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## **A Conceptual Model for Integration of Indian Food Supply chains**

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### **Abstract**

*This paper is an attempt to explore the problems faced by Indian agriculture for food security in terms of inadequate infrastructure and highly inefficient supply chain. Due to lack of efficient infrastructure, supply chain mechanism and food processing leads to around 30-35 percent of all foods produce in India are wasted. This paper examines the critical issues at sub-system of agriculture supply chain, with a view to integrating them in efficient and effective manner. Paper broadly covers some of important aspects of agriculture supply chain in India- identification of issues at different levels in the supply chain; transformation in the agriculture due to various supply chain interventions; the role of information technology in supply chain management. As this paper is based on both primary and secondary research methodology, it has led us to finding that there is not much research in this field in India and importance of integration in agricultural development. The paper concludes that efficient supply chain plays very important role for development and contemporary issue for agriculture therefore; government and corporate must address the issue of integration, infrastructure development and information management to achieve the objective of a feasible agricultural sector which will lead to food security for all.*

**Keywords:** Agriculture; Supply chain; Integration; Infrastructure; Food Security; Development; Investment; Socio-economic

## 1.0 Introduction

An integrated system in agriculture is a network of producers (suppliers), manufacturing units, warehouses (cold storage), distribution channels and retailers through which raw materials or product are acquired (procurement), processed (value addition) and delivered to the end consumer. An integrated supply chain framework is the strategic, planned and operational level decision making that enhances value addition of produce and supply chain performance. The strategic level comprise of aspects such as selection of suppliers, transportation routes, manufacturing facilities, production levels, warehouses, etc. The tactical level includes planning and scheduling the supply chain and third one is operational level which executes plans with decision making functions across the supply chain.

In order to improve productivity, supply chain agencies must function in an integrated manner. But the underlying forces of the enterprise and the market make this difficult; raw materials do not reach on time, failure of production facilities, inefficient workers, and unpredictable dynamics of consumer behaviour etc. causing deviations from plan. Some issues can be dealt with locally but many cases require modifications across functionality of various stakeholders and an effective supply chain management framework must coordinate all the schedules and re-schedules across supply chain mechanism.

The Integrated Supply Chain Management (ISCM) at both tactical and operational levels comprised of a set of cooperating, intelligent agents, each performing chain functions, and coordinating their activities with other agents. The focus of paper is on the development of 1) a theory on coordination that allows stakeholders in agricultural sector to cooperatively manage change, 2) a model of stakeholders problem solving that enables stakeholders to cooperate with other agents in their search for solutions and 3) a model of agency and support tools that enable firms to develop multi-agent systems with minimal programming effort, based on reliable components.

Agricultural sector in India since the introduction of reforms of 1991 had very significant impact on agriculture and supply chain. Further, first part of reforms brings out that there was a visible deceleration of growth in agriculture during the post reforms period. It also comes out that the growth of agriculture exports which picked up after 1991 slowed down after 1996-97 have stagnated since then and infect it went down and fluctuating in nature as it picked up due to some policy reforms and good monsoon in 2010-11 and it rose to growth rate of 5.4 percent. The deceleration of agriculture growth was also accompanied by visible deceleration of growth in growth rate of employment. The growth rate for employment collapsed to nearly zero during that period. The data on both barter and income terms of trade brings out that both of them did shows some improvement in mid-eighties up to 1996-97 but had stagnated since then. All these numbers point out that agriculture sector is lagging sector in the Indian economy and farmers and other agricultural workers engaged in this sector have not been able to derive much benefit from new economic policies initiated in 1991.

Indian agriculture with nearly 12 percent of the world's arable land, 13.8 percent of the country's gross domestic product, compared to 51 percent in the 1950s (Government of India,

2011). India is the world's third-largest producer of food grains, the second-largest producer of fruits and vegetables and the largest producer of milk; it also has the largest number of livestock. Add to that a range of agro climatic regions and agri-produce, extremely industrious farmers, a country that is fundamentally strong in science and technology and an economy which one of the largest in the world with one of the highest growth rate and you should have the makings of a very good harvest.

Economic reforms and liberalization in the agriculture sector has emphasized on transforming Indian agriculture by designing agricultural supply chain model covering innovations at farming levels, which can help farmers regain profitability in a sustainable manner under changing conditions with proper assurance of market arrangements (Rao and Punwar, 2004). The reforms in agricultural marketing system to ensure participation for establishing direct linkage with farmers, capacity building and infrastructure development in regulated markets, extension of road network and transportation, storage and warehousing, market intelligence system, introduction of commodity by establishing commodity are some important areas of interventions, but the changes are taking place at a very slow pace.

As paper mainly focuses on current food supply chain process in Indian agriculture and its impact on Indian agriculture and food security. It has been assessed on the basis of data and information collected from both primary and secondary data, which has been obtained through application of scientific research method by formulating research design and conducted research by utilization of diverse kind of methods to assess the objective which includes research methods such case study, in-depth interview content analysis, triangulation method, observation method for primary data and information as well as for the secondary one. Most of secondary data are sourced from annual reports of ministry of agriculture, ministry of food processing, Food Corporation of India (FCI), article of respected authors, article and book review from reputed national and international journals, Economic survey etc. The literature review covers many areas related to the nature of the research questions put forward, and thus includes: agriculture, food management, supply chain approaches, information technology and supply chain interfaces. Tracing the references by looking to the reference list is also performed and relevant papers found in journals have been tackled as well. The literature sources are mainly books, scientific journals, conference proceedings, dissertations, projects documentations, and management-oriented publications. These sources are of particular importance and engender all research process development, especially the early phase for initial exploration of the food supply chain management. Published materials on the internet, annual reports and archival records of the involved companies and organizations are helpful and are used as a compensation for some empirical shortcoming.

## **2.0 An Assessment of Indian Agricultural supply chain**

Food supply chain management refers to the process whereby the movement of agro based product(s) from the initial supplier to the ultimate user occurs with all non-value adding expenses. Usually supply chain management is between partners such as a retailer and a preferred supplier, or a restaurateur and a preferred supplier of a particular ingredient. From a

supplier's perspective, supply chain management can mean more than this. It means that with due care, one can actually providing the needed produce to penultimate user with a lower cost. A effective supply chain management can be summed in the one phrase; detail, detail and detail. In reality it means studying in detail the entire process from harvest to the penultimate user. In doing so, all steps and costs should be established. After that, it is a matter of establishing what economies can be exercised along the way to the benefit of all the stockholders and adapt that in slightly different way for perishable agriculture produce.

The production of agricultural commodities has substantially increased in the country over the decades due to continuous efforts made by the government in terms of technological intervention at different level of production system, coupled with its price support policy. The production, supply and distribution of many agricultural commodities are mainly influenced by government regulations. In the process of economic liberalization, it has been felt that there is need to re-orient policies and regulations related to agricultural commodities. In response to this, the government has initiated agricultural policy reforms related to the production and marketing of agricultural commodities. Although, the pace of this reform process is very slow. Besides, there are numerous rules and regulations, and the infrastructural gaps, which are hindering the smooth flow of agricultural commodities from farm to fork (Mittal and Mukherjee, 2008). A lack of integration from various stakeholders in the supply chain leads to inefficiency in the agricultural system, causing high post-harvest losses, quality deterioration, high cost of commodity transfer, information symmetry and lack of transparency. Each participant of chain acts independently with little and no collaboration in physical and information flow.

It is important the corporate participants in agricultural chain have an understanding of supply chain, right strategy and leadership. Indian agriculture also prerequisites more public investment and policy support in several areas to overcome prevailing structural weaknesses such as low scale of operations, high post-harvest losses, poor state of rural infrastructure, lack of product diversification, inadequate research and development (R & D) spending, low productivity, absence of marketing infrastructure and inadequate financial support.

### ***2.1 Various Integrative aspect of Agricultural Supply Chain***

With perspective of corporates the Supply chain management (SCM) represents the way to customer retention and growth, competitive advantage and profitability. But there is not enough attention has been given to possible ex-ante measures to reduce, mitigate or share risks, although in some circumstances assessments will be conducted during/after adverse 'shocks' and attention will certainly be needed on workable coping strategies. There is also lack of emphasis on both formal and informal risk management options available to the different parties, although in practice, most analytical attention will likely focus on the scope for improving or supplementing formal mechanisms, including institutional and financial arrangements, technological changes, adoption of improved management practices, and/or investments in infrastructure. To the extent that the overall assessment is focused on the position and welfare of poorer farmers, then greater attention on alternative informal mechanisms and improving their efficacy.

Study also observe that there is lack of attention has been paid to areas categorized as ‘high vulnerability’, either for individual chain participants or the chain as a whole. This high vulnerability may already be evident from recent/past experience or be expected due to unfolding changes in market conditions, regulations, or other circumstances. Depending upon the purposes for which the assessment is done, primary attention might be given to addressing areas of high vulnerability for specific entities (smallholder farmers, the government agencies). Study on food supply chain has not been given its due and that should be undertaken on the needs/options for policy and regulatory reforms that affect farmer/agro-enterprise risk management as well as the possible revision/reform of governmental risk management instruments. Aspects of cold chain are to be given more consideration as it has contributed tremendously to trade in fruits, vegetables and flowers in developed countries and it could game changer in India. As cold chain, results in the reduction of losses and retention of the quality of horticultural produce. While the introduction of a cold chain facility nationwide due to some institutional, structural and financial constraints may not be immediately possible in India, attempts must be made to develop a cool chain. It is evident that *“food loss reduction is less costly than an equivalent increase in food production”*. If efforts are not made to modernize the harvest handling system for horticultural crops, then postharvest losses will continue to have a negative economic and environmental impact. There is no doubt that postharvest food loss reduction significantly increases food availability.

## ***2.2 Post Harvest Loses and Supply chain***

Post-harvest losses and its impact and ways to reduce it and to achieve has led to the understanding that it is important to educate the farmers in selecting the correct inputs and in postharvest handling, including cleaning, food safety, drying, sorting, and packaging at the farm gate. There has been gradual improvement in the accuracy of demand forecast by dynamic adjustments to reflect changes in demand, lead times, transit time, capacity, and transportation and distribution routes, as well as events outside the organization due to advancement in information and communication technology and it has done a good job as per reducing the post-harvest losses and it means that variance of lead-time can be reduced by removing non value-added steps and activities, improve the reliability and robustness of manufacturing, administrative and logistics processes. Standards for the handling and storage of all perishable items has been improving but still far away from where it can be and better the handling ,storage and preservation of quality of fruits and vegetables, which would increase the price and consumption, which in turn, would provide a better return to the farmer.

Supply chain management systems have the ability to track critical events & activities and when these events do not unfold as expected send out alerts and messages to notify appropriate managers to take corrective actions. Flexibility is still lacking supply chain system and it can be improved by enhancing responsiveness, companies need flexible strategies that match their operations, such as product design, sourcing, manufacturing and postponement. Establishment of pack house facilities having basic requirements such as

washing tanks, sorting and grading devices and cold storage facilities at the premises of the Dedicated Economic Centres (DEC) (collecting centres) in major fruit and vegetable producing areas in the country, will overcome the problems of quality deterioration, contamination of fresh produce with harmful bacteria and other extraneous matter and will improve the safety of produce to a great extent

### ***2.3 Backward and Forward linkage in food supply chain in agriculture of Rural India***

As if one talks about Promotion of Production, Backward and Forward linkage, Marketing and Consumption in food supply chain in agriculture and it takes us to rural India and in rural India most of Mandies or wholesale markets are not equip with the capacity to accommodate the volumes of fresh produce production. Physical infrastructure variables such as roads and electricity which link villages to nearby assembly and wholesale markets and in turn with large wholesale and terminal markets and ports. There is huge lack of warehousing & cold storage and encouragement for the establishment of cold storage facilities and refrigerated carriers to facilitate storage and transportation of perishable commodities. Its important to encourage technological developments in the packaging of agricultural commodities and in promoting packaging facilities appropriate to specific commodities. Develop mega markets and food parks or terminal markets with a higher level of all facilities are not accessible to common farmers. To integrate whole supply chain there is requirement of collaboration and co-operation among supply chain partners will only happen if there is trust among the parties, upfront agreement on how to share the benefits, and a willingness to change existing mind sets. Once these elements are in place, supply chain partners can do joint decision making and problem solving, as well as share information about strategies, plans, and performance with each other.

As our study also suggest that consensus building for change in agricultural policy has been difficult in India, structural adjustment has been very slow to its new economic environment and limiting the new public and private investment needed to allow the sector to participate in the growth of Indian economy. The implication of current policies and institutions can be understood in the context of agricultural sector large contributions to economic production, employment and the welfare of rural people, all of which has made it difficult for policy makers to take risk on agricultural policy reforms. Study also suggest that stimulating private agri business investment, whether domestic or foreign will require not only public investment in market infrastructure, but also supporting price and trade policies and comprehensive development of public market regulations and the institutions.

### **3.0 Information and Knowledge Management in Indian Agriculture**

The application of IT is very important for achieving the common good for the society, which is not possible unless agriculture sector of India uses it for maximum benefit (Kumar, Agrawal & Sharma, 2013). Modern agriculture is highly knowledge intensive and increasingly information driven, under which each participant in supply chain yearns for

timely and accurate information for various decision. Therefore, knowledge and information are important factor for accelerating agricultural development by increasing agricultural production and improving marketing and distribution efficiencies. In addition to connecting small farmers and artisans to markets, ICTs also facilitate most agricultural decisions such as what to cultivate, how to cultivate and harvest, when and where to sell, and at what price to maximize the returns. Effective decision making related to all these aspects ultimately determines the efficiency of supply chain (Rao, 2007). Therefore, a proper and information flow among stakeholders of ant business activity is key for strengthening supply chain efficiency. The rapid and innovative developments in ICTs can provide immense opportunities to public as well as private sector agencies to integrate these technologies in their supply chain systems. ICTs are especially useful for dissemination of information, provision of services, and enabling various transactions and awareness creation among the rural masses far removed from the government. ICTs provide modern, effective and speedy modes of communication that convey new resources of knowledge and information to society. A case study on ITC e-Choupal tries to explore above mentioned points and discusses how effectively and efficiently information and communication technology has been used by an organization in agriculture in Indian set-up.

Strengthening vertical relationships between various stages of production and processing in the agribusiness sector has always been an important area for empirical analysis by researchers and policy makers across the world. However, the pace of change in supply chain integration and responsiveness of production system towards a market driven approach is slower in India compared to elsewhere in the world (Haan et al., 2003). Farmers are still more comfortable growing traditional crops, particularly rice and wheat, as they have already discovered the market for their marketable surplus- be it a government procurement arrangement or private local traders. But the shift in market demand needs a balancing approach to meet the supply of deficit commodities such as pulses, oilseeds and high value food items. This balancing in demand and supply can be ensured by strengthening buyer-supplier relationship efficiently, and by disseminating of accurate and timely information to all the participants of the business chain (Mittal and Mukherjee, 2008).

Therefore, efficient and effective flow among various stakeholders of any business activity is key to strengthening supply chain efficiency. The major problem faced by farming community and associated stakeholders is related to efficient and effective decision making at different stage of agribusiness activities, right from crop planning to marketing of final produce. At each stage of farming a farmer require data and information on a number of variables. In the absence of timely availability or non-accessibility of this data, farmers are not able to decide what, how and how much to produce as per market needs. The fast and innovative development in ICTs can provide immense opportunity to public and private sector agencies to integrate these technologies in there supply chain systems. ICTs are extremely important for dissemination of information, provision of services, enabling various transaction and awareness creating among rural masses far removed from government. ICTs

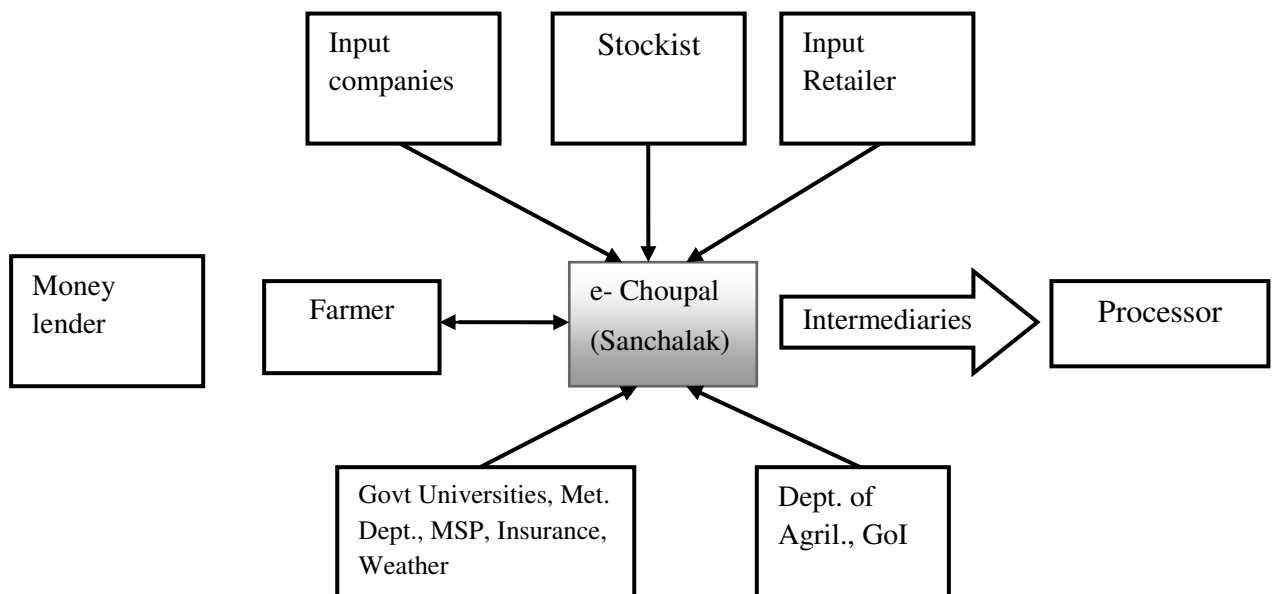


provide a modern, effective and speedy mode of interaction and communication that conveys new resources of knowledge and information to the society.

### 3.1 ITC e- Choupal Integrated Supply Chain Model

A case study of ITC e- Choupal clearly gives an idea that how information and communication can revolutionize Indian agriculture. The e-Choupal has been most successful initiative to connect rural India and to involve the farmers in learning. ITC e-Choupal has also attracted attention from the renowned academicians, since e-Choupal has managed to innovate the supply-chain, and model applied by ITC has enough potential to be replicated in the under-developed and developing countries. ITC’s example also shows the key role of information technology- in this case provided and maintained by a corporation, but used by local farmers- in helping to bring about transparency, to increase access to information, and to catalyse rural transformation, while enabling efficiencies and low cost distribution that make the system profitable and sustainable. ITC has been successful in making the farmer feel the sense of ownership and encourage them to generate additional revenue by eliminating middleman. Participating farmers have been able to enhance their income and eliminate the delay in getting the payment once the product is sold. It has helped in reducing debt burden of the farmers.

**Figure 1: Integrated ITC e-Choupal supply chain model**



Source: Conceptualised by Author

The e-Choupal model has been specifically designed to tackle the challenges posed by the unique features of Indian agriculture, characterized by fragmented farms, weak infrastructure and the involvement of numerous intermediaries, who block critical market information from passing to the farmers and use that information for getting a big margin for themselves. But e-Choupal sets things in order as it smoothens the flow of information to the farmers by disintermediating intermediaries from the chain of information flow and at the same time leverages the physical transmission capabilities of the them as they deliver critical value at every link for a very low cost in a weak infrastructure environment. The structure of e-Choupal network is shown in Figure 1.

The project e-Choupal is an ICT platform for carrying out trade at a number of locations. In this, ITC sets up a back-up physical service support at the village level, called Choupal, through Sanchalak: a lead farmer, who acts as the interface between computer and the farmer. ITC accumulates information regarding weather, modern farming practices, and market prices from sources like Meteorological Department, Agri-universities, mandis (regional market) etc., and upload all information on to e-Choupal web site.

All information is customized according to local farmer's needs and provided into the local language through computer set up established by ITC in Sanchalak's house. As one observe in above (figure 1) that Sanchalak access this information and facilitates its dissemination to farmers which is generated through the information gathered from Dept. of Agriculture (GoI), Universities, Indian Meteorological Department (IMD), input firms, stockist, retailers and many more. Information regarding weather and scientific farming helps farmers to select the right crop and improve the productivity of their farms. Availability of market information helps farmers to become market oriented. They know what price ITC is quoting and the price prevalent in the local market (Mandi), thereby helping better price realization for farmers.

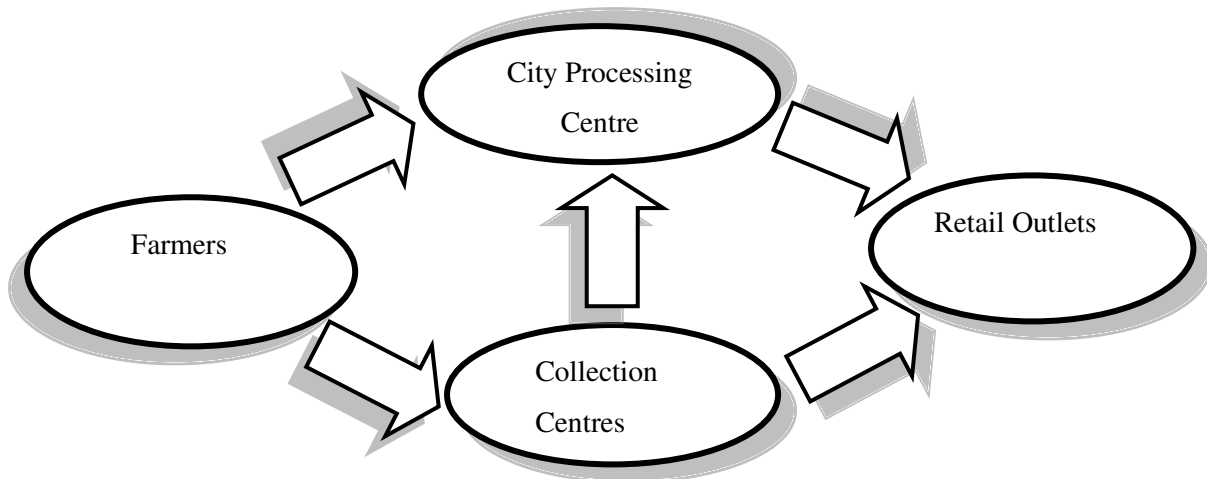
For establishing an efficient and effective supply chain system in the Indian agriculture, there is an urgent need to improve the functioning of regulated markets and amend the APMC Act by the state government in India as per the model act on agricultural marketing suggested by the central government to ensure private participation in supply chain system in an organized and legal manner. This will enable private agro processing units and business operators to link themselves with farming community directly, eliminating multiple intermediaries. For increasing efficiency in food processing segment, the process of raw material sourcing needs to be redesigned in an efficient organizational framework with proper backward linkages. The emergence of agribusiness activities and food retailing are providing both opportunities and challenges to policy makers. Assessment of existing policies affecting the agricultural supply chain and modify them as per the requirements of market forces, with proper regulatory mechanisms to protect the interest of all the stockholders in the chain is the need of hour.

### ***3.2 Reliance Fresh Supply Chain framework***

Reliance Fresh was the first foray into retailing by behemoth known as Reliance Industries Limited (RIL). Reliance Fresh is somehow different from business model of ITC e-Choupal mainly in terms of use of information technology and being working as a tool for increase in productivity by assisting farmers, which is major part of ITC e-Choupal model but for the Reliance Fresh it is more about procuring the material, processing it then distribution to various retail outlet for timely availability of the food produce in most efficient and effective form by utilisation of information technology tool such as Enterprise Resource Planning (ERP) and SAP software in best possible way. Reliance Fresh launched by opening retail stores in Hyderabad on November 2006 then it 12 opened "Fresh" outlets in Chennai increasing the total store count to 40. Reliance was testing its retail concept by controlled entry, beginning in the southern states.

There were three basic reasons for Reliance Industries Limited choosing foods and vegetables for entering into retailing sector as Reliance Fresh. First, it wanted to go after the very core of the great Indian retail opportunity in terms of agricultural based business. Second, its aim was to build a high-profitability business and food was perhaps the best place to start. Third, the grossly inefficient food supply chain provided a well-resourced and well managed organization like RIL with an opportunity of amending the flaws which would also make business sense and to materialise that it has increased the number of stores to till June 2013, around 1,500 from 1,150 in 2010.

**Figure 2: Reliance Fresh Supply Chain Network**



*Source: Conceptualised by Author*

Reliance Fresh has been contracting farmers, and being linked to the Reliance Fresh supply chain to ensure availability and that number will grow to millions. By going to the farmer directly, Reliance Fresh hoped to disintermediate the supply chain and eliminate waste. Even contract farming by assisting farmers in procuring high-quality seeds, fertilisers and other essential raw materials to ensure quality of agricultural produce then to collect the produce through collection centre then send it to City processing centre which works as central hub.

As figure 2 suggest that source has been the farmers and City processing centre and Collection centres works as intermediary part of chain to avail the produce at retail outlet. Farmers also see advantage of quantity procurement by Reliance Fresh of vegetables they need from them and they can go there and get there consignment graded at their collection centre. The centre would get the price-band and quantity of vegetables it needed to collect that particular day. Reliance Fresh provides a good example of a successful case, depicting improvement in the economic conditions of the farmers through their network, rising income levels and more opportunities.

Contract farming, unlike corporate farming, brings farmers into the mainstream of the economy by development of hassle free process, paying farmers the pre-agreed market price of produce in advance, providing the transaction cost leads to rise in income resulting increase in accessibility to education and health facilities. In case of the corporate farming, farmer act as one of the factor input in production process and payment to farmers depend upon policy of firm, which is generally more profit friendly and less farmer friendly. Contract farming reduces farmer's market risks by paying them pre-agreed market price irrespective of fluctuation in market, and enhances supply chain efficiencies by providing both knowledge and material inputs but in terms of corporate farming a firm act to minimise its own risk. Reliance Fresh model operates on a small scale, and is able to meet the administrative and infrastructural constraints to turn out to be a successful model for the firm and to the certain extent for the farmers. If this supply chain model is expanded, then the viability of it largely depends on the integration of variables and development of agricultural infrastructural facilities.

The supply chain mechanism of organizations like Reliance Fresh and ITC e-Choupal has given new lessons to the government agencies and corporates in the country in context of importance of supply chain mechanism in agriculture sector. By embarking on this initiative, ITC has shown that ICT platforms can benefit farmers and rural India.

### ***3.3 Integration is vertical food supply chain and implementation***

Whether the process for integration is vertical or virtual, the requirement for integration of supply chains is inherently strategic, and a potential source of competitive advantage for multiple trading partners. The nature of the integration model is an implementation issue that needs to be addressed with a view to consumer's needs and other variables such as industry and market characteristics. One theme that appears to hold constant throughout the literature in this area is the importance of taking a holistic view, and the systemic nature of interactions between the participants. The recognition of the interdependence of all partners in a supply network appears to be an important catalyst for effective integration. In this sense, organizations moving to implement integrated supply chain management systems could be seen to be formalizing strategies to better manage this inter-dependence, and to leverage it to mutual advantage. At the same time, it is also apparent that this requirement to take such an holistic and systemic view of the supply chain acts as an impediment to more extensive

implementation. The strategic nature of adopting a supply chain-wide perspective, on the one hand provides significant potential benefit, and on the other requires trading partners to think and act strategically. The challenge for developing more effective and integrated networks is to encourage such a mind-set, and use it to promote adoption and implementation of enabling technologies and methods. In other words, this review of the literature serves to highlight the inter-dependence between integration (technologies, logistics, and partnerships), a strategic view of supply chain systems, and implementation approach. All three need to inform and underpin each other in order for management of supply chains to be able to deliver on the promise of benefits for all trading partners.

### ***3.4 Government Intervention Agricultural prices***

The price support system was introduced by government in 1965 by setting up Agricultural Prices Commission (APC) now renamed as Commission of Agricultural Costs and Prices (CACP). This provided the opportunities to farmers to sell their produce on Minimum Support Price (MSP) if the market price dropped below the MSP for that commodity. The government is supposed to procure all agricultural commodities for which MSP has declared in such situation. The basic objective of foodgrain procurement by government agencies is to ensure remunerative prices to producer and reasonable prices to consumers, and to maintain price stability in market (Jha and Srinivasan, 1999).

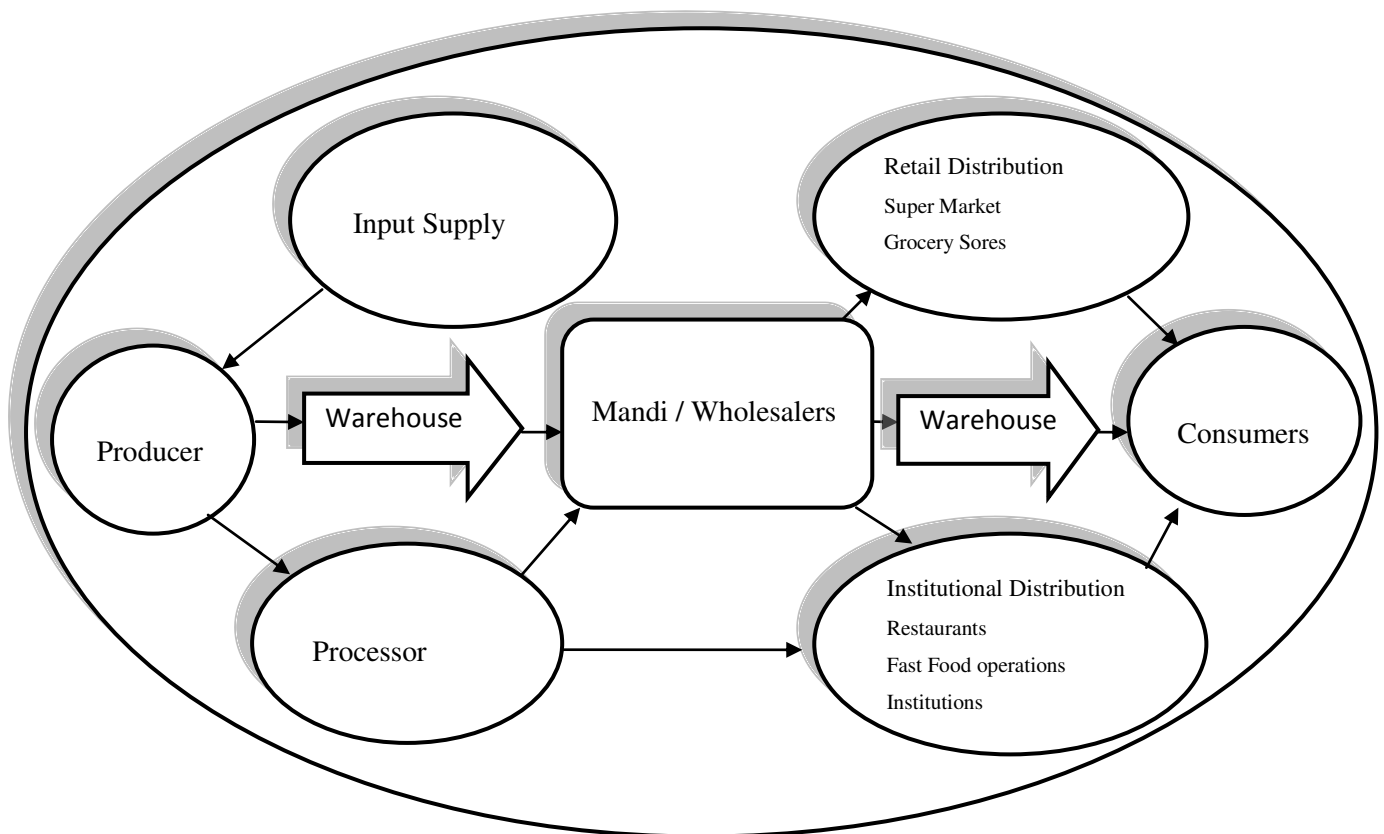
Agriculture can realize its full potential by applying the principal of supply chain management by strengthening the collaboration between various stakeholders, non-exploitative vertical and horizontal integration, market reforms, precision farming, contract farming, demand led diversification, and the extensive and intensive use of information technology for real time communication across the chain (Balakrishanan, 2006).

## **4.0 Integrated Knowledge Model for Agricultural Supply Chain**

Strengthening vertical relationships between various stages of production and processing in Agribusiness sector has always been an important area of empirical analysis by researchers and policy makers across the world (Martinz and Reed, 1996; Lawrence et al., 1997; Martinz, 1999; Gulati et al., 2005; Kaabia et al., 2005; Mora and Menozzi, 2005). Vertical coordination in Indian agriculture sector is limited to some selected high value commodities such as poultry product, milk, fruits, and vegetables.

Empirical studies has suggested that vertically integrated agribusiness activities are reducing production cost among contract growers, as well as producer- consumer margins with a comparatively high involvement of smallholders (Landes et al.,2004; Brithal at al., 2005). However the pace of change in supply chain integration and responsiveness of the production system towards a market driven approach is slower in India as compared to elsewhere in the world (Haan et al., 2003; Deshingkar et al., 2003).

**Figure 3: Agricultural Supply Chain Network**



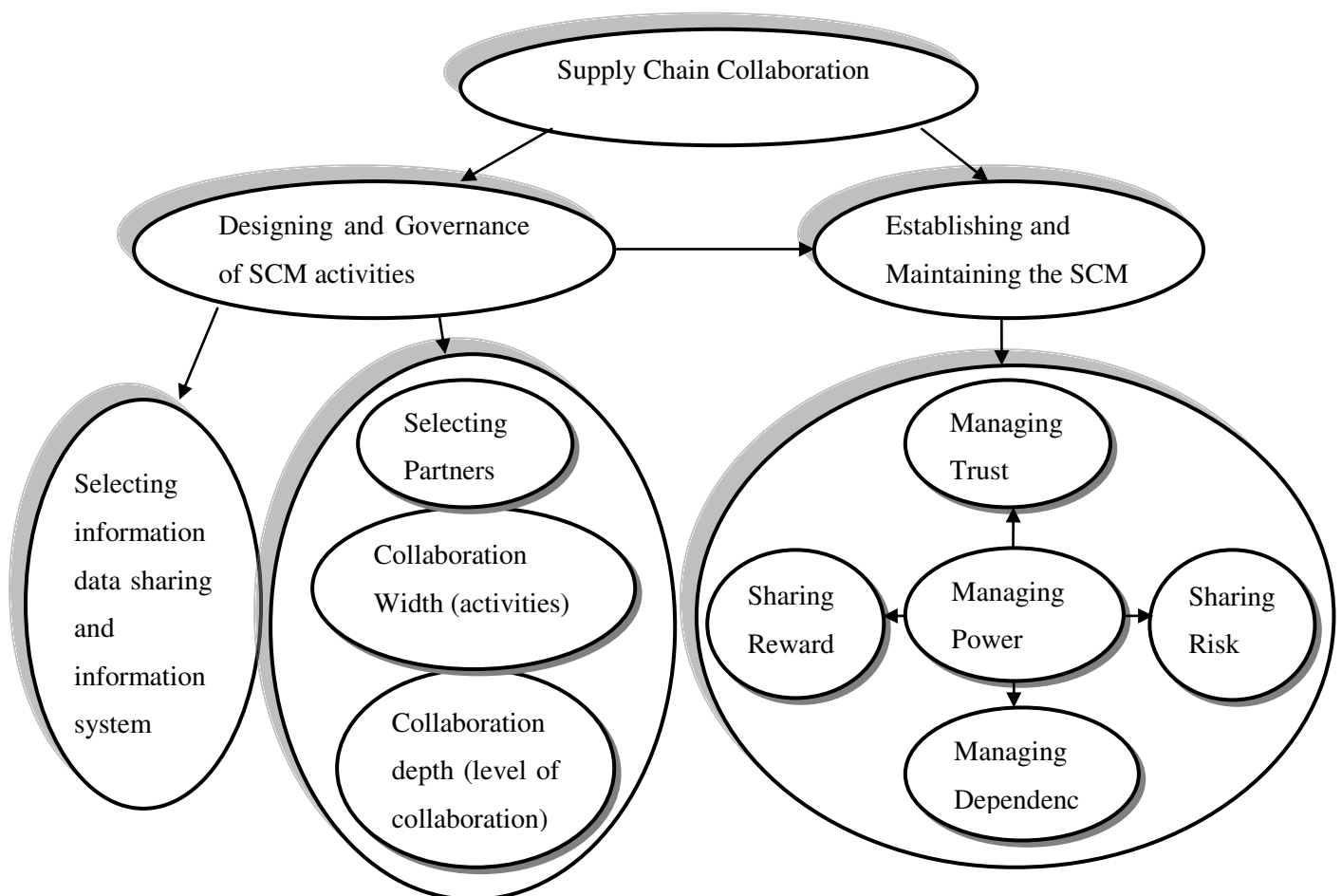
*Source: Adapted from Matopoulos et al., 2007.*

Farmers are still more comfortable growing the traditional crops, particularly rice and wheat, as they have already discovered the market for their marketable surplus- be it government procurement arrangement or private local traders. But the shift in market demand needs a balancing approach to meet the supply of deficit commodities such as pulses, oil seeds and high value food items. This balancing of demand and supply can be ensured by strengthening buyer-supply relationships in an efficient way, and disseminating accurate and timely information to all the participants of the business chain. The major issues in Indian agricultural supply chain is lack of integration between different sub- systems of the chain (Figure 3).

Each participant in the chain acts as an independent agent with a very low level of business relationship. As supply chain network (Figure 3) of system and sub-system in traditional agriculture explore that farmers produce the agricultural product by getting input material from input companies and most of time farmers has to bear the brunt of expenses of production process. Chain also suggests that Mandi and wholesalers act as prime middle intermediaries, who receive produce from farmers via warehouse and processing units. Then produce or processed produce being distributed for retail market and institutional distribution which eventually lead to ultimate consumer.

Based on practical experiences, Grimsdell (1996) proposed six fundamental requirements for an efficient supply chain between vegetable growers and major retail customers- scale of operation, strategic alliances, production flexibility, continuity of supply, quality control, and communication. These parameters are very relevant while establishing a supply chain community between farming community, processors, handlers, government and consumers in the country to ensure a cost effective and safe flow of agricultural commodities through the chain, which requires extended relationship between the supply chain stakeholders. Collaboration and relationship management along the chain is key instrument for integrating the supply chain system (Benton and Maloni, 2005) and the ability to establish effective relationship is necessary to reach supply chain success (Fearne and Hughes, 2000; Quinn, 2004). Several empirical studies has recognized the increase need for collaboration is a way to construct even more efficient and responsive supply chains, in order to deliver exceptional value to customers (Gunasekaran et al., 2001; Kampstra et al., 2006).

**Figure 4: Framework of supply Chain Collaboration**



*Source: Adapted from Matopoulos et al., 2007; Mittal and Mukherjee, 2008.*

According to Matopolous et al., there are two major pillars of supply chain collaboration - the design and governance of supply chain activities, and the establishment and maintenance of supply chain relationship (Figure 4). By going through framework of supply chain collaboration (Figure 4), it is very much visible that supply chain collaboration provides an opportunity for integration among all the stockholders in agricultural supply chain system. It gives the picture that through supply chain collaboration a system can be established in which governance of SCM activities can be achieved by sharing information and in-depth coordination among partners and activities. Same time maintenance of SCM can established through effective management of power via trust, rewards, risk and dependence among all the partners.

The success of collaboration depends largely on the physical structure of the chain flow and the way relationships among various channel members are maintained in the system. The recent policy changes and amendments in the existing Agriculture Produce Marketing Committee (APMC) Act by state government provide an opportunity to private firms to extend their supply chain to the farm level. The design of supply chain governance system depends on an efficient flow of information on various aspect of the chain, such as numbers of participants required at each stage i.e. Selection of partners; types of goods and services required to strengthen the relationship, i.e. Width supply chain activity; and level of decision taking relationship required (Matopolous et al., 2007).

The sustainability of supply chain collaboration largely depends on how relationship are established and maintained among the chain partners. Generally, business relationships are maintained by adopting two basic approaches behavioural and economic. A balance between risk and reward considered to be an important economic factor for enhancing relationship (Matopolous et al., 2007). Similarly, trust among channel partners, power share and interdependence are other important factors for enhancing relationship in the supply chain system (Handfield and Bechtel, 2004). Empirical studies shows that institutions paly important and potential role in strengthening the markets for produced commodities produced, bought and sold by smallholders; enabling collective action; and redressing missing markets.

## **5.0 Further Research and Development Opportunities in Agricultural Supply Chain**

As our assessment indicates, there is a lack of empirical research on the significance and benefits of food supply chain management. Although a majority will agree to the importance and potential benefits of it, somehow food supply chain management does not seem to occur often enough in practice. Organizations appear to have significant difficulties in evolving from theory to the successful implementation and practice of supply chain management. This is a crucial yet challenging dilemma to solve. In many cases, food supply chain not has seamless chains, optimized flows, or networks of integrated organizations. In reality, the frameworks and their corresponding terminologies, once more elaborately illustrated, ultimately are dealing with companies trying to make dyadic relationships better. Therefore, Indian agriculture need methodical approaches to the implementation of supply chain system



and we need sound empirically based research to continue to develop the field and to explore the concepts related to supply chain. It will require significant efforts, applying both qualitative and quantitative research projects to further develop these concepts in order to advance both practical applications and academic theories.

As above points emphasis on need of greater problem oriented research which employs integrated approaches to solving postharvest issues. Apart from missing links in our understanding and implementation of food supply chain, postharvest technology, proper linkages must be established in agriculture and processing sector. Innovations in postharvest technology and particularly in the development of infrastructure could help achieve this goal. The processing of fruits and vegetables for export and for domestic markets requires utmost attention in developing country like India. Waste generated by processing factories must be put to profitable usage, either through conventional technologies or through the adoption of biological processes (Verma and Joshi, 2000).

The need for further research to capture both the characteristics of successful implementation, and the factors determining the level of implementation is captured by Akkermans (1999) when he states:

*. . . the Supply chain management literature has shown very little empirical evidence of successful strategic moves towards supply chain management [and later] . . . we do not yet have causal relationships between the various factors driving effective supply chain management and their interrelations with performance improvements in areas like inventory management, supply chain costs, and consumer satisfaction.*

There has been some research into a range of barriers to extensive adoption, particularly with regards to cost, ease of implementation and conflicting standards being identified as restricting wider use. An emergent theme in the literature is the discussion of implementation in terms of extent (i.e. formal organizational links with suppliers and customers, application ICT tools to incoming goods, formal agreements with suppliers, etc.), focus (overall strategic plan), and expected benefit (source of competitive advantage). There is an opportunity to pursue a range of questions. What is the true extent of implementation of techniques and methodologies used for the management of the supply chain? Do organizations that implement supply chain management techniques progress from a basic implementation to a more extensive one over time? Are there significant geographic and demographic factors that impact on the decision to implement such as company size or industry sector? Can companies be distinguished from one another on the basis of this extent of implementation model? How Food Corporation of India (FCI) has been coordinating among its different sister units and different scheme run by government of India. All the different aspect of PDS and contract farming is subject with desire of further more research work. Given the apparent contradiction in the literature between promised benefits and still limited evidence of

extensive implementation, the examination of factors creating and reinforcing this apparent gap would appear beneficial.

One additional aspect that requires discussion is the challenge in designing, developing and managing cross-organizational processes when organizations are still struggling with internal process management. Few, if any, examples exist of truly process-oriented organizations. Yet process management is, in many ways, mentioned as a prerequisite for supply chain management. As a final thought, supply chain management is complex, it is often yet still poorly defined and it includes innumerable concepts and ideas that need clarification. The supply chain does not have clear roles or rules, nor does it have measurement or reward systems. How can such a structure possibly be managed?

## **6.0 Conclusion**

While going through the assessment of infrastructure and food supply chain in Indian agriculture one can say upliftment and integration of agricultural system is utmost important. There is also lack of emphasis on both formal and informal risk management options available, although in practice, most analytical attention will likely focus on the scope for improving or supplementing formal mechanisms, including institutional and financial arrangements, technological changes, adoption of improved management practices, and/or investments in infrastructure. To the extent that the government is mainly focused on the position and welfare of poorer farmers, then greater attention would need to be given to alternative informal mechanisms and improving their efficacy. Study also suggests that there is lack of attention has been paid to areas categorized as 'high vulnerability', either for individual chain participants or the chain as a whole. There is requirement of considerations of alternative (especially new) approaches/instruments should include at least preliminary coverage of expected costs and benefits, potential technical or regulatory constraints, possible distributional consequences, and realistic scenarios for adoption and impact on underlying vulnerabilities. Review of agricultural infrastructure and supply chain has not been given its due and that should be undertaken on the needs/options for policy and regulatory reforms that affect farmer/agro-enterprise risk management as well as the possible revision/reform of governmental risk management instruments. Aspects like cold chain needs to be given more consideration as it could results in the reduction of losses and retention of the quality of horticultural produce. While the introduction of a cold chain facility nationwide due to some institutional, structural and financial constraints may not be immediately possible in India, attempts must be made to develop a cool chain. Food loss reduction is less costly than an equivalent increase in food production. If efforts are not made to modernize the harvest handling system for horticultural crops, then postharvest losses will continue to have a negative economic and environmental impact. There is no doubt that postharvest food loss reduction significantly increases food availability. An efficient collaboration between stakeholders will reduce risk, losses and greatly improve the efficiency to ensure food security and development.

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