential to push the overall agriculture growth. India has been bestowed with wide range of climate and physio-geographical conditions and as such is most suitable for growing various kinds of F&V. This has placed India among the foremost countries in F&V production just behind China. F&V together constitute about 92 % of the total horticultural production in India (ASSOCHAM, 2013).

During 2012-13, India's contribution in the world production of F&V was 12.6 % and 14 % respectively (NHB, 2013). China's share has been highest with 21.2% in world's fruit production and 49.5% in world's vegetables production followed by India and Brazil. The world production and percent share of F&V is shown in **Table 1**.

Table1. World production and percent share in 2012-13

FRUITS			VEGETABLES		
Country	Production	Share	Country	Production	Share
China	137066750	21.2	China	573935000	49.5
India	81285334	12.6	India	162186567	14
Brazil	38368678	5.9	USA	35947720	3.1
USA	26548859	4.1	Turkey	27818918	2.4
Indonesia	17744411	2.7	Iran	23485675	2
Philippines	16370976	2.5	Egypt	19825388	1.7
Mexico	15917806	2.5	Russian Federation	16084372	1.4
Turkey	14974561	2.3	Mexico	13599497	1.2
Spain	13996447	2.2	Spain	12531000	1.1
Italy	13889219	2.1	Italy	12297645	1.1
OTHERS	270594597	41.8	OTHERS	261467661	22.6

Source: *Indian Horticulture Database, NHB, 2014*

1.1. Trends in Fruits and Vegetables Production & Present Status of India

India is the second largest food producer in the world, after China and one of the centers of origin of F&V with the total production of 88.977 million metric tonnes of Fruits and 162.897 million metric tonnes of vegetables till the year end 2014 (NHB, 2015). The production of F&V in India has been shown in **Figure 1** from the year 1991-2014 which has increased from 28.63 million metric tonnes to 88.97 million metric tonnes in fruits and 58.53 million metric tonnes to 162.89 million metric tonnes in vegetables.

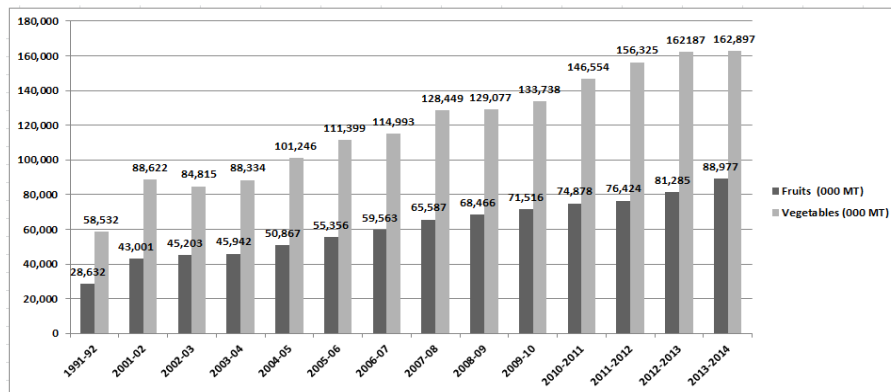


Figure1. Fruits and Vegetables Production in India

Source: Indian Horticulture Database, NHB, 2015

A large variety of F&V are grown in India like Banana, Mango, Apple, Papaya, Sapota, Citrus, Pine Apple, Grapes & Guava etc. in Fruits and Potato, Tomato, Onion, Brinjal etc. in Vegetables. India has the potential to be the world's largest food producer which is bestowed with one of the best natural resources in the world and several factors like Increasing urbanization, nuclear families, working women, disposable income and changing lifestyles are gearing up the Indian food supply chains for a better future. Organized retail and Private label penetration, demand for functional food, and increased spend on health food are major drivers for the growth of this sector (Rathore et al., 2010).

F&V are also rich source of vitamins, minerals, proteins, and carbohydrates etc. which are essential in human nutrition. These are referred to as protective foods and assumed great importance as nutritional security of the people. As the population is increasing, the demand for such food is also increasing. To meet such demand and provide a food in proper quality and nutrition, Supply chain plays a very vital role in this sector and becomes even more important because of perishability nature and very short shelf life. It not only helps to cut costs, but also adds to maintain and improve the quality of produce delivered, which are perishable in nature (Veena et al., 2011). Owing to the very short shelf life and perishable in nature, these items require proper transportation, handling and storage facilities in order to reach in fresh state to a customer. It also manages the relationship between businesses responsible for the efficient production and supply of fresh produce products from farm level to ultimate consumers, to reliably meet the requirements of the customer in terms of quality, quantity, and price. The whole supply chain is suffering from maximum inefficiency and facing various issues which motivated authors to identify the factors affecting the supply chain of Fruits and Vegetables sector in India.

2. OBJECTIVE OF THE STUDY

F&V is one of the most significant and thrust sector of the economy of India. The entire supply chain of F&V in India is laden with the major issue of post-harvest losses and wastages due to various factors. Since the identification of the issues and challenges may pave a path for planning and implementation of effective mitigation strategies. Hence the present study has been conducted with the following objectives:

- To identify the factors affecting supply chain of Fruits & Vegetables sector in India.
- To suggest mitigation strategies for the identified challenges in Supply Chain of Fruits & Vegetables sector in India

3. METHODOLOGY

Descriptive research has been used for this study. The supply chain of Fruits and Vegetables sector has been explained and attempt has been made towards identifying the factors affecting the supply chain of the sector. The present study undertakes a thorough review of basic and contemporary literature available and identified the issues which are affecting the supply chain of agricultural products, especially Fruits and Vegetables.

Authors have collected Literature, including research papers from peer-reviewed journals, conference proceedings, white papers and presentations from the industry. Papers were collected applying a structured search, using phrases such as “Fruits and Vegetables”, “agriculture supply chain”. Later Fruits supply chain, Vegetables supply chain, Mango, Apple, Tomato etc. were also included. Research databases such as Emerald (www.emeraldinsight.com), EBSCO (Search.ebscohost.com), Wiley (www.wiley.com), Springer(www.springerlink.com) and Elsevier (www.sciencedirect.com) were searched for related papers. The authors have referred various International Journals like Supply Chain Management: An International Journal, International Journal of Operations and Production Management, International Journal of Physical Distribution&Logistics Management, Journal of Agribusiness in Developing and Emerging Economies, International Food and Agribusiness Management Review, IUP Journal of Supply Chain Management etc.

The literature has been divided into various themes according to the issues in the supply chain of Fruits as well as Vegetables like Cold Chain, Transportation of Fruits & Vegetables, Infrastructure, Supply Chain of Fruits & Vegetables, Quality Management, Food Supply Chain etc. Further an investigation has been attempted to identify various factors affecting the supply chain.

4. DISCUSSION AND RESULTS

In this section authors has discussed the various models of supply chain running in fruits and vegetables sector in India and the challenges faced in the supply chain of the above said sector.

4.1. Supply Chain Management

Supply chain management (SCM) may be defined as a set of approaches utilized to efficiently integrate suppliers, manufacturers, warehouses, and stores, so that merchandise is produced and distributed at the right quantities, to the right locations, and at the right time, in order to minimize system-wide costs while satisfying service level requirements (Simchi-Levi et al., 2008).

4.2. Supply Chain Management in Fruits and Vegetables Sector

F&V constitutes a major part of the world economy and is the raw material for many industries. Among the agricultural produce, perishable food produce like F&V have got the least attention. The SCM of perishable food produce constitutes the processes from production to delivery of the agri-fresh produce, i.e. from the farmer to the customer. SCM of perishable food produce is complex as compared to other SCMs due to the perishable nature of the produce, high fluctuations in demand and prices, increasing consumer concerns for food safety & quality (Vorst & Beulens, 2002), and dependence on climate conditions (Salin, 1998)

There are several players involved in fulfilling the needs of the consumer in the supply chain management of F&V like farmers, local traders, transporters, processors, retailers etc. From a farm gate to a consumer, a horticulture product passed through six-seven different distribution

channels (Viswanadham, 2007). Perishable food produced in the farmer's field reaches the end consumer through a chain of intermediaries. These intermediaries carry out various functions, such as transfer of ownership of commodities, its movement, maintenance and preservation of quantity & quality, payment to the seller and commodity delivery to the buyer (Halder & Pati, 2011). All the links from farmers to end user of the commodity constitute supply chain of the agricultural commodities.

4.3. Supply Chain Models of Fruits and Vegetables Sector in India

Generally there are three types of models in Supply Chain of F&V in India i.e. Traditional Supply Chain, Hub and Spoke Model, and Value chain Model (Halder & Pati, 2011) which are discussed below in detail.

4.3.1. Traditional Supply Chain

'Traditional Model' is a complex chain for the supply flow of F&V, which is predominantly followed currently in traditional chain. The **Figure 2** outlines the supply chain of Traditional Model of F&V in India. Players involved in this model are agents (commission agents), auctioneers, wholesalers, traditional retailer of all type of formats family run 'mom and pop' stores, roadside shops, pavement shops and cart vendors apart from farmers and customers. Agents, auctioneers, and wholesalers are traders in F&V supply chain. Farmers are the cultivators of produce and source of F&V produce. Farmers in India are small by land holding, yield volume of crop and are highly fragmented across geographical areas. In this traditional supply chain model, farmers sell their products to the customers through various intermediate partners who eat the entire price share in the market.

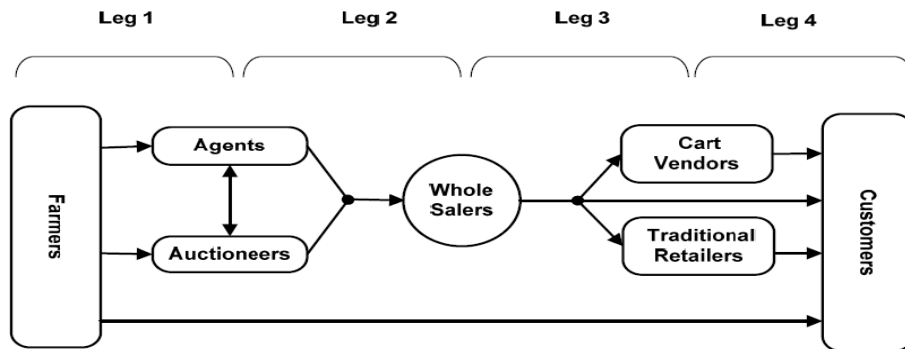


Figure2. Supply Chain of Traditional Model

Source: Halder & Pati (2011)

4.3.2. Hub and Spoke Model

Organized retailers including prominent players like Food Bazaar (Pantaloan Retail (India) Ltd), Spencer's Retail and More (Trinethra Super retail Ltd.) are adopting 'Hub and Spoke' Model for the Supply Chain of F&V. **Figure 3** illustrates the Hub and Spoke Model of F&V Supply Chain. Only few players are involved in this type of supply chain model. Farmers, organized retailers, wholesalers and customers are the partners who involved in this chain. In this type of model, buying centers, hub and stores (retail outlets) are operational units of the organized retailers. Small farmers and Contract farmers are the main source of supply of F&V in this model.

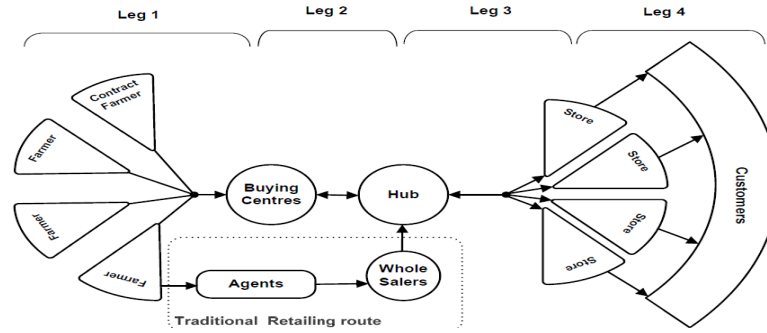


Figure3. Supply Chain of Hub and Spoke Model

Source: Halder & Pati (2011)

The organized retailers collect the F&V directly from the farmers to their buying centers and then transport to their hub which is served by one or more buying center and then the F&V are further distributed to their retail outlets. Hub infrequently buys small volume of vegetables from the local wholesale market to balance demand supply gap. A retail store is served by only one hub. Store sells F&V in retail quantity to the customers as per the demand. In this model, F&V travel in four phases, namely farmers to buying centers of organized retailers, buying center to hubs, from hub to the organized retail stores and then finally retail outlet to the end consumer.

4.3.3. Value Chain Model

Currently, only few organized retail players like Reliance Fresh (Reliance Retail Ltd) follows a Value Chain Model. Organized retailers who adopt this type of model procure the F&V directly from farmers either through contract farming or by taking the farm on lease and sell to customers without the help of any intermediaries. This model is purely based on backward integration and focused towards building an entire value chain starting from the farmers to the end consumers as shown in **Figure 4**. Compared to the other Supply chain models, value chain model comprise of only few partners i.e. Farmers, organized retailers, and customers. In this practice, farmers, organized retailer's operational units, consolidation centers, hub (distribution centers) and retail outlets stores, and customers are players.

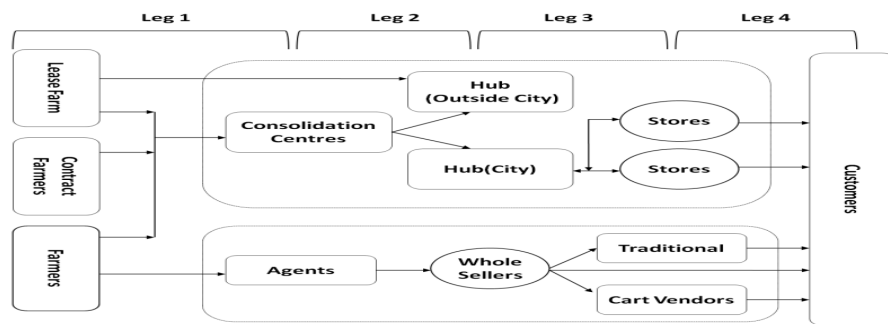


Figure4. Supply Chain of Value Chain Model

Source: Halder & Pati (2011)

Generally, the traditional supply chain model is followed in India with the share of around 95-98% which involves large number of intermediaries who eat up all the share of about 75 percent of the total net margin accruing to the entire supply chain (Modi et al., 2009). The local traders/auctioneers and commission agents performs the function of aggregators who procure the F&V from small landholding farmers on behalf of big traders and sell to Mandi. Some large

landholding farmers used to sell their F&V produce directly at the local Mandi (market place) without the help of any local agents. Usually, farmers preferred to sell their produce to local agents or trader rather than selling directly in Mandi. Sidhu et al. (2010) in his study found that in India, more than 90 percent of the produce dispose through commission agents/wholesalers and a small proportion sell through retailers and directly to consumers. It involves large number of intermediaries i.e. agents (commission agents), auctioneers, wholesalers and traditional retailer apart from farmers and customers. The agents collect F&V from the small farmers and sell to the big trader who then transports the commodity to the Mandi after processing or some value addition. The wholesaler buys F&V from the Mandi through auction and then sells to the retailer which includes pavement shops, cart vendors, family run 'mom and pop' stores and roadside shops. Then these retailers sell the F&V to the end consumers.

4.4. Issues and Challenges in the Supply Chain of Fruits and Vegetables in India

The authors feel that there are numerous factors which will act as roadblocks for the efficient supply chain of Fruits and Vegetables sector in India. In a process of finding out the dimensions to different factors, the authors have made an effort to summarize these factors and categorized them as Cold Chain issues, Fragmented Supply Chain issues, Linkage and Integration issues, Infrastructural issues, Packaging issues, Technological issues, Farmer's knowledge and awareness issues, Quality and Safety issues, Processing issues, Supply chain efficiency issues, Financial issues, Post-harvest losses issues, Transportation issues, Information issues. The variables found have been chronic across different states. Some of these variables need to be assessed in different states as per its demographics and market, also to which the mitigation strategies should be worked out.

The sorted issues have been divided into factors, which are further expanded into different variables and their observations.

4.4.1. Cold Chain issues

There are various issues related to cold chain in India, such as lack of cold chain facilities, inadequate capacity of cold chain, lack of cold chain network. Due to this concern it has become difficult for the farmers and businessman to do their business effectively and get proper remuneration for their produce. The concerned factors effecting the Supply Chain of Fruits and Vegetables sector pertaining to India and their corresponding mitigation strategies to overcome from these challenges have been depicted in **Table 2**.

Table 2 Compiled Cold Chain issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Cold Chain Issues	Variables	Source	Strategies
Cold Chain Facilities	Lack of cold storage & Warehousing facilities. Infrastructure in terms of cooling shed, cold storage. Inadequate cold chain capacities to serve the needs. Need for cold chain network in the hilly areas.	Jain, 2007; FICCI, 2010; Viswanadham, 2007; Bhardwaj & Palaparthi, 2008; Halder & Pati, 2011; Rathore et al., 2010; Veena et al, 2011; Narula, 2011; Singh et al. 2009; Sharma & Singh, 2011	Development of Cold chain infrastructure at the center area of major F&V production belt. Cold storage facilities may be set up by private players or by cooperatives societies.

4.4.2. Fragmentation issues

One of the main issues in the supply chain of F&V sector in India is the large number of local trader and intermediaries who eat all the share of farmer’s income. The whole supply chain in India is dominated by local traders. **Table 3** shows the fragmented supply chain issues for F&V supply chain in India.

Table 3 Compiled supply chain fragmented issues in F&V sector in India and their corresponding mitigation strategies

Fragmentation Issues	Variables	Source	Strategies
Fragmented Supply Chain	Large number of Intermediaries present in the Supply chain. Traders dominant supply chain. Farmers have greater reliance on Intermediaries. Presence of large number of local agents and commission agents.	Satyanarayana et al, 2007; Mathi, 2007; Viswanadham, 2007; Halder & Pati, 2011; Dharmi and Sharma, 2008; Bhardwaj and Palaparthi, 2008; Veena et al, 2011; GOI, 2012; Halder and Pati, 2011; Narula, 2011; Singh et al, 2009; Modi et al, 2009]	At producers/farmers level, the state Government agencies could take up the functions of a village level aggregator. Cooperative marketing societies may be created by the village farmers. State Government agencies can enter into the higher value addition activity of fruits and vegetables processing.

4.4.3. Integration issues

Linkage and integration between the various players in the supply chain plays a very important role to make the whole supply chain effective and profitable. But in the supply chain of F&V sector in India there is a lack of forward and backward integration between the farmers and the other partners. Some of the integration challenges faced are listed in **Table 4**.

Table 4Compiled Supply chain Integration issues in F&V sector in India and their corresponding mitigation strategies

Integration Issues	Variables	Source	Strategies
Linkages and Integration between the partners	Lack of Backward-Forward integration from farmer to customer in the hilly areas. Lack of linkages between Industry, Government and Institution. Poor linkage in the marketing channel, from farm gate to Mandi because of small land sizing farmers. Lack of linkage between farmer and processing unit because of unavailability of processing unit.	Jain, 2007; Satyanarayana et al, 2007; Mathi, 2007; Singh et al, 2009	Contract farming may be done with the private food companies. Outsourcing of F&V can be done by processing units. NGOs can play a vital role as an intermediary between farmer and companies.

4.4.4. Infrastructure issues

Supply chain infrastructure plays an important role in the F&V sector. Proper and adequate infrastructure helps farmers and agri businessman to run their business successfully and helps to deliver the goods in the right time with right condition. In India, Infrastructure in the main impediment in the supply chain of agricultural products which leads to high amount of losses.

Table 5 covers the challenges pertaining to infrastructure, concerns relating to marketing infrastructure, facilities for packaging, proper loading and unloading, connectivity in hill terrain areas etc.

Table 5 Compiled Infrastructural issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Infrastructure issues	Variables	Source	Strategies
Infrastructure Facilities	Lack of storage / Warehouse condition in the village areas.	Jain, 2007; Shukla, 2010; Kapoor, 2009;	Semi Processing Unit can be set up by Govt. agencies/entrepreneur nearer to agriculture produce area. Small size food parks can be developed at various center points of districts areas with the facilities of packaging, semi processing, grading, better equipments for loading and unloading and machinery for value addition in F&V.
	Poor Loading/unloading facilities in the farm and Mandi place.	Satyanaarayana et al, 2007; FICCI, 2010;	
	Lack of Processing facilities (Waxing, washing).	Viswanadham, 2007; GOI, 2012;	
	Lack of Packaging facilities.	Bhardwaj and Palaparthi, 2008;	
	Hilly terrain and poor road connectivity.	Veena et al, 2011;	
	Poor transportation infrastructure (Road, Rail etc.).	Halder and Pati, 2011; KPMG & ASSOCHAM, 2009;	
	Infrastructure connecting the farm is very poor.	Dhami & Sharma, 2008; Singh et al, 2009; Narula, 2011;	
	Inadequate Marketing infrastructure such as grading, standardization and other machinery near the farm region and at Mandi place.	Sharma & Singh, 2011	

4.4.5. Packaging issues

Packaging is very important for F&V as they are highly perishable goods and it needs proper packaging for the handling of these fresh produce. Without proper packaging it is very difficult to maintain their shelf life. Cost is very important factor for this issue. High cost of packaging material makes difficult for the farmers to do proper packaging of their goods. **Table 6** shows the related challenges for effective packaging of agri produce.

Table 6 Compiled Packaging issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Packaging issues	Challenges	Source	Strategies
Packaging Material	High cost of packaging material.	Jain, 2007; Mathi, 2007;	State Government can tie up with the packaging material providing company. Packaging unit can be set up by federations which will provide employment opportunities to the local peoples.
	Unavailability of packaging material.	Sharma & Singh, 2011	

4.4.6. Technological issues

The technology is surrounded by many technical issues, such as advancement issues, inefficient technology, obsolete techniques, and old machineries. Due to these concerns it has become difficult for the farmers and agri businessman to use an appropriate technologies and techniques to reduce the post-harvest losses and time in operational activities. The concerned factors have been depicted in **Table 7**.

Table 7 Compiled Technological issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Technological issues	Variables	Source	Strategies
Technology and techniques	Limited use and Lack of appropriate technologies & advanced techniques in food processing. Non adoption of efficient technology. Processing plant with cost effective machineries and packaging technologies.	Kapoor, 2009; FICCI, 2010; Rathore et al., 2010; Singh et al, 2009; Narula, 2011	Development of rural entrepreneurs in technologies, engineering and food sciences. Access to Food Park. Communication of modern technologies & Marketing knowledge through seminars and exhibitions by the institutions.

4.4.7. Farmer's Knowledge and Awareness

Farmer's in India have very poor knowledge regarding the use of latest technologies, techniques etc. to work effective and efficient. They have very poor knowledge regarding the management of post-harvest produce, quality of seed etc. Without proper knowledge and awareness level of the farmer the supply chain of F&V cannot be efficient, because farmers are the main source of the fresh agri produce. **Table 8** covers factors pertaining to knowledge and awareness level of farmers.

Table 8 Compiled Knowledge and awareness issues in the Supply Chain of F&V in India and their corresponding mitigation strategies

Knowledge and Awareness issues	Variables	Source	Strategies
Farmer's Knowledge and Awareness	Lack of knowledge of post-harvest technologies. Lack of farmer's awareness and education related to post harvest management. Lack of knowledge about the quality seeds.	Shukla, 2010; Mathi, 2007; FICCI, 2010; Shukla & Jharkharia, 2013; GOI, 2012; Bhardwaj and Palaparthi, 2008; Singh et al, 2009; Modi et al, 2009; Sharma & Singh, 2011	Exhibitions and technical fair can be conducted for recent developed technologies. Support of Research Institutions to provide knowledge on latest technologies.

4.4.8. Quality issues

Quality is a very important factor in food industry/sector, because it directly relates to the health of the people. It is very important for supply chain to deliver the fresh goods in a timely manner and in a proper quality to the customer. Proper supply chain helps to maintains the shelf life of produce and prevent from deteriorating the quality. Quality has a strong impact on the supply chain, so it leads to efficiency and less rejection by the customer. In India, there is a lack of quality standards to meet international quality for export, Poor hygiene and safety standards, high quality degradation etc. **Table 9** shows the related challenges and their corresponding mitigation strategies to overcome the problems.

Table 9 Compiled Quality and Safety issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Quality issues	Variables	Source	Strategies
Quality and Safety standards	Level of productivity and quality standards to International market is poor.	Shukla, 2010; Kapoor, 2009; Ramesh, 2009;	Knowledge support from institutions like Indian Institute of Packaging, regarding labeling and requirements in receiving countries, Food laws for packaging. Government support for providing facilities for auto handling of F&V. Government support for providing hygienic packaging material to the farmers at reasonable prices. Use of Preservation and Chilling technologies or use of cold storage for processing control
	Poor hygiene and safety standards.	Naidu, 2007;	
	Lesser control of product safety and quality across the supply chain because of manual handling.	FICCI, 2010;	
	Lack of tracking and traceability facilities.	Veena et al, 2011; Halder & Pati, 2011; Blackburn & Scudder, 2009;	
Quality degradation is very higher.	Singh et al, 2009; Narula, 2011		

4.4.9. Processing and Value addition issues

Processing and Value addition is a way to increase the shelf life of food produce and reduce the losses. High amount of food processing may leads to low wastage of Fruits and Vegetables. It gives an immense opportunity to export the processed food to the various destinations. But, in India the food processing is very low as compare to other countries. The state process about only 1-2 % of total F&V's produce and there is a very low level of value addition due to lack of processing units and no closest proximity of processing units. Challenges related to Processing and Value addition and their mitigation strategies have been depicted in **Table 10**.

Table 10 Compiled Processing and Value addition issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Processing and Value addition issues	Variables	Source	Strategies
Processing and Value Addition	Low level of value addition because of lack of processing unit. Poor infrastructure facilities connecting to processing units.	Kapoor, 2009; Satyanarayana et al, 2007; FICCI, 2010; GOI, 2012; Bhardwaj & Palaparthi, 2008; Halder & Pati, 2011; Narula, 2011; Sharma & Singh, 2011	Semi Processing Unit can be set up by Govt. /entrepreneur nearer to agriculture produce area. Small size food parks can be developed at various center points of districts areas.

4.4.10. Financial issues

Income of farmers is very low in the state. They don't get proper income for their agricultural produce and maximum amount of share eat up by the intermediaries. The difference between the final consumer price and farmer's realization is very high (Farmers get only 25 % of the total consumer price share's) in the state. There are lack of transparencies in pricing at all Mandis in India due to which farmer don't get right prices for their efforts and fresh produce. **Table 11** shows related challenges and their corresponding mitigation strategies.

Table 11 Compiled Financial issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Financial issues	Variables	Source	Strategies
Farmer's Income	Difference between the final consumer price and farmer's realization is very high (Farmers get only 25 % of the total consumer price shares).	Ramesh, 2009; GOI, 2012; Veena et al, 2011; Halder & Pati,	Contract farming can be done. Agro cooperative markets can be set up.
	Lack of transparency in pricing at local Mandis.	2011; Modi et al,2009; Narula,	The federations can take up retailing of fruits and vegetables, and thus, ensure fair returns to the farmers by eliminating all intermediaries such as, village aggregator, wholesaler, and retailers from supply chain.
	Heavy fluctuations in the Mandi prices.	2011; Sharma & Singh, 2011	
	Farmers are not receiving right price for their produce in the market even in seasonal F&V.		

4.4.11. Post-harvest losses issues

Post-harvest losses are the major problem in the supply chain of Fruits and Vegetables sector in India. There are huge amount of losses in the supply chain of perishable food in reaching to the main market, processing units etc. Around 30 -40 % of total food produce gets wasted in India. Huge amount of losses incurred during transportation and storage of fresh food produce. Post-harvest losses are high in India because of lack of cold chain facilities, poor logistics connectivity in the hilly areas etc. **Table 12** shows related challenges and their corresponding strategies to overcome from the issue of post-harvest losses.

Table 12 Compiled Post-harvest losses issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Financial issues	Variables	Source	Strategies
Supply chain losses and wastage of fresh produce	High wastage along the supply chain.	Ramesh, 2009; Satyanarayana, Math, Jyothirmayi, & Rao,	Setting up cold chain facilities in various districts and major production belts.
	High wastage in reaching to the processing unit.	2007; FICCI, 2010; GOI, 2012; Veena et al, 2011; KPMG & ASSOCHAM, 2009;	Cold chain can be set up in the area where lack of road facilities is there.
	Losses during transportation and storage are high.	Rathore et al.,2010; Murthy et al,2009;	Setting up of food processing unit needs to be emphasized.
	High level of wastage because of lack of cold chain and infrastructure.	Narula, 2011; Modi et al, 2009; Singh et al, 2009	Semi Processing Unit can be set up by entrepreneur nearer to agriculture produce area. Construction of post-harvest facilities.

4.4.12. Transportation issues

Transportation plays a very important role in the supply chain. Without proper transportation the goods can't be delivered to the customer in a right time and in a right quality. It plays even a more important role in Perishable food like Fruits and Vegetables because of short shelf life, high perishable, required controlled temperature. Transportation related challenges are very high in the India because of unavailability of well transportation mode, high cost of transportation, lack of temperature controlled vehicle for the movement of goods etc. Compiled challenges related to transportation have been depicted in **Table13**.

Table 13 Compiled Transportation issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Transportation issues	Variables	Source	Strategies
Transportation Facilities	Unavailability of transportation mode. Inefficient and costly transportation for the movement.	FICCI, 2010; GOI, 2012; Shukla,	State Government refrigerated transportation system can be set up for F&V transport.
	Lack of Refrigerated vehicles for the transportation of F&V in hilly and rural areas.	2010; Modi et al, 2009; Singh et al, 2009; Narula, 2011	Refrigerated vans can be initiated in rural areas by public private partnership.

4.4.13. Market Demand and Information issues

Proper information is the basis of efficient supply chain. Without proper information regarding market demand the supply chain cannot run successfully. In India, farmers have lack of information regarding the prices in the market, demand, food processing units etc. Poor information leads to poor realization of prices, high amount of losses, late delivery of goods in the market place etc. **Table 14** shows the challenges related to demand and information regarding market, prices etc. and their mitigation strategies to overcome the issues.

Table 14 Compiled Market Demand and Information issues in Supply Chain of F&V in India and their corresponding mitigation strategies

Information issues	Variables	Source	Strategies
Demand and Market information	Lack of market information to the farmers such as prices, flow of the product, food processing unit etc.	Mathi, 2007; Viswanadham, 2007; Bhardwaj &	Knowledge on demand forecasting.
	Lack of knowledge about the demand in the market.	Palaparthi, 2008; Veena et al, 2011;	ITC initiative of e-chaupal can be replicated in the state F&V sector.
	Lack of timely information.	Halder & Pati, 2011;	Government portal can be developed showing daily prices of F&V.
	Lack of knowledge about the intermediaries.	Shukla and Jharkharia, 2013; Singh et al., 2009; Narula, 2011; Modi et al, 2009	

5. CONCLUSION

The study and research conducted on the Supply chain of Fruits and Vegetables in India suggest that there is an improper supply chain management, lack of cold chain infrastructure and Food Processing units which are leading to maximum inefficiencies and resulting to losses and wastage of Fruits and Vegetables.

The entire supply chain of F&V is laden with the issue 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 facilities, high cost of packaging, poor quality of distribution, weak link in supply chain etc. which resulting to poor price realization of growers on one hand and exorbitant prices paid by consumers on the other end. Highly inefficient supply chain and cold chain infrastructure is the major impediment in the path of speedy growth of

agriculture sector in India. India's Fruits and Vegetables sector is a very growing sector and presents a huge opportunity for the agribusiness and the development of the rural areas through a well-established supply chain. However there are various factors affecting to the supply chain as discussed above which constitutes serious challenges for Fruits and Vegetables sector and are affecting the growth of the development of India. Some of them require immediate attention that can support in mitigating the potential challenges and provide impetus to supply chain of Fruits and Vegetables sector.

As Indian economy is based on agriculture, there is a need to develop proper supply chain models which may play an important role in increasing the shelf life and in turn reduce the losses and wastages in F&V, increase in farmer income, generate employment opportunities for the local peoples, and improve the livelihood of the farmers which leads to the development of Indian economy as a whole.

CONTRIBUTION

The present study identifies the factors affecting the supply chain of Fruits and Vegetables sector in India. The major factors identified from the study are pertaining to the category of infrastructure, processing & value addition, financial and information. Some of the major identified key challenges are Lack of Infrastructure Facilities, Low Processing and Value Addition, Low farmer income, Supply Chain inefficiency, large number of intermediaries/fragmented supply chain, Poor Quality & Safety standards. Overcoming these issues will benefit the farmers, state government, transporters and food processing unit in the form of reduced losses and wastage, increase in the price share of the farmer, provides employment opportunities to the local people etc.

FUTURE DIRECTIONS FOR RESEARCH

The factors identified may further be empirically tested and validated on the F&V supply chain of different states. A similar empirical study may further be carried out for the supply chain of various related sector like food processing unit, beverages industry, cold chain industry and also in F&V products such as Mango, Apple, Litchi, Tomato etc.

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