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Full Length Research paper

A Review of the Problems and Difficulties in the India Fruits and Vegetables Supply Chain

Risa* and Kanth

Doon University, Dehradun, Uttarakhand, India

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Purpose- *There are numerous problems and difficulties with India's whole fruit and vegetable supply chain. The supply chain of the Indian fruit and vegetable industry must be studied in order to identify potential obstacles and offer solutions. Therefore, the aim of this study is to explain the problems that are harming the Indian fruit and vegetable supply chain. In order to address the concerns and obstacles that were found, the authors also proposed the appropriate mitigation techniques.*

Design/methodology/approach- *For this study, descriptive research was employed. The Fruits and Vegetables industry's supply chain has been described, and an effort has been made to pinpoint the problems affecting it. The current study attempts to explain the factors influencing the supply chain of the fruits and vegetables sector in India by conducting a thorough analysis of the basic and current literature.*

The literature has been categorized into several themes based on supply chain problems, and an effort has been made to determine the different elements that have an impact on the supply chain.

Findings- *The study discovered that infrastructure facilities, a fragmented supply chain, links and integration between partners, taxation issues, the cost of packaging materials, technology and techniques, and cold chain facilities Knowledge and awareness of farmers; standards for quality and safety; processing and value addition; inefficiencies in the supply chain; farmers' earnings; fresh product waste and supply chain losses; facilities for transportation; The fruits and vegetables industry has significant obstacles due to issues like demand and market data, which also have an impact on India's total agricultural development.*

Research limitations/implications- *The authors may examine other sectors such as food processing facilities, cold chains, and other perishable goods like meat, dairy products, chocolate, drinks, etc., but they have solely focused on the fruits and vegetables market.*

Practical implications- *In order to improve planning and management in the field of the supply chain for fruits and vegetables, decision makers and other stakeholders, including farmers, the state government, transporters, and food processing units, will benefit from resolving these problems.*

Originality/value- *The majority of earlier research has been on broad concerns related to the supply chain for fruits and vegetables, such as cold chain and marketing effectiveness. A review of the supply chain, particularly in the F&V sector, is required in order to identify all the elements influencing it and offer mitigation methods. The vacuum in the literature on supply chain management for the fruits and vegetables industry is filled by this review.*

Key words: Fruits & Vegetables, Supply Chain Management, Inefficiency, Infrastructure, Wastage.

INTRODUCTION

A robust growth trend in Indian agriculture has been fueled by the Fruits and Vegetables (F&V) industry. This sector is anticipated to propel agricultural growth in the upcoming years due to the increasing proportion of high-value commodities in the overall value of agricultural output and their potential for growth (ASSOCHAM, 2013). By raising rural residents' incomes, it contributes in a special way to India's economy. Due to the labor-intensive nature of their cultivation, these crops provide a large number of job possibilities for rural residents.

Given the abundance of job opportunities and potential to increase the agricultural community's income, the F&V sector is arguably the most lucrative of all farming endeavors. Additionally, it has the ability to significantly boost the growth of agriculture as a whole. India is ideal for cultivating a variety of F&V because it has a wide range of climatic and physio-geographical conditions. India is becoming one of the leading producers of F&V, trailing only China in this regard. Together, F&V account for over 92% of India's entire horticultural output (ASSOCHAM, 2013).

India contributed 12.6% and 14.0%, respectively, to global F&V production in 2012–13 (NHB, 2013). With 21.2% of global fruit output and 49.5% of global vegetable production, China has the largest proportion, followed by Brazil and India. Table 1 displays the global output and percentage share of F&V.

Trends in Fruits and Vegetables Production & Present Status of India

With a combined production of 88.977 million metric tons of fruits and 162.897 million metric tonnes of vegetables as of the end of 2014, India is the world's second-largest food producer, behind China, and one of the origins of F&V (NHB, 2015). From 1991 to 2014, India's fruit and vegetable production climbed from 28.63 million metric tonnes to 88.97 million metric tonnes, and from 58.53 million metric tonnes to 162.89 million metric tonnes, as depicted in Figure 1.

In India, a wide range of fruits and vegetables are grown, including bananas, mangos, apples, papayas, sapotas, citrus, pine apples, grapes, and guavas, as well as vegetables including potatoes, tomatoes, onions, and brinjal. With one of the world's best natural resources, India has the potential to become the world's largest food producer. A number of factors, including working women, nuclear families, increasing urbanization, changing lifestyles, and disposable income, are preparing the Indian food supply chains for a better future. The demand for functional foods, the penetration of private labels and organized retail, and rising health food expenditures are the main factors propelling this industry's expansion (Rathore et al., 2010).

Vitamins, minerals, proteins, carbs, and other nutrients that are vital to human nutrition are also abundant in F&V. These foods are known as protective foods and are considered to be very important for people's nutritional security. The demand for this type of food is rising along with the population. Because of its perishable nature and short shelf life, the supply chain is even more crucial in this industry to satisfy such demand and provide food of the right quality and nutrients. In addition to reducing expenses, it also helps to preserve and enhance the quality of the delivered produce, which is perishable (Veena et al., 2011). Because they are perishable and have a very short shelf life, these goods must be handled, transported, and stored properly to get to a client in a fresh state. In order to consistently satisfy the needs of the client in terms of quality, quantity, and cost, it also oversees the interactions between companies in charge of the effective production and distribution of fresh produce items from the farm level to final customers. The authors were inspired to determine the elements influencing the supply chain of the Indian fruits and vegetables industry because the entire supply chain is experiencing extreme inefficiency and a number of problems.

OBJECTIVE OF THE STUDY

F&V One of the most important and dynamic sectors of the Indian economy is F&V. Due to a number of variables, post-harvest losses and wastes are a serious problem throughout the whole F&V supply chain in India. Because identifying the problems and obstacles could open the door to developing and putting into practice efficient mitigation techniques. 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

METHODOLOGY

For this study, descriptive research was employed. The fruits and vegetables industry's supply chain has been described, and an effort has been made to pinpoint the variables influencing it. The current study identifies the problems influencing the supply chain of agricultural products, particularly fruits and vegetables, by conducting a comprehensive analysis of the basic and current literature.

Research papers from peer-reviewed journals, conference proceedings, white papers, and industry presentations are among the literature that the authors have gathered. A systematic search was used to gather papers, and terms like "fruits and vegetables" and "agriculture supply chain" were used. Later, the supply chains for fruits, vegetables, mangoes, apples, tomatoes, and other items were included. Related publications were found by searching research databases like Elsevier (www.sciencedirect.com), Springer (www.springerlink.com), Wiley (www.wiley.com), EBSCO (Search.ebscohost.com), and Emerald (www.emeraldinsight.com). 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, and Supply Chain Management: An International Journal are just a few of the international journals that the authors have cited.

According to the problems in the supply chain of fruits and vegetables, the literature has been categorized into a number of subjects, such as cold chain, transportation of fruits and vegetables, infrastructure, supply chain of fruits and vegetables, quality management, food supply chain, etc. To determine the different elements influencing the supply chain, more research has been done.

DISCUSSION AND RESULTS

The 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.

Supply Chain Management

One definition of supply chain management (SCM) is a collection of strategies used to effectively integrate manufacturers, suppliers, warehouses, and retail locations so that goods are produced and delivered at the appropriate times, to the appropriate locations, and in the

appropriate quantities to reduce system-wide costs and meet service level requirements (Simchi-Levi et al., 2008).

Supply Chain Management in Fruits and Vegetables Sector

F&V is the raw material for numerous sectors and makes up a significant portion of the global economy. Perishable food production, such as F&V, has received the least attention among agricultural products. The processes from agri-fresh produce's production to delivery—that is, from the farmer to the consumer—make up the supply chain management (SCM) of perishable food products. Due to the perishable nature of the produce, significant price and demand fluctuations, growing consumer concerns about food safety and quality (Vorst & Beulens, 2002), and reliance on climate conditions (Salin, 1998), supply chain management (SCM) of perishable food produce is more complicated than other SCMs.

In the supply chain management of food and beverage, a number of stakeholders—including farmers, local traders, transporters, processors, retailers, and others—are involved in meeting customer needs. A horticultural product traveled through six-seven different distribution channels before reaching a consumer (Viswanadham, 2007). Through a series of middlemen, perishable food grown in the farmer's field is delivered to the final customer. These middlemen perform a number of tasks, including transferring ownership of goods, moving them, maintaining and preserving their quantity and quality, paying sellers, and delivering goods to buyers (Halder & Pati, 2011). The supply chain of agricultural commodities is made up of all the connections between producers and the final consumer.

Models of the Indian Fruits and Vegetables Supply Chain

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.

Traditional Supply Chain

The "Traditional Model" is a complicated supply chain for F&V that is primarily used in traditional chains at the moment. The supply chain for the Traditional Model of F&V in India is depicted in Figure 2. In addition to farmers and consumers, participants in this model include agents (commission agents), auctioneers, wholesalers, traditional retailers of all kinds, family-run "mom and pop" stores, roadside shops, pavement shops, and cart vendors. In the F&V supply chain, traders include agents, auctioneers, and wholesalers. The producers and suppliers of F&V produce are farmers. In terms of land holdings, crop yield volume, and geographic dispersion, Indian farmers are modest. In this conventional supply chain model, producers sell their goods to consumers via a number of middlemen who take up the whole market share.

Figure2. Supply Chain of Traditional Model

Source: Halder & Pati (2011)

Hub and Spoke Model

The "Hub and Spoke" model is being used by organized retailers, including well-known companies like Food Bazaar (Pantaloon Retail (India) Ltd.), Spencer's Retail, and More (Trinethra Super retail Ltd.), for the F&V supply chain. The Hub and Spoke Model of the F&V

Supply Chain is shown in Figure 3. This kind of supply chain model has a small number of participants. Partners in this chain include farmers, wholesalers, organized retailers, and consumers. Buying centers, hubs, and stores (retail outlets) are the operational components of the organized merchants in this kind of organization. According to this approach, the primary sources of F&V supply are small farmers and contract farmers.

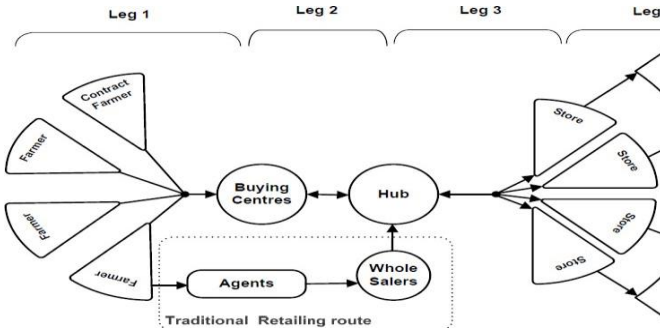


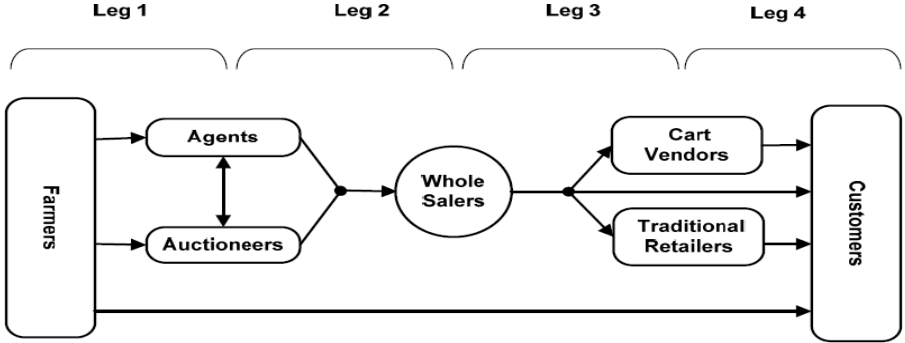
Figure3. Supply Chain of Hub and Spoke Model

Source: Halder & Pati (2011)

Direct F&V collection from farmers is handled by organized retailers, who then transport it to their hub, which is supported by one or more buying centers, before distributing it to their retail locations. To close the gap between supply and demand, Hub occasionally purchases a modest quantity of veggies from the neighborhood wholesale market. A single hub serves a retail establishment. In response to client demand, the store sells F&V in retail quantities.According to this approach, F&V travels in four stages: farmers visit organized retailer buying centers, buying centers visit hubs, hubs travel to organized retail stores, and retail outlets travel to final customers.

Value Chain Model

A Value Chain Model is currently only used by a small number of organized retail companies, such as Reliance Fresh (Reliance Retail Ltd). This kind of strategy is used by organized merchants who buy the F&V directly from farmers, either by contract farming or by leasing the farm, and then sell it to consumers directly,



bypassing any middlemen. As illustrated in Figure 4, this approach is solely predicated on backward integration and aims to construct a complete value chain from farmers to final consumers. The value chain model has fewer stakeholders than the other supply chain models, including farmers, organized retailers, and consumers. Farmers, the operational units of organized retailers, consolidation centers, hubs (distribution centers), retail outlets, and consumers are all participants in this business.

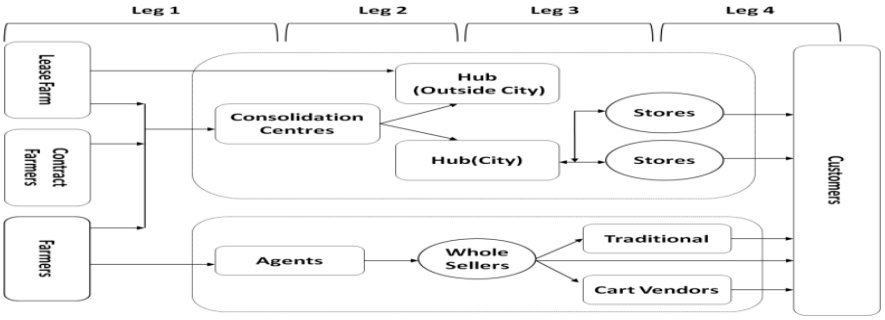


Figure4. Supply Chain of Value Chain Model
Source: Halder & Pati (2011)

With a 95–98% share, the traditional supply chain model is typically used in India. It involves a high number of intermediaries that consume roughly 75% of the total net margin that accrues to the entire supply chain (Modi et al., 2009).On behalf of large traders, local dealers/auctioneers and commission agents act as aggregators, acquiring F&V from small landholding farmers and reselling it to Mandi. Without the assistance of any local agents, several large landholding farmers used to sell their F&V produce directly at the Mandi, or marketplace. Instead of selling directly to customers in Mandi, farmers typically favored selling their produce to regional brokers or merchants. According to a research by Sidhu et al. (2010), over 90% of output in India is disposed of by commission agents or wholesalers, with a smaller percentage going to retailers or customers directly.In addition to farmers and consumers, it involves a lot of middlemen, such as commission agents, auctioneers, wholesalers, and traditional retailers. After processing or adding value, the large trader brings the product to the Mandi. The agents collect F&V from the small farmers and sell it to the trader. The wholesaler purchases F&V from the Mandi at auction and thereafter sells it to retailers, including roadside shops, sidewalk shops, cart sellers, and family-run "mom and pop" stores. The F&V is then sold to final customers by these shops.

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

According to the authors, a number of obstacles would obstruct the fruit and vegetable industry's effective supply chain in India. As they worked to identify the dimensions of various factors, the authors attempted to compile these factors into the following categories: Cold Chain Issues, Fragmented Supply Chain Issues, Linkage and Integration Issues, Infrastructure 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, and Information Issues. Chronic variables have been identified in many states. In order to develop mitigation plans, some of these factors must be evaluated in various states based on their markets and demography.
The issues that were sorted were separated into factors, which were then further subdivided into various variables and their observations.

Cold Chain issues

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 & Palaparthy, 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.

India has a number of cold chain-related problems, including a lack of cold chain network, insufficient cold chain capacity, and a lack of cold chain facilities. Farmers and business owners now find it challenging to operate efficiently and receive fair compensation for their produce as a result of this worry. Table 2 shows the significant variables affecting the Indian fruit and vegetable supply chain as well as the related mitigation techniques to get over these obstacles.

Fragmentation issues

The numerous local traders and middlemen who take all of the farmers' earnings is one of the primary problems with the F&V industry's supply chain in India. Local traders dominate India's entire supply chain. The fragmented supply chain problems for the F&V supply chain in India are displayed in Table 3.

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

results in significant losses.

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; Dhami and Sharma, 2008; Bhardwaj and Palaparthy, 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.

Integration issues

Linking and integrating the many supply chain participants is crucial to the overall effectiveness and profitability of the chain. However, there is a lack of forward and backward integration between farmers and other stakeholders in the F&V sector's supply chain in India. Table 4 lists a few of the integration difficulties encountered.

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, 2007Singh 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.

Infrastructure issues

In the F&V industry, supply chain infrastructure is crucial. Farmers and other agribusiness owners may operate their operations more successfully and deliver items in the correct condition at the right time with the support of proper and sufficient infrastructure. The primary barrier to the supply chain of agricultural products in India is infrastructure, which

Infrastructure issues	Variables	Source	Strategies
Infrastructure Facilities	Lack of storage / Warehouse condition in the village areas. Poor Loading/ unloading facilities in the farm and Mandi place. Lack of Processing facilities (Waxing, washing). Lack of Packaging facilities. Hilly terrain and poor road connectivity. Poor transportation infrastructure (Road, Rail etc.). Infrastructure connecting the farm is very poor. Inadequate Marketing infrastructure such as grading, standardization and other machinery near the farm region and at Mandi place.	Jain, 2007; Shukla, 2010; Kapoor, 2009; Satyanarayana et al, 2007; FICCI, 2010; Viswanadham, 2007; GOI, 2012; Bhardwaj and Palaparthy, 2008; Veena et al, 2011; Halder and Pati, 2011; KPMG & ASSOCHAM, 2009; Dhami & Sharma, 2008;Singh et al, 2009; Narula, 2011; Sharma & Singh, 2011	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.

Infrastructure issues, marketing infrastructure issues, packaging facilities, appropriate loading and unloading, connection in hilly terrain, etc. are all covered in Table 5.

Packaging issues

Since F&V products are very perishable and handling these fresh produce requires appropriate packing, packaging is crucial. It is very difficult to keep them fresh for a long time without the right packaging. Cost is a crucial consideration in this matter. Farmers find it challenging to properly package their goods due to the high cost of packaging materials. The associated difficulties for efficient agri-produce packing are presented in Table 6.

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. Unavailability of packaging material.	Jain, 2007; Mathi, 2007; Sharma & Singh, 2011	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.

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

Technological issues

Numerous technical problems surround technology, including problems with advancement, ineffective technology, outdated methods, and antiquated machinery. These worries have made it more challenging for farmers and agribusiness owners to employ the right tools and methods to cut down on post-harvest losses and operational time. Table 7 shows the factors that are of concern.

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

Technological	Variables	Source	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 Palaparthy, 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.
Quality issues	**Variables**	**Source**	**Strategies**
Quality and Safety standards	Level of productivity and quality standards to International market is poor. Poor hygiene and safety standards. Lesser control of product safety and quality across the supply chain because of manual handling. Lack of tracking and traceability facilities. Quality degradation is very higher.	Shukla, 2010; Kapoor, 2009; Ramesh, 2009; Naidu, 2007; FICCI, 2010; Veena et al, 2011; Halder & Pati, 2011; Blackburn & Scudder, 2009; Singh et al, 2009; Narula, 2011	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

Farmer's Knowledge and Awareness

Indian farmers are not particularly knowledgeable on how to employ the newest technologies, methods, etc. to work effectively and efficiently. Regarding post-harvest crop management, seed quality, etc., they know very little. Since farmers are the primary source of fresh agricultural produce, the F&V supply chain cannot function effectively without the appropriate degree of farmer education and awareness. Factors related to farmers' knowledge and awareness levels are covered in Table 8.

Quality issues

Since quality has a direct impact on people's health, it is a crucial component of the food industry. Delivering fresh items to customers in a timely way and in a suitable quality is crucial for the supply chain. A healthy supply chain keeps produce fresher for longer and keeps its quality from declining. Because quality has a significant effect on the supply chain, it increases efficiency and decreases consumer rejection. Poor hygiene and safety standards, significant quality degradation, and a lack of international quality requirements for export are all problems in India. The associated difficulties and the necessary mitigating techniques to get beyond them are displayed in Table 9.

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

Processing and Value addition issues

Food produce can have its shelf life extended and losses decreased through processing and value addition. Low fruit and vegetable waste may result from extensive food processing. It offers a huge possibility to sell processed foods to different countries. However, compared to other nations, food

processing is quite low in India. Only 1-2 percent of all F&V produce is processed by the state, and because there aren't enough processing facilities or ones that are close to one another, there is very little value addition. Table 10 illustrates the difficulties associated with processing and value addition as well as the methods used to overcome them.

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 & Palaparthy, 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.

Financial issues

In the state, farmers' incomes are quite poor. They don't receive enough money for their produce, and the middlemen take up the majority of their portion. In the state, farmers only receive 25% of the overall consumer price share, which is a very large disparity between the final consumer price and their realization. Farmers in India do not receive fair prices for their labor and fresh produce because of the lack of transparency in pricing at all Mandis. Related issues and the corresponding mitigating techniques are given in Table 11.

Table 11 Compiled Financial 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. High wastage in reaching to the processing unit. Losses during transportation and storage are high. High level of wastage because of lack of cold chain and infrastructure.	Ramesh, 2009; Satyanarayana, Math, Jyothirmayi, & Rao, 2007; FICCI, 2010; GOI, 2012; Veena et al, 2011; KPMG & ASSOCHAM, 2009; Rathore et al.,2010; Murthy et al,2009; Narula, 2011; Modi et al, 2009; Singh et al, 2009	Setting up cold chain facilities in various districts and major production belts. Cold chain can be set up in the area where lack of road facilities is there. Setting up of food processing unit needs to be emphasized. Semi Processing Unit can be set up by entrepreneur nearer to agriculture produce area. Construction of post-harvest facilities.

Post-harvest losses issues

The main issue facing India's fruit and vegetable supply chain is post-harvest losses. In the process of getting perishable food to the main market, processing facilities, etc., there are significant losses. In India, between 30 and 40 percent of all food supply is wasted. Significant losses occur when fresh food produce is transported and stored. Due to a lack of cold chain facilities, inadequate logistics connectivity in hilly areas, etc., post-harvest losses are substantial in India. Table 12 lists associated difficulties and solutions for resolving the post-harvest losses problem.

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

Transportation issues

An essential component of the supply chain is transportation. The consumer cannot receive the goods in a timely and high-quality manner without adequate transportation. Given their short shelf life, high perishability, and need for a controlled temperature, it is even more crucial for perishable foods like fruits and vegetables. India faces many transportation-related problems, such as a shortage of suitable modes of transportation, high transportation costs, and a dearth of vehicles with temperature control for moving cargo, among other issues. Transportation-related problems have been compiled and are shown in Table 13.

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

Market Demand and Information issues

The foundation of an effective supply chain is accurate information. It is impossible for the supply chain to function properly without accurate information about market demand. Farmers in India lack knowledge about market prices, demand, food processing facilities, etc. Inadequate information results in low price realization, significant losses, delayed product delivery in the marketplace, etc. The difficulties with demand and information about the market, prices, etc. are displayed in Table 14, along with their solutions.

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. Lack of knowledge about the demand in the market. Lack of timely information. Lack of knowledge about the intermediaries.	Mathi, 2007; Viswanadham, 2007; Bhardwaj & Palaparthy, 2008; Veena et al, 2011; Halder & Pati, 2011; Shukla and Jharkharia, 2013; Singh et al., 2009; Narula, 2011; Modi et al, 2009	Knowledge on demand forecasting. ITC initiative of e-chaupal can be replicated in the state F&V sector. Government portal can be developed showing daily prices of F&V.

CONCLUSION

According to the study and research on the Indian fruit and vegetable supply chain, there is a lack of cold chain infrastructure, food processing facilities, and poor supply chain management, which results in maximum inefficiencies and fruit and vegetable losses and waste.

Due to a number of factors, including a long and disjointed chain, reliance on middlemen, poor road infrastructure, an ineffective Mandi system, inadequate cold chain infrastructure facilities, high packaging costs, poor distribution quality, weak links in the supply chain, etc., the entire F&V supply chain is plagued by post-harvest losses and wastes. As a result, growers realize low prices, while consumers pay exorbitant prices. The main obstacle to the rapid expansion of the supply chain and cold chain infrastructure is their extreme inefficiency.

India's agricultural sector. Through a reputable supply chain, the rapidly expanding Indian fruit and vegetable industry offers enormous potential for agribusiness and rural development. However, as was previously said, there are a number of factors influencing the supply chain that pose significant obstacles to the fruits and vegetables industry and are influencing India's development. Some of these need to be addressed right now in order to help mitigate any possible issues and provide the fruit and vegetable industry's supply chain a boost.

Since agriculture is the foundation of the Indian economy, it is necessary to create appropriate supply chain models that could be crucial in extending the shelf life and thereby lowering F&V losses and wastes, raising farmer income, creating jobs for the local population, and improving farmer livelihoods, all of which contribute to the growth of the Indian economy overall.

CONTRIBUTION

The current analysis highlights the variables influencing the Indian fruit and vegetable supply chain. The study's primary findings pertain to the following categories: information, financial, processing & value addition, and infrastructure. Lack of infrastructure facilities, low processing and value addition, low farmer income, inefficient supply chains, a large number of intermediaries and a fragmented supply chain, and poor quality and safety standards are some of the main issues that have been found. By reducing losses and waste, increasing the farmer's price share, creating jobs for locals, and other benefits, resolving these problems will help farmers, the state government, transportation companies, and food processing facilities.

FUTURE DIRECTIONS FOR RESEARCH

Additional empirical testing and validation of the identified parameters may be conducted on the F&V supply chain in various states. The supply chain of several allied industries, such as the food processing plant, beverage industry, cold chain industry, and F&V items like mango, apple, litchi, tomato, etc., may likewise be the subject of a comparable empirical investigation.

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