

A Review of Supply Chain in Fresh Food Industry

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Abstract

Supply chain for fresh foods can be complex and fragmented, with variations across different regions and food categories. Additionally, factors such as seasonality, weather conditions, infrastructure limitations, and government regulations also influence the efficiency and reliability of the supply chain. Fresh food supply chains is a topic of interest of research for academicians and practitioners for controlling wastages during management of supply chain. The coordination between the participants of supply chain is important to ensure that the end user gets the right product at the right time and right price. Its also important from the point of view of supply chain participants including manufacturer. The wastages in supply chain are significant as these undesirable wastages related to high product losses result in lower price realization making the supply chain inefficient and ineffective.

This paper provides a comprehensive overview and understanding of the entire supply chain of fresh food, including its various stages, key players, and processes involved. This paper will create a deeper understanding of the complexities, challenges, and opportunities within the supply chain of fresh food and provide insights for improving its efficiency, sustainability, and resilience.

Keywords: Customer expectations, Fresh food supply chain (FFSC), Improvement initiatives, India, Supply Chain Performance.

Introduction

The supply chain of fresh foods in India involves several stages and players, each contributing to the movement of products from farms to consumers. The important components and factors considered while designing the fresh food supply chain may be enumerated as follows:

Farming and Production:

The process starts at farms where farmers cultivate various types of fresh produce such as fruits, vegetables, grains, and dairy products. Farming practices vary across regions and can be small-scale or large-scale depending on the crop and the farmer's resources.

Harvesting: Once the crops are ready, they are harvested. Harvesting methods depend on the type of crop and can range from manual picking to mechanized harvesting for larger farms.

Sorting and Grading: After harvesting, fresh produce goes through sorting and grading processes to ensure quality and consistency. This step involves separating the produce based on factors like size, color, ripeness,

and quality standards

Packaging: Following sorting and grading, the fresh produce is packaged for transportation and sale. Packaging materials vary depending on the type of product but commonly include crates, boxes, bags, and containers. Packaging not only protects the produce but also helps maintain freshness during transportation and storage.

Transportation: Fresh produce is transported from farms to various distribution points such as wholesale markets, processing facilities, or directly to retailers. Transportation methods include trucks, refrigerated vans, and in some cases, trains or ships for long-distance transportation.

Wholesale Markets: In India, wholesale markets play a crucial role in the fresh food supply chain. These markets, such as Azadpur Mandi in Delhi, Vashi Market in Mumbai, and Koyambedu Market in Chennai, act as trading hubs where farmers, wholesalers, and retailers converge to buy and sell fresh produce in bulk quantities. Some fresh foods undergo processing before reaching consumers. Processing activities may include washing, cutting, packaging, and preserving to extend shelf life or enhance convenience. However, not all fresh foods undergo processing, and this step is more common for certain products like fruits, vegetables, and dairy.

Retail Distribution: After leaving wholesale markets or processing facilities, fresh produce is distributed to retail outlets such as supermarkets, grocery stores, local markets, and street vendors. Retailers may source their products directly from wholesalers or through intermediaries, depending on their scale and location.

Consumers: Finally, consumers purchase fresh foods from retail outlets for consumption. Factors influencing consumer choices include price, quality, freshness, convenience, and availability. Increasingly, consumers are also showing interest in factors like sustainability, organic certification, and local sourcing. Once purchased, consumers consume the fresh foods either immediately or store them for later use. Proper storage and handling practices are essential to maintain freshness and prevent spoilage. However, some fresh foods may still go to waste due to factors like overbuying, improper storage, or spoilage. Effective waste management strategies are crucial to minimize food waste and its environmental impact.

It's important to note that the supply chain for fresh foods can be complex and fragmented, with variations across different regions and food categories. Additionally, factors such as seasonality, weather conditions, infrastructure limitations, and government regulations also influence the efficiency and reliability of the supply chain.

This paper attempts to make a detailed review of the supply chain for the fresh foods.

Objectives of the Study

1. Provide a comprehensive overview of the literature and understanding of the entire supply chain of fresh food, including its various stages, key players, and processes involved.
2. Identify and discuss the literature related to the key players and stakeholders involved in the fresh food supply chain, including farmers, wholesalers, retailers, transportation providers, government agencies, and consumers.
3. Review the literature of the role of technology and innovation in optimizing and improving the

fresh food supply chain, including advancements in areas such as transportation, logistics, packaging, cold chain management, traceability, and quality control.

Research Methodology

This research methodology used in this paper is to represent the interconnected variables that influence the dynamics and performance of the supply chain. Each category encompasses specific aspects of the supply chain that is investigated to understand its functioning and identify areas for improvement. The analysis is divided in the following important categories:

- a) Agricultural Supply Chain
- b) Fresh Food Supply Chains
- c) Linkages between resources and application

Data Analysis

Oliver and Webber (1982) defined ‘Supply Chain Management’ as an inventory management approach with an emphasis on the supply of raw materials. They emphasized it as a single entity which does not delegate fragmented responsibility for various segments to the functional areas such as purchasing, manufacturing, distribution, and sales; it is an integrated system where the objectives are shared across every function in the chain; it has particular strategic significance due to its impact on overall costs and market share, used as a balancing mechanism of last, not first, resort.

Jones and Riley (1985) argued that SCM should fulfill final customer’s service requirements. Authors proposed where to position inventories along the supply chain and how much to stock at each point. Cooper and Ellram (1993) stated that SCM is an approach whereby the entire network, from suppliers through to the ultimate customers, is analyzed and managed to achieve the ‘best’ outcome for the whole system.

Bechtel and Jayaram (1997) emphasized on facilitating product movement and coordinating supply and demand between a supplier and buyer. They claimed the greater importance of relational rather than a transactional factor in supply chain. Cooper and Gardner (1993) extended SCM beyond logistics and highlighted the need for coordination of activities and processes within and between organizations in the supply chain.

Lambert and Cooper (2000) put forth the supply chain as a network rather than a chain, that is, management of the supply chain is about managing multiple relationships across the network. Authors pointed out the differences between supply chain and logistics. It was emphasized that supply chain involve the network structure, business processes, and the management components. Its objective is to create the most value, not for the company alone, but for the whole supply network including the customer. It was argued that competition is no longer between companies but between supply chain.

Mentzer *et al.* (2001) defined it as the systemic, strategic coordination of the traditional business functions, to improve the long-term performance of the individual companies and the SC as a whole. It is considered

as a strategic advantage through reduced market risks through cooperation among the members, a collaborative approach for value creation (Collins *et al.* 2002) and collaborative innovation.

Gunasekaran and Ngai (2006) consider supply chain as a long-term benefit of all parties through cooperation and information sharing. Woods (2004) also claimed it as the integration of all the players in the chain from the farm to consumers and satisfying them with the right quantity, quality and price of the products.

Simchi-Levi *et al.* (2008) defined these 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”.

Chandrashekar (2009) put forth the essential steps involved in supply chain formation as:

understanding the existing trade system and the trade environment, analysis and identification of the potential supply chain players along with their function, role and relationships in the trade system, and choice of a leader

Considering the huge losses occurring annually along the agricultural supply chain, and the importance of the sector to the economy, it is important to understand the supply chain issues and challenges related to agricultural produce. Lowe and Preckel (2004) and Brysecon and Smith (2008) claimed these as very complex in nature and hard to manage. Keeping in view the conceptual understanding and management of supply chain, the subsequent section discusses the development of studies in context of ASC.

Agricultural Supply Chain Management: An overview

The academic and the commercial interest of bringing the concept of supply chain management in Agriculture came into 1990s in Europe and USA (Woods, 2004). Need for SCM was felt among decision-makers and practitioners (Dimiyati, 2004) due to the transition of firms from a family-based into a more dependent one across the production and distribution of the value chain (Boehlje, 1999).

Agricultural supply chain (ASC) is a network of organizations involved in a number of processes and activities to meet the customer demands and satisfy them (Christopher, 2005). These are also termed as Agri-food supply chains (AFSC), coined to describe the activities from production to distribution that bring agricultural or horticultural products (Aramyan *et al.*, 2006) from farm to the table. The literature has used the term Agri-food supply chain which is composed of a wide diversity of products and companies which operate in different markets and sell a variety of food products. Van der Vorst *et al.* (2007) referred these as “food supply chain networks” that depict a peculiar characteristics which differentiates them from other supply chains discussed in Table 2.1. Each feature affects the environment where an agribusiness manager practices their craft (Barnard *et al.*, 2012). As this sector is unique it requires unique abilities and skills to manage.

Increasing competitiveness in the environment and frequent changes in customer requirements have posed a great pressure on ASC which is altering the production and distribution activities of the chain (Barnard *et al.*, 2012). This has in turn posed the necessity of applying the concept of SCM in Agriculture. Components of agricultural supply chains are presented next.

Components of Agricultural Supply Chains (ASC)

Woods (2004) studied the role of SCM in meeting the future challenges in agricultural production and marketing system, bringing competitiveness and shared value to the players involved in the chain. The author presented the planning, developing and managing agribusiness through SCM in developing countries. It was put forth that consumers determine the preference and the market size in a supply chain. All the products reach the consumer through a supply chain but there exists a poor interaction, commitment and efficiency in delivering the final product.

Bezuidenhout *et al.* (2012) evaluated the different attributes of collaboration in the South African sugarcane production and processing chain. Fragmentation was asserted as the major factor for the disintegration in the supply chain where local benefit was focused rather than the benefit of the whole supply chain. Other factors which inhibit the supply chain collaborations discussed were insufficient support from stakeholders; inadequate measurement and information systems; the nature of the organizational and collaborative culture; and resistance to change (Barratt, 2004). Sharing the risk among each other is a boon for collaboration (Sahay and Maini, 2002).

Zhang (2012) analyzed the drivers influencing the choice of food purchase, focusing on the changing lifestyle and the behavior of Chinese consumers. The author identified the major drivers for change in the food sector viz., consumer taste and behavior, advances in technology, environmental consciousness, policy influences, internationalization and globalization, competition and production efficiency. It was highlighted that there is a concentration of power with the retailers in the Chinese food market. In order to maximize profit, it is important to focus on the market place which is very important due to the market led feature of agricultural production

Xaba and Musuku (2012) studied the vegetable supply chain in Swaziland and claimed that an increase in the income of the population with an increase in the demand for food and food products but decrease in the farm income and stagnating productivity result in crop diversification. It was found that direct sales to consumers brought largest producer's share.

Bravo *et al.* (2012) studied the micro (cultivation, harvesting, scheduling) and macro (environmental and political) factors that hinders the efficiency and effectiveness of the biomass supply chain. The paper suggested the need for biomass-to-energy supporting policies, importance of the delimitation of cultivation areas for biomass-to-energy production, design of harvesting systems, importance of conversion decision-making for bio-fuel competitiveness, importance of transport planning in the framework of a supply chain strategy.

Demir (2013) studied the network structure and the critical activities of the organic sector in Turkey. Study suggested the collective transportation as the way to reduce the cost. Study proposed a vehicle routing solution against a high unit transportation cost.

SCM help develop strategies which include reducing market risks, collaborative innovation and value creation. This entire thinking has been extended to agriculture. If farmers are aware of the value products that customers require through better understanding of the chain, then through improved products like grading, can help them achieve high payment for their produce. Another vital way of reducing the transaction cost could be by making products available in consumer friendly packages with bar codes, which reduces the training and weighing time of the products at the check outs (Woods, 2004). Due to the customer requirements number of changes in the packaging, value added products and many advancements have taken place in food product development (Zhang, 2012).

Classification of Agricultural Supply Chains

Based on target customers (Dani, 2015):

1. **Commodity and producer focused chains:** here the commodity products are dealt such as palm oil, rubber, coffee, sugar, cereal and grains etc.. The contracts are made on these commodity for the delivery at the future date.
2. **Consumer-driven value chain:** These are more vertically integrated, regulated and requires more collaboration and cooperation among the members. Food traceability is essential in these chains for effective supply chain management.

Based on the type of crops:

A report by natural environment resources and development (GOI, 2013) has classified the major crops of India as below:

1. **Food grains:** crops that are for human consumption. These include rice, wheat, maize, millets, pulses and oil seeds.
2. **Commercial crops:** crops which are grown for sale either in raw form or in semi-processed form. These are cotton, jute, sugarcane, tobacco and oilseeds.
3. **Plantation crops:** crops that are grown on plantation covering large estates. eg. tea, coffee, coconut and rubber.
4. **Horticulture crops:** crops include fruits, vegetables and flower.

Based on the degree of processing (Van der Vorst *et al.*, 2007):

1. Fresh agricultural products:

These include fresh vegetables, flowers, and fruit. In general, these chains may comprise growers, auctions, wholesalers, importers and exporters, retailers and specialty shops and their input and service suppliers. The main processes are the handling, conditioned storing, packing, transportation and especially trading of these goods.

Processed food products:

These include portioned meats, snacks, juices, desserts, canned food products. In these chains, agricultural products are used as raw materials for producing consumer products with high value addition. In most cases, conservation and conditioning processes extend the shelf-life of the products.

Among the different crop varieties fruits and vegetables amount to about 18% wastage valuing about INR 133 billion every year (CIPHET, 2012). The highest wastage is found among tomatoes (18.4%) and other fruits and vegetables at the retailers end (ICAR, 2015) which require special attention. We briefly explain the fresh food supply chains (FFSC) subsequently.

Fresh food Supply Chains (FFSCs)

Fresh Food supply chains (FFSC) include activities from production to distribution of fresh fruits and vegetables that undergo minimal processing (Aramyan *et al.*, 2006). FFSCs are very complex due to the interactions among intermediaries such as wholesaler, processors and customers. A typical FFSC is depicted in Figure 2.7 where players in FFSC include producers, aggregators, wholesalers, retailers and customers. Here, we consider the supply chains of fruits and vegetables.

Players in FFSC

Usually food supply chains involve processors, but the study focusses on the fresh fruits and vegetables that do not involve processing. Hence, the supply chain has been explained involving aggregators or wholesalers rather than processors.

Producers

They are the primary producers involved in farming and producing products for their livelihood. They receive raw material (seeds, farming machinery, pesticides, fertilizers etc.) for production from input suppliers. In fresh food supply chains the producers of fruits and vegetables are involved in minimal processing such as cleaning, grading, sorting and packaging.

Aggregators / wholesalers

These are the intermediaries involved in collecting the produce from the farmers. In India these are

Agricultural produce market committee (APMC) where producers sell their product. In APMC produce are auctioned and sold to the downstream players such as retailers or distributors. Direct procurement of the farmers produce is also done by retailers surpassing APMC.

Retailers/ Distributors

These entities act as a linkage between the producer and the customers and are responsible for selling the produce in stores while maintaining high customer satisfaction. The stores are in the form of supermarkets, hypermarkets, convenience stores where produce is sold at competitive prices with high SKUs. Distributors on the other hand buy the produce in bulk and sell them downstream as and when required. These are important when the product involves export or import while dealing the international market.

Indian retail sector is dynamic and is expected to grow at a CAGR of 13% (IBEF, 2018). The supermarket penetration almost touched 8500 in 2016, where it was only 500 in 2006. This exponential growth is due to the entry of new players since the introduction of 100% FDI in Indian retail. Approximately, 8% of the food and grocery segment is organised, remaining being unorganised. Among the various product categories, food segment comprises 42% of the total retail market. By 2020, organised food retail is expected to penetrate up to 24% contributing 66% of the total revenue (IBEF, 2018). Retail growth has become promising in India compared to China due to the expanding economy, urbanizing population, booming consumption rates and growing middle class (Sengupta, 2008). India topped the Global Retail Development Index (GRDI) among the 30 developing countries in 2017, from the 20th position in 2014. Under this condition, fresh food supply chains need to innovate and align their processes with the changing retail atmosphere.

Consumers

They are the final entity in the fresh food supply chain who highly influence the sustainability of the chain as they are involved in buying activities and make the cash available in the SC that travels upstream. These entities also influence the food wastage and ultimately the profitability of the chain as a whole. Few of the major concerns of the consumers involve food safety, traceability, product prices and availability.

Factors influencing fresh food supply chains (FFSC)

Bryceson and Smith (2008) asserted FFSC as complex decision-making systems due to their inelasticity of demand coupled with the tremendous wastages happening annually. These wastages result due to improper handling, poor transportation and storage facilities (Reddy *et al.*, 2010; Viswanadham, 2006) along with improper production planning, poor buyer-supplier relationship, poor demand forecasting and improper inventory management (Shukla and Jharkharia, 2013). Though intermediaries help overcome the lack of infrastructure but add to the waste and increasing the per unit price of the product (De Boer and Pandey, 1997).

Murthy *et al.* (2009) brought in concern in the food wastages happening in agri-fresh produce and pinpoints the sources being improper handling, transportation, and storage. It was also claimed for an absence of an efficient system to measure the wastages in various operational stages of FSC.

Changing customer requirements pose a great pressure on food supply chains altering the production and distribution activities (Barnard *et al.*, 2012). Thus, process improvement framework for agri-food supply chains, linking demand data more directly with production decisions upstream is essential for reducing the variability in the supply chain (Taylor and Fearn, 2006). Special care is required for the formation of cross-border supply chains as differences in business, and social culture can have for instance large influences in the performance of the chain collaboration. SAFAL market in Karnataka is an example of the short food supply chains (SFSC) in India, which was established with an objective to benefit the farmers by cleaning, grading, sorting and cooling the fruits and vegetables to reduce their deterioration. The farmers are provided with support regarding the growing and selling of their produce, acting as a direct link between the producers and consumers. SAFAL benefits the farmers with the proper weighing of produce, low transaction cost and less input cost, efficient transportation, less wastage and providing right price and extension services.

Reddy *et al.* (2010) brought in concern in the food wastages happening in Agri-fresh produce and pinpoints the sources being improper handling, transportation, and storage. The absence of an efficient system to measure the wastages in various operational stages of FSC remains unaddressed.

Shukla and Jharkharia (2013) put forth the causes, limitations, and recommendations for the Agri-fresh produce. They asserted the operational issues /causes of the post-harvest wastes as, poor transportation, demand forecasting, improper inventory management, improper handling by farmers, improper production planning and poor buyer-supplier relationship and e-commerce.

Ahumada and Villalobos (2009) pointed out the strategic, tactical and operational issues for Agri-fresh produce. Where strategic decisions involve financial planning, supply network design, selection of capacity, and technology. Tactical decisions include: harvest planning, scheduling of crops, selection of labor, capacity and crops, etc. and operational decisions are production and scheduling activities.

In FFSC individual product characteristics need to be considered while predicting the demand because of their relative importance influenced by the climatic condition and the consumption habit of that region (Shukla and Jharkharia, 2013).

Transportation is one of the most important factors in FSCM as mostly wastages occur from poor handling during transit (Shukla and Jharkharia, 2013). James *et al.* (2006) studied the refrigerated vehicle transportation through and ways of controlling the temperature according to the environmental conditions. There are several other issues such as quality, strategy (Blackburn and Scudder, 2009), technology

implementation (Salin, 1998) discussed the existing barriers faced by the various stakeholders in FFSC. Their association with the market deteriorate due to intermediaries, lack of transport facilities and lack of inadequate market information. In the wake of the above irregularities and inefficiencies in ASC and FFSC in particular, there is a need for a structural and business process transformation to exploit its best practices to achieve competitive advantage. By taking up interventions w.r.t. Proper warehouses, transportation and storage facilities, collaborative innovation across the FFSC will help achieve a holistic growth.

Few recommendations put forth in the studies include: forecasting demand for Agri-fresh produce at a disaggregate level rather than an aggregate level because of its seasonal and perishable nature, inclusion of the consumer demand in the production planning, proper harvest scheduling, integration of production planning and inventory management with demand and transportation lead times and inclusion of real data of consumer demand and transportation lead times during planning stage.

The performance of Agri-food supply chains need to be scrutinized to enhance its effectiveness and efficiency. This means the intensification of production which will require the best management practices along with a defined SCM for Agri-products. The categorization into demand forecasting, inventory management, transportation, inventory management is adopted from Shukla and Jharkharia (2013). Additionally, focus on food wastages and collaboration issues are also presented. Though the studies in food wastages and demand forecasting are less but these are growing. To measure the way an FFSC works, it is required to define the different performance measures.

Performance Measures in FFSC

Supply-chain performance is defined as the degree to which a supply chain fulfills end-user and stakeholder requirements concerning the relevant performance indicators at any point in time. The quantification of the effectiveness and efficiency of the action is called performance measurement while the measures which are used to quantify the same are performance indicators (Neely, 2005).

Performance indicators (or performance metrics) are operationalized process characteristics, which compare the performance of a system with a norm or target value. Organizations measure their performance in order to check their position (as a means to establish position, compare position or benchmarking, monitor progress), communicate their position (as a means to communicate performance internally and with the regulator), compel progress (as a means of motivation and rewards) and confirm priorities (as a means to manage performance, cost and control, focus investment and actions) (Neely, 1998).

Anderson *et al.* (1989) claimed that for an effective supply chain customer satisfaction should be included as one of the performance measures. Van der Vorst (2000) defined two levels of supply chain performance indicators, i.e., supply chain level and organization level. The supply chain level indicators include food quality, efficiency, responsiveness, and flexibility while the second level includes in addition

to these that is in line with the organizations' objectives. Shepherd and Gunter (2006) provided the SC performance measures based on the processes viz., time, cost, quality, innovativeness, and flexibility). Aramyan (2007) developed a conceptual framework to measure the performance of the Agri- food supply chain using four criteria: efficiency, food quality, responsiveness and flexibility which considers the tangible and intangible measures. The same was studied in Dutch context to understand the factors affecting the tomato supply chain. Bourlakis *et al.* (2009) studied these parameters and replaced efficiency with consumption in Greek supply chain. Carvalho *et al.* (2011) presented measures such as environmental, financial, innovation, flexibility, integration and operational. Few of the performance measures are presented subsequently.

Flexibility: As supply chains are becoming competitive and complex they require handling market demand; supplier lead time, product quality, and information delay (Giannoccaro, 2003). In this situation flexibility becomes a crucial weapon. Singh and Sharma (2013) define flexibility as the ability to accommodate the external changes while maintaining the system performance. This with respect to the supply chain is to produce new products with modification over the existing one rapidly, to produce a wide variety of products, and to react to customer needs. Golden and Powell (1999) claim flexibility as measure of system's ability to accommodate schedule and volume fluctuations from manufacturers, customers, and suppliers. Flexibility has been defined as the means to cope with uncertainty (Stevenson and Spring, 2007) which can include changing customer demand and competitor actions (Yi *et al.* 2011).

Responsiveness: Today the supply chains are competing with each other to respond to the customer requests at the earliest. It is defined as the delivery of the product to the customer at the shortest possible time (Persson and Olhager 2002). The parameters considered for responsiveness are fill rate, product lateness, shipping errors, customer complaints, customer

response time and lead time. An ability to quickly respond to the short-term demand changes from the customer is implied to as a responsive company (Reichhart and Holweg, 2007). It was claimed that responsiveness helps achieve flexibility and delivery performance (Hallgren and Olhager 2009). Moreover, internal and external integration among the stakeholders influence the responsiveness of the supply network (Yi *et al.*, 2011).

The operational effectiveness of the supply chain is implied by the information interchange, reduced transaction cost, improved logistics, integration among the chain members, quality and standards maintained throughout the chain. The performance of the supply chain should be measured according to the criteria set by the chain partners. The prioritization and the intricate relationships among the performance measures is crucial for the supply chain managers to understand the implications of their decisions (Srivastava *et al.*, 2015). Studies of Akyuz and Erkan (2010), Rosales *et al.* (2012) and Cai *et al.* (2013) emphasized the importance of understanding the hierarchical

relationships among the performance measures. As, any improvement initiative has an impact on the performance measures, these are studied in the context of FFSC subsequently.

Improvement initiatives in FFSC

Supply chain improvement initiatives (SCII) are the initiatives taken up in the supply chain to enhance its performance measures (Ayers, 2010). Many large-scale SCM improvement efforts fail in reaching goals within the defined limits of scope, budget and time, as these are very complex and difficult to control impacting the company's performance (Hulsmann *et al.* 2008).

Critical aspects of SCII involve SCM business processes, information systems, and organizations (internal and external). These improvement initiatives (IIs) demonstrate structural complexity, uncertainty between elements. Nyman and Hirkman (2012) discussed the failures in the SCII through popular examples of Global beverages UK, Nike and i2 and Hersheys. Lack of scope, organizational complexity, SCM business process complexity and information system (IS) complexity were the reasons for the failure. SCII would not be possible without a significant level of IT support to orchestrate logistics and to communicate with SC partners (Auramo *et al.*, 2009). Bermudez (2002) claimed that SC business processes are difficult to comprehend as they cross many organizational silos and because few companies have multi- department supply chain processes defined on a corporate level.

Changing customer requirements pose a great pressure on food supply chains altering the production and distribution activities (Barnard *et al.*, 2012). Thus, process improvement framework for Agri-food supply chains, linking demand data more directly with production decisions upstream is essential for reducing the variability in the supply chain (Taylor and Fearn, 2006). Considering the inherent challenges in fresh food, it becomes crucial to identify the improvement initiatives to overcome the concerns and achieve desired performance.

To understand this in detail, we discuss the initiatives in food supply chains related to supplier, customer and product and process. Studies of Caniato *et al.* (2013); Golini and Kalchschmidt (2011) categorized the improvement initiatives w.r.t. the supplier and customer in non-food sector. Considering the inherent characteristics of fresh foods adding one more dimension in FFSC, i.e., product and process related initiatives is crucial.

Supplier related Initiatives

Initiatives related to the suppliers are those that are undertaken to benefit the suppliers and enhance their overall performance. Suppliers here considered are the suppliers of the fresh produce involved in growing fruits and vegetables and the suppliers of packaging material. In FFSC literature initiatives related to suppliers involve supplier development, strategic sourcing, Customer-focused initiatives

Satisfying the customers at the point of sale (POS) is the most crucial and challenging task for any supply chain. These initiatives include sales promotions, providing better shopping experience and ensuring product freshness.

Product and process related initiatives

These are the initiatives undertaken for enhancing the quality of the product and the process that are briefly explained in Table 2.4. Product and process related initiatives are discussed w.r.t. the fresh fruits and vegetables that undergo minimal processing like primary cleaning, sorting and grading.

Linkages between improvement initiatives and performance measures

Managers need to understand both the implications of their decisions and the actions that they can take to attain improved performance. This requires a careful analysis of the key drivers of performance and a measurement of both the drivers and the linkages between them (Epstein and Roy, 2001).

Tsolakis *et al.* (2014) presented a hierarchical decision-making framework for Agri-food supply chain, where the decisions were categorized into strategic, tactical and operational. The study put forth few strategic initiatives like efficient procurement, collaboration, and selection of the contract types in Agri-food domain. Mistry (2005) claimed proper material handling, quality control and improved efficiency, resulted in improvements in financial performance in non- food sector.

Studies (Choi and Hartley, 1996; Craighead *et al.*, 2010,) claim that investments in supplier development have a positive influence on the performance. Golini and Kalchschmidt (2010) found that companies have invested in coordination with customers in order to keep lead time performance under control. Muralidharan *et al.* (2001) found a positive impact of vendor rating systems on performance. Handfield *et al.* (2006) also found a positive impact of supplier development programs focusing the attention on the importance of keeping the entire network under control on performance.

Studies have focused on how companies invest in their supply chain (SC) in order to improve operational performance, examining factors such as cost, delivery, quality and flexibility (Craighead *et al.*, 2007; Golini and Kalchschmidt, 2011; Juttner *et al.*, 2003; Minner, 2003; Tang, 2006). Caniato *et al.* (2013) studied the supply chain improvement programs/ initiatives in manufacturing sector and concluded that the improvement programs differs with the local and global sourcing. Moreover, extending supply chains globally increases lead times and, by consequence, inventory levels (Frear *et al.*, 1992; Zeng and Rossetti, 2003).

The overall supply chain configuration is a major contingent factor that must be considered when evaluating investments in supply chain improvement programs, in addition to the traditional variables such as company size (Caniato, Golini, & Kalchschmidt, 2013). In order to improve operational performance, companies can act differently (Krause *et al.*, 1998; Tan, 2001). For instance, they can leverage the definition of a supply strategy and a purchasing organization (Driedonks *et al.*, 2010).

and Zuurbier (2008) stated quality assurance to dominate the process of production and distribution in food chains in the future. This also means that product flows with different quality attributes could be directed to different logistical distribution channels (with different environmental conditions) and/or different customers (with different quality demands) in the supply chain. In fact, one of the keys to SCM for the food industry is an integrative view on logistics and product quality, which was labelled as “quality controlled logistics” (Van der Vorst *et al.*, 2007).

The studies have focused on the improvement programs for suppliers and customers in developed countries in non-agricultural sector. The impact of these programs on the performance also differ with the supply chain configuration. Thus, studies could be extended to the developing countries such as India to understand the impact of the various supply chain improvement investments on performance measures. Considering the current literature there are various opportunities for research in FFSC. These are combined and presented in the subsequent section.

Findings

Literature indicates that there are very few studies that have integrated the improvement initiatives with the performance measures considering the different supply chain configurations in fresh foods. Moreover, an exhaustive framework is missing that considers the initiatives including the product and process related to supplier and customer in supply chains of fresh foods in developing nations like India. The papers reviewed have discussed the improvement programs in non-food supply chains and framework linking with the performance measures. But similar studies in fresh food relating the improvement initiatives with the performance measures are scarce.

Although the literature has focused on the improvement initiatives influencing the performance regarding cost, flexibility, and delivery, some of the key performance measures like food quality and customer service which are very crucial in food have not been comprehensively studied. Moreover, studies are very limited that have identified the initiatives at the different stages of the FFSC. These improvement initiatives also do not provide sufficient information whether these are aligned with the customer expectations or not. This provides an opportunity to identify and understand the influence of improvement initiatives on the performance measures in fresh foods.

Conclusion

Majority of studies have focused on FFSC planning and delivery. An integrated understanding of the initiatives at three stages and their impact on the performance measures is very limited. That is, which initiatives should be taken in FFSC and what impact does each IIs will have on the performance measures is limited. It is required to deal in a comprehensive manner the relationship of IIs with the performance measures and investigate further if any casualty is there. In India where there are a lot of infrastructural issues and loopholes in food storages, investments are essential to bring in at different phases and at different stages of the FFSC to reduce the unwanted wastages that are at an up-rise.

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