

# Supply Chain of Fruits & Vegetables' Agribusiness in Uttarakhand (India): Major Issues and Challenges

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## ABSTRACT

Fruits & vegetables (F&V) crops being high value crops are important in raising the incomes of the farmers besides creating employment opportunities. Fruits and vegetables sector in India has gained its credibility for providing sustainable income, nutritional security and for providing employment opportunities, both in rural and urban areas. India is the second largest food producer in the world, after china and one of the centers of origin of fruits and vegetables with the total production. Various high temperate fruits and vegetables like apples, oranges, pears, peaches, litchis, plums, tomato, green leafy vegetables etc. are widely grown in Himalayas and tarai region of Uttarakhand and are important to the large food processing industry. Fruits and vegetables is one of the most significant and thrust sector of the economy of Uttarakhand state. The entire supply chain of fruits and vegetables in Uttarakhand is laden with the various issues which resulting to poor price realisation of growers on one hand and exorbitant prices paid by consumers on the other. Highly inefficient supply chain and cold chain infrastructure is the major impediment in the path of speedy growth of F&V production sector in Uttarakhand. The present study undertakes a thorough review of basic and contemporary literature available and discussed the issues and challenges related to supply chain of fruits and vegetables sector in state of Uttarakhand, India and suggested the corresponding mitigation strategies.

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

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

## INTRODUCTION

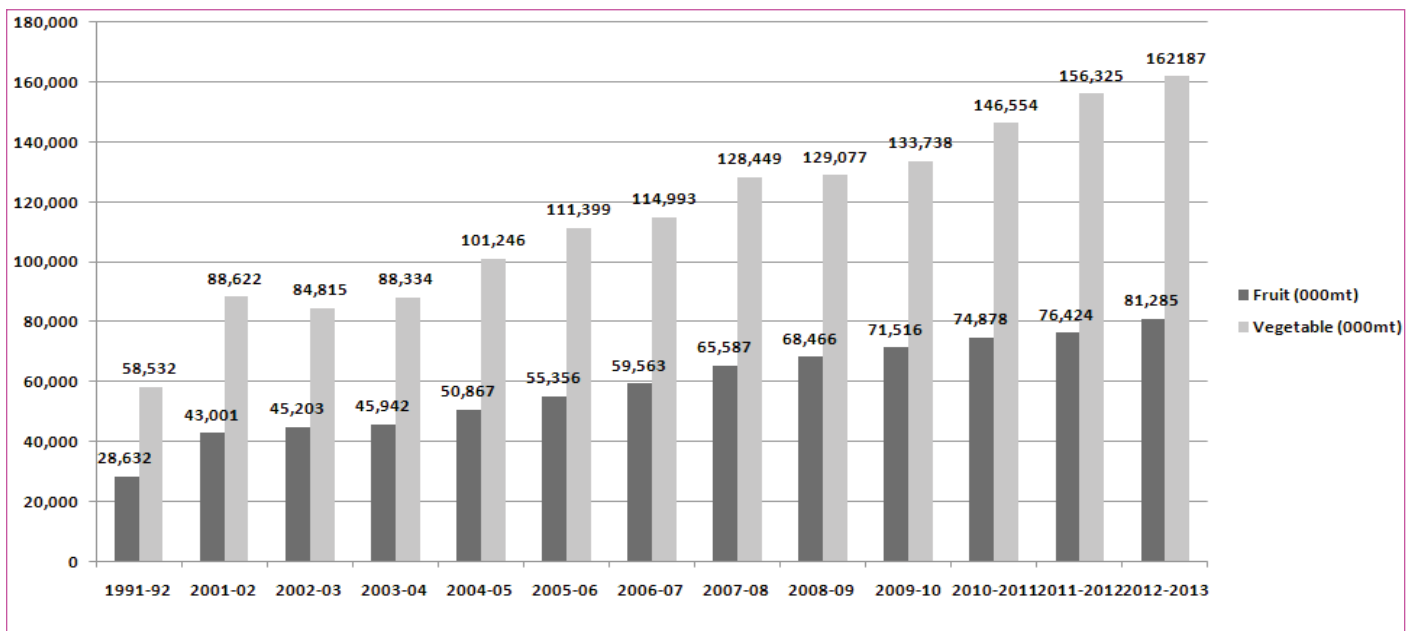
The Fruits and Vegetables (F&V) sector has been a driving force in stimulating a healthy growth trend in Indian agriculture. Given the rising share of high value commodities in the total value of agricultural output and their growth potential, this segment is likely to drive agricultural growth in the 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 labour intensive and as such they generate lot of employment opportunities for the rural population. Thus, cultivation of these crops plays a vital role in the prosperity of a nation and is directly linked with the health and happiness of the people.

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 and be the world's largest food producer in the world. It is bestowed with one of

the best natural resources in the world and several factors like increasing urbanisation, nuclear families, working women, disposable income, and changing lifestyles are gearing up the Indian food supply chains for a better future. Organised retail and private label penetration, demand for functional food, and increased spend on health food are major drivers for the growth of this sector (Viswanadham, 2007). 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 and very short shelf life. In India F&V together constitute about 92 % of the total horticultural production in India (ASSOCHAM, 2013).

## Trends in Fruits and Vegetables Production & Present Status of India

During 2012-13, India's contribution in the world production of F&V was 12.6 % and 14 % respectively

**Figure 1: Fruits and Vegetables Production in India**

Source: Indian Horticulture Database, NHB, 2013

(NHB, 2013). 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 81.28 million metric tonnes of fruits and 162.87 million metric tonnes of vegetables till the year end 2013(NHB, 2013).

The production of F&V in India has been shown in Figure 1 from the year 1991-2013 which has increased from 28.63 million metric tonnes in fruits and 58.53 million metric tonnes in vegetables. 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, okra, green leafy etc. in vegetables.

### Trends in Fruits and Vegetables Production & Present Status of Uttarakhand

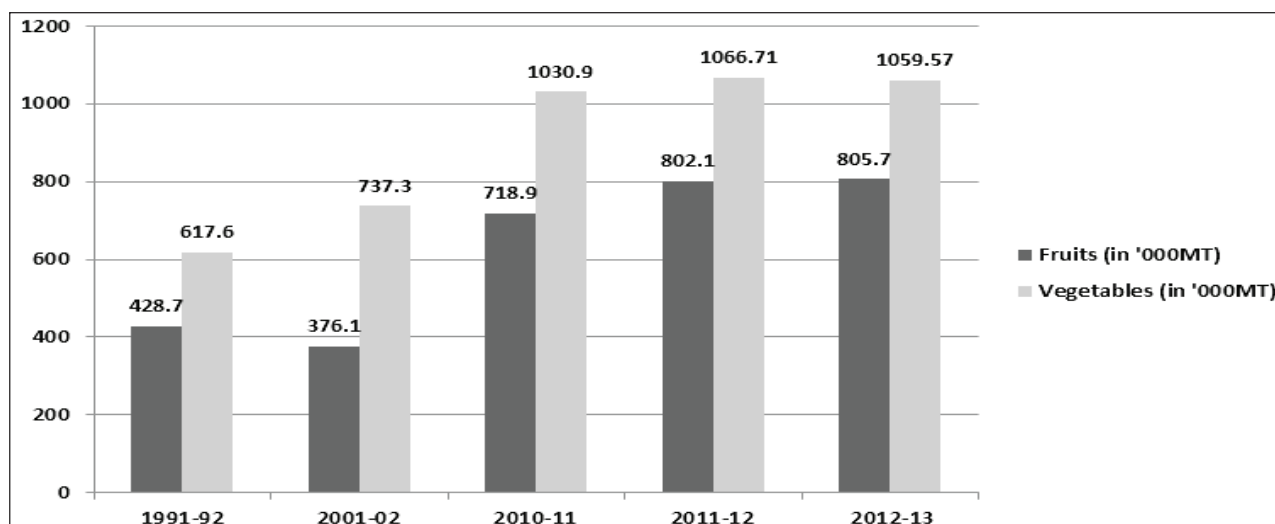
Various high temperate F&V like apples, oranges, pears, peaches, litchis, plums, tomato, green leafy vegetables etc. are widely grown in Himalayas and tarai region of Uttarakhand. It is also one of the centres of F&V supply for plain areas and large food processing industries with the total production of 8.05 lakh metric tonnes of fruits and 1.59 million metric tonnes of vegetables till the year end 2013 (NHB, 2013).

It is also one of the fastest growing states of India where the economy grew more than 9% during the last decade. Its gross state domestic product (GSDP) (at constant price) more than doubled from INR 24, 786 crore in FY 2005-FY2012. The real GSDP grew at 13.7 % (CAGR) during the FY 2005-FY2012 period (MOSPI, 2013). It is a land of opportunities, since it is strategically located at the foothills of the Himalayan ranges and has a mountainous topography. The F&V production scenario of Uttarakhand has been shown in Figure 2.

### OBJECTIVES of The Study

F&V is one of the most significant and thrust sector of the economy of Uttarakhand state. The entire supply chain of F&V in Uttarakhand 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 issues and challenges related to fruits and vegetables supply chain in Uttarakhand state of India.

**Figure 2: Fruits and Vegetables Production in Uttarakhand**

Source: Indian Horticulture Database, NHB, 2013

- ◆ To suggest mitigation strategies for the identified challenges in the supply chain of fruits & vegetables sector in Uttarakhand state.

## METHODOLOGY

Descriptive research has been used for this study. The issues in the supply chain of fruits and vegetables have been investigated and attempt has been made towards the identifying factors leading to this phenomenon. The present study undertakes a thorough review of basic and contemporary literature available and tries to explain the issues and challenges encountered in the supply chain of agricultural products, especially Fruits and Vegetables.

The literature has been divided into various themes according to the issues of supply chain for fruits as well as vegetables. Further an investigation has been attempted to identify various factors.

## DISCUSSION AND RESULTS

### Supply Chain Model of Fruits and Vegetables in Uttarakhand

Supply chain refers to all those activities associated with the transformation and flow of goods and services, including their attendant information flows, from the sources of raw materials to end users (Ballou, 2004). Supply chain management (SCM) may be defined as a set of approaches utilised 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). It is the network of organisations that are involved, through upstream and downstream linkages, in the different processes and activities that produce value in the form of products and services in the hand of the ultimate customer (Christopher, 1998). In other words, a supply chain consists of multiple parties/firms, both upstream (i.e., supply) and downstream (i.e., distribution), and the final consumer. It is the planning and control of the flow of total material from suppliers to manufacturers to distributors and finally to the end users (Jones & Riley, 1985).

F&V constitutes a major part of the world economy and is the raw material for many industries. Among the agricultural produce, fruits and vegetables have got the least attention. The SCM of fruits and vegetables constitutes the processes from production to delivery of the agri-fresh produce, i.e. from the farmer to the customer. SCM of fruits and vegetables 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).

In India, the existing supply chain in F&V sector involves many 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). In Uttarakhand also there are several players involved in fulfilling the needs

of the consumer in the supply chain management of fruits and vegetables like farmers, local traders, transporters, processors, retailers etc. From a farm gate to a consumer, a horticulture product passed through several different distribution channels. Fruits and vegetables grown in the farmer's field reach the end consumer through a long chain of intermediaries. These intermediaries carry out various functions, such as transfer of ownership of commodities, its movement, quantity & quality maintenance, payment to the farmers and commodity delivery to the buyer (Halder & Pati, 2011). All the links from farmers to end user of the commodity constitute supply chain of fruits and vegetables.

In India, generally there are three types of supply chain models followed in fruits and vegetables sector i.e. traditional supply chain model, hub and spoke model, and value chain model. As the study is limited to Uttarakhand state, authors have discussed only traditional supply chain model which is followed in the state of Uttarakhand for the movement of fresh fruits and vegetables where the commodity has to pass from various intermediaries from the farmer to reach to the ultimate consumers. It has been discussed in detail in the next section.

### Traditional Supply Chain Model

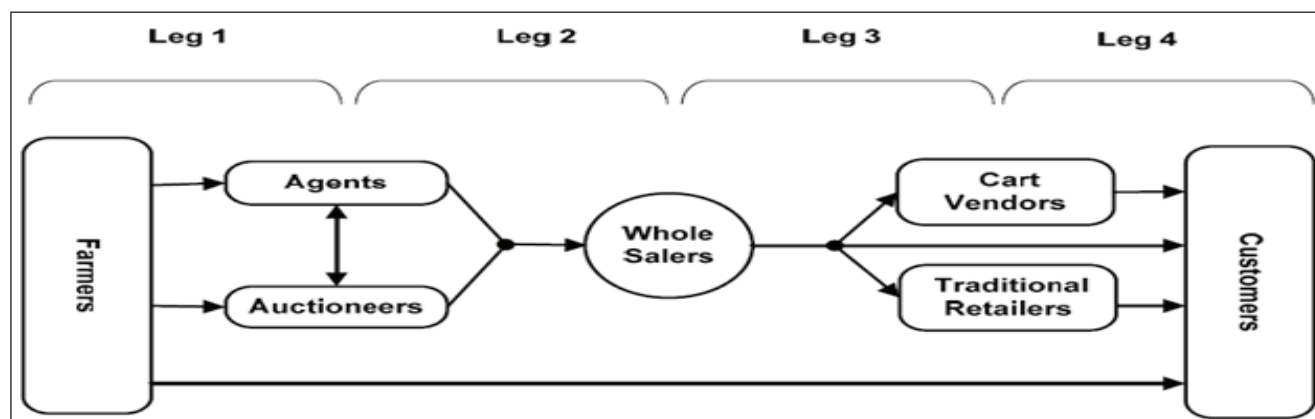
“Traditional Model” is a complex chain for the supply flow of F&V, which is predominantly followed currently in traditional model of agribusiness. Players involved in this model are agents (commission agents), auctioneers, wholesalers, traditional retailer of all type of formats family run ‘mom and pop’ stores, roadside shops, pavement shops and cart vendors apart from farmers and customers. Agents, auctioneers, and wholesalers are

traders in fruits and vegetables supply chain. Farmers are the cultivators of produce and source of fruits and vegetables produce. Farmers in Uttarakhand are small by land holding size and 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. Figure 3 outlines the traditional supply chain model of fruits and vegetables in India.

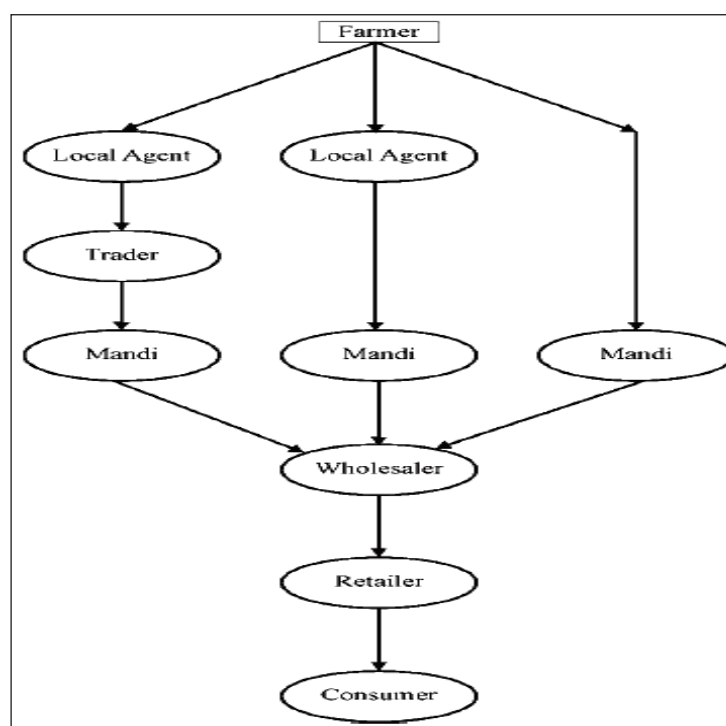
### Supply Chain Management of Fruits and Vegetables (F&V) Sector in Uttarakhand

The existing supply chain for the F&V in Uttarakhand involved large number of intermediaries (Figure 4) 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 perform the function of aggregators who procure the fruits and vegetables from small landholding farmers on behalf of big traders and sell to mandi. Some large landholding farmers used to sell their fruits and vegetables produce directly at the local mandi (market place) without the help of any local agents. A large share of the F&V produce from Uttarakhand state used to send to the mandis in Haldwani, Delhi, Dehradun, Khatima, Bareilly etc. (Modi *et al.*, 2009). Usually, farmers preferred to sell their produce to local agents or trader rather than selling directly in mandi. Sidhu *et al.* (2010) also found in his study that more than 90 percent of the produce dispose through commission agents/wholesalers and only a small proportion sell through retailers and directly to consumers in India.

Figure 3: Supply Chain of Traditional Model



Source: Halder & Pati (2011)

**Figure 4: Supply Chain of Fruits and Vegetables in Uttarakhand**

Source: Modi et al., 2009

Mandi (market) system has number of inefficiencies like high amount of losses as high as 40 percent in case of fruits and vegetables (Singh *et al.*, 2009), due to non-scientific inadequate infrastructural support, handling and storage, non-transparent price setting where seller and buyer are often cheated. Large share of a farmer's realizable value is lost as commission, supply chain mishandling and losses (Narula, 2011).

The supply chain of F&V in Uttarakhand 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. The whole supply chain in Uttarakhand is fraught with the various intermediaries and the share prices are divided among all the intermediaries which leads to less price realisation by the one who is the main source of these F&V i.e. farmer (Modi *et al.*, 2009).

### Issues and Challenges in the Supply Chain of Fruits and Vegetables Sector

Changing eating habits and increasing awareness towards food safety have increased the challenges for fruits and vegetables supply chain (Cook, 1990, 1999; Reardon & Barrett, 2000).

In this section authors have discussed the past available literature which has discussed or highlighted the issues and challenges in the supply chain of fruits and vegetables sector across the countries. Various studies have been done on the supply chain of fruits and vegetables sector across the countries. The research on fruits and vegetables supply chain has got the attention of developed as well as developing countries. For example, Fearne & Hughes (1999), Vander Vorst & Beulens (2002) and Taylor (2005) have conducted study on fruits and vegetables supply chain in the context of developed countries. On the other hand, there are evidences of fruits and vegetables supply chain studies in developing countries as well. Joshi *et al.* (2009) and Sagheer *et al.* (2009) have conducted their studies in the Indian context where as Perera *et al.* (2004) has done the study in Sri Lankan context. Swinnen & Maertens (2007) studied the effect of globalisation on agri-fresh produce supply chain in the developing

countries. In the recent years there is a significant increase in collaboration and globalisation related issues in fruits and vegetables supply chain. Accordingly, the research works in these areas by Matopoulos *et al.* (2007), Dunne (2008), Mikkola (2008) and Van Donk *et al.* (2008) are also found in the literature. There are several other issues such as quality, strategy (Blackburn & Scudder, 2009), technology implementation (Salin, 1998), etc. addressed in the literature in order to understand issues and challenges in the fruits and vegetables supply chain.

Various issues have been highlighted in the studies and can be broadly categorised into the following factors namely: poor infrastructure, poor transportation system, lack of market information, poor knowledge of farmers, large number of intermediaries etc. Viswanadham (2006) highlighted lack of adequate infrastructure for processing, cold-storage and transportation in developing countries such as India as the major problems. Road connectivity and network is also one of the major challenges in this sector (Kader & Rolle, 2004). Poor and inadequate transportation facilities contribute more to this problem (Gauraha & Thakur, 2008; Sharma & Singh, 2011; Kader, 2005, 1992). A large number of intermediaries supplement the lack of infrastructure, but add to the waste and increase the per unit consumption price (De Boer & Pandey, 1997). The other major issue is the lack of proper planning and management practices in the fruits and vegetables supply chain. This is because majority of the farmers are small land holders and share croppers and have little knowledge of technology, market demand, and financial incentives (Shukla & Jharkharia, 2013). Flow of information is very vital in the supply chain to run the smooth flow of functions. It becomes even more important in case of fresh produce supply chain due to short shelf life and perishable nature. Lack of information regarding demand was considered as a major reason of waste by the researcher (Viswanadham, 2007). Buyukbay, Uzuno, & Bal (2011) also attributed lack of demand information as one of the main reason for waste. Kader (2005) also discussed lack of information as one of the socioeconomic factor causing post-harvest losses.

One of the major and the most important concerns for fruits and vegetables supply chain management is the post-harvest wastage. It has been reported that a huge amount of fruits and vegetables is wasted in various operational stages of this sector (Murthy *et al.*, 2009). The amount of post-harvest waste ranges from 20 to 60 percent of the total production across the countries (Widodo *et al.*, 2006). Supply chain of fruits and vegetables requires proper temperature to maintain and sustain the quality and

increase the shelf life of the produce but there have been staggering losses in this sector due to the weak and ill equipped cold chain infrastructure (Rathore *et al.*, 2010) and improper marketing systems and facilities (Gauraha & Thakur, 2008; Singh *et al.*, 2008) of the country ensuing losses and wastages in the supply chain of perishable food produce.

Many studies have attempted to estimate the post-harvest losses at various stages of supply chain of fruits and vegetables (Anon, 1982, 1985; Atibudhi, 1987; Waheed *et al.*, 1986; Aradya *et al.*; Madan & Ullasa, 1993; Gauraha, 1997; Srinivas *et al.*, 1997; Murthy *et al.*, 2002; Sudha *et al.*, 2002) and banana in particular (Gajanana *et al.*, 2002; Murthy *et al.*, 2003; Murthy *et al.*, 2007; Murthy *et al.*, 2009). There are many studies reporting quality and quantity losses during and after harvest (Turan, 2008; Murthy *et al.*, 2009; Troger, 2007; Ozcan, 2007; Karabulut *et al.*, 2005; Kumar *et al.*, 2004; Lawande, 2004; Reddy, 2004; Singh *et al.*, 2004; Tatlidil *et al.*, 2003; Klein & Lurie, 1991; Ozcan & Baklaya, 1995; Ozcan *et al.*, 1997; Dokuzoguz, 1997; Gunduz, 1997; Kaynas *et al.*, 1988).

As the present study is focused on the issues and challenges pertaining to fruits and vegetables sector in Uttarakhand state, so the same have been discussed in detail in the next section. Very few studies have been done particularly on the supply chain issues pertaining to Uttarakhand state and this is the limitation of the study.

### Issues and Challenges in the Supply Chain of Fruits and Vegetables in Uttarakhand

Uttarakhand has the potential to be the largest supplier of seasonal and tropical fruits and vegetables which is bestowed with one of the best natural resources in the world. Organised 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).

The authors feel that there are numerous issues and challenges 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 issues and challenges, the authors have made an effort to summarise these issues and challenges and categorised 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, and information issues. The variables found have been chronic across different states. Some of these variables need to be assessed in Uttarakhand as per its demographics and market, also to which the mitigation strategies should be worked out.

### Issues and Challenges

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

#### Cold Chain Issues

There are various issues related to cold chain in the state, 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 the state of Uttarakhand and their corresponding mitigation strategies to overcome from

these challenges have been depicted in Table 1.

#### Fragmentation Issues

One of the main issues in the supply chain of F&V sector in Uttarakhand is the large number of local trader and intermediaries who eat all the share of farmer's income. The whole supply chain in the state is dominated by local traders. Table 2 shows the fragmented supply chain issues for F&V supply chain in Uttarakhand.

#### 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 state there is a lack of forward and backward integration between the farmers and the other partners. Some of the integration challenges faced in the state are listed in Table 3.

#### Infrastructure Issues

Supply chain infrastructure plays an important role in the F&V sector. Proper and adequate infrastructure

**Table 1: Compiled Cold Chain Issues in Supply Chain of F&V in Uttarakhand 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.	Narula, 2011; Singh <i>et al.</i> 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.

**Table 2: Compiled Supply Chain Fragmented Issues in F&V Sector in Uttarakhand 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.	Narula, 2011; Singh <i>et al.</i> , 2009; Modi <i>et al.</i> , 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.

**Table 3: Compiled Supply chain Integration Issues in F&V sector in Uttarakhand 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.	Singh <i>et al.</i> , 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.

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 most of the northern and eastern region is covered with hilly terrain areas and are the major sources of fruits and vegetables. The road connectivity and network infrastructure in such areas are very poor which takes a long time to take the fresh fruits and vegetables product to the market and deteriorate the quality and condition of the produce which results in wastage. Villages, farms and the markets in the Uttarakhand state (hilly region) are not well connected and the farmers have to somehow bring their harvests to the nearby road for transportation, which increased the wastage of their produce (Modi *et al.*, 2009). In Uttarakhand state infrastructure in the main impediment in the supply chain of agricultural products which leads to high amount of losses. Table 4 covers the challenges pertaining to infrastructure, concerns relating to marketing infrastructure, facilities for packaging, proper loading and unloading, connectivity in hill terrain areas.

### 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 5 shows the related challenges for effective packaging of agri-produce.

### 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 6.

**Table 4: Compiled Infrastructural Issues in Supply Chain of F&V in Uttarakhand and Their Corresponding Mitigation Strategies**

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, standardisation and other machinery near the farm region and at Mandi place.	Singh <i>et al.</i> , 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.

**Table 5: Compiled Packaging Issues in Supply Chain of F&V in Uttarakhand and Their Corresponding Mitigation Strategies**

Packaging issues	Challenges	Source	Strategies
Packaging Material	High cost of packaging material. Unavailability of packaging material.	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 6: Compiled Technological Issues in Supply Chain of F&V in Uttarakhand 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.	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.

### Farmer's Knowledge and Awareness

Farmers in Uttarakhand 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 7 covers factors pertaining to knowledge and awareness level of farmers.

### 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 Uttarakhand state there is a lack of quality standards to meet international quality for export, poor hygiene and safety standards, high quality degradation etc. Table 8 shows the related challenges and their corresponding mitigation strategies to overcome the problems.

### 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 the state of Uttarakhand the food processing is very low as

**Table 7: Compiled Knowledge and Awareness Issues Supply Chain of F&V in Uttarakhand 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.	Singh <i>et al.</i> , 2009; Modi <i>et al.</i> , 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.

**Table 8: Compiled Quality and Safety Issues in Supply Chain of F&V in Uttarakhand 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. 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.	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

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 9.

### 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 realisation is very high (farmers get only 25 % of

the total consumer price shares) in the state. There are lack of transparencies in pricing at all mandis in Uttarakhand state due to which farmer don't get right prices for their efforts and fresh produce. Table 10 shows related challenges and their corresponding mitigation strategies.

### 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

**Table 9: Compiled Processing and Value Addition Issues in Supply Chain of F&V in Uttarakhand 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.	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.

**Table 10: Compiled Financial Issues in Supply Chain of F&V in Uttarakhand and their Corresponding Mitigation Strategies**

Financial Issues	Variables	Source	Strategies
Farmer's Income	Difference between the final consumer price and farmer's realisation is very high (Farmers get only 25 % of the total consumer price shares). Lack of transparency in pricing at local Mandis. Heavy fluctuations in the Mandi prices. Farmers are not receiving right price for their produce in the market even in seasonal F&V.	Modi et al., 2009; Narula, 2011; Sharma & Singh, 2011	Contract farming can be done. Agro cooperative markets can be set up. 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.

**Table 11: Compiled Post-Harvest Losses Issues in Supply Chain of F&V in Uttarakhand 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 in Uttarakhand.	Narula, 2011; Modi <i>et al.</i> , 2009; Singh <i>et al.</i> , 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.

**Table 12: Compiled Transportation Issues in Supply Chain of F&V in Uttarakhand 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.	Modi <i>et al.</i> , 2009; Singh <i>et al.</i> , 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.

transportation and storage of fresh food produce. Post-harvest losses are high in Uttarakhand because of lack of cold chain facilities, poor logistics connectivity in the hilly areas etc. Table 11 shows related challenges and their corresponding strategies to overcome from the issue of post-harvest losses.

### 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 right time and in proper quality. It plays even more important role in perishable food like fruits and vegetables because of short shelf life, highly perishable nature, and requirement of controlled temperature. Transportation related challenges are

very high in the state 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 in the state have been depicted in Table 12.

### 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 Uttarakhand, farmers have lack of information regarding the prices in the market, demand, food processing units etc. Poor information leads to poor realisation of prices, high amount of losses, late delivery of goods in the market place etc. Table 13 shows the challenges related to

**Table 13: Compiled Market Demand and Information issues in Supply Chain of F&V in Uttarakhand and their Corresponding Mitigation Strategies**

Transportation 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.	Singh <i>et al.</i> , 2009; Narula, 2011; Modi <i>et al.</i> , 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.

demand and information regarding market, prices etc. and their mitigation strategies to overcome the issues.

## CONCLUSION

The study and research conducted on the supply chain of fruits and vegetables in Uttarakhand 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 in Uttarakhand and India as a whole.

The entire supply chain of F&V in Uttarakhand 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 realisation 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 F&V produce sector in Uttarakhand.

Uttarakhand 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 setting up the cold chain infrastructure and food processing units. However there are various challenges pertaining 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 Uttarakhand state. As Uttarakhand 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 employments opportunities for the local peoples, and improve the livelihood of the farmers which leads to the development of Uttarakhand and Indian economy as a whole.

## CONTRIBUTION

The present study identifies the issues and challenges in the fruits and vegetables sector in Uttarakhand. The major issues and challenges 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 and challenges 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 and challenges identified in the state of Uttarakhand may further be empirically tested and validated on the F&V supply chain of other states. A similar empirical study may further be carried out for the supply chain of various related sector like food processing unit, beverages industry and also in F&V products such as mango, apple, litchi, tomato etc.

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