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Underdeveloped Supply Chain dynamics of Indian Agriculture: Reference to Information Technology and Knowledge Management

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Abstract

Agriculture in India is most important sector for food security and socio-economic development. Agriculture accounted for about 14% of the GDP and employed about 60% of the country's population. Paper tries to explore the problems faced by Indian agriculture for food security in terms of inadequate infrastructure and highly inefficient supply chain in context of information technology. This paper examines the critical issues at each sub-system of agriculture supply chain, starting from the input to the consumer, with a view to integrating them in efficient and effective manner. As proper flow of information across the chain constitutes an integral part, the role of information and communication technologies (ICTs) in improving supply chain efficiency in agriculture discussed in detail. Thus, this 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 ICTs in supply chain management: and this chapter also covers the suggestion to improve efficiency at different levels in supply chain. There is wide research gap in this sector, having such potential and prospectus for overall growth there is not much research in this field. The paper concludes that ICT plays very important role for development and contemporary issue for agriculture therefore; government action must address the issue of infrastructure development to achieve the objective of food security for all.

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

1.0 Introduction

India has experienced a remarkable growth in the production of various agricultural commodities over the last four decades. Technological intervention in mid 1960s contributed significantly towards bringing the country from deficit to surplus stage in food grain production, the recent trends of cropping system is creating lots of problem relating to sustainability and market imbalances. Several studies and research work suggest that the reform policy of government only focused on the price measures and ignored the infrastructure and institutional changes which have caused an unfavourable effect on agricultural growth in recent decades (Kumar, 2002; Chand, 2005). Various empirical studies have also shown the strong and positive impact of public investment on agricultural productivity and growth in India (Chand, 2001; Landes, 2004), which has been declining over time. But contrary to this, for competing in the world market with the emergence of World Trade Organisation (WTO), Indian agriculture needs more public investment and policy support in several areas to overcome prevailing structural weaknesses such as low scale of operation, high post-harvest losses, poor rural infrastructure, a lack of product diversification, inadequate R & D spending, low productivity, an absence of marketing infrastructure and inadequate financial support (Chandrashekhar, 2002; Naik, 2003).

The agricultural production is broadly categorized in to these sub-system-input supply, production, processing, sales and distribution to consumer and quality and food safety measures. Integration between these components is negligible throughout the agriculture sector in India. In practice, most of these components act independently and the flow of information between different components is either missing or very poor. Due to lack of coordination between various sub-systems, the agriculture operates inefficiently at each stage of supply chain. A low level of adoption of high yielding seeds and other modern inputs show that these inputs are not reaching the potential client effectively and completely. It is not only the purchasing power of farmers which hinders the adoption rate, it also the farmer's insecurity about the crop failure that prevents them for adopting any change. Likewise, at the production level, farmers' usually do not make decisions based on market trends in a planned manner, nor they plan the use of resources in appropriate way.

The agricultural production system is still operating at low scale with low productivity and high uncertainty in the country. There is little or no alignment between the growing for the agricultural commodities in the market and the production and supply of these commodities.

Despite faster growth and increased diversification in consumer food demand, empirical studies suggest sluggish growth in the agricultural production sector in recent decades. The opportunity to strengthen growth in agriculture in India lies in value addition through agro processing, which is very low level at present. The Agribusiness food processing industry is facing constraints and barrier such as non-availability of adequate critical infrastructure facilities (cold chain, packing and grading centers) lack of adequate quality control and testing infrastructure, lack of suitable varieties of farm produce for processing, seasonality of raw material , high inventory carrying cost, and high taxation and packaging costs (Mittal and Mukherjee, 2008).

The consumption pattern in India is undergoing significant shifts towards high value consumption commodities like fruits, vegetables, milk, meat and eggs due to an increase in per capita income, urbanization, changes in lifestyle and preferences, relative prices and increased awareness among consumers about food nutrients (Kumar, 1998; Kumar and brithal, 2004; and Pingali, 2007). India's consumer class is growing rapidly and becoming more and more attracted towards the availability of fresh, convenient, palatable, nutritious and safe food. Besides, these consumers are able to make purchasing decision based on criteria other than price constraints and therefore high value processed food and beverages are gaining more space in shopping baskets (Business Monitor international, 2007). To meet these requirements agricultural sector needs intensive and new farming techniques to address new challenges for sustainable production, processing practices and promotes a balanced approach to the problems of food quality, safety, and good environmental management (Ziggers and Trienekens, 1999).

The private sector organizations investment in agribusiness sector is not up to mark due the high level of government regulations including regulation governing procurement and movement, storage , warehousing and marketing of major commodities, plant- scale restriction in food processing, and restriction on contract farming and land leasing. However, the transformation in global food systems is leading to changes in food production and marketing in form of emerging contractual and sharecropping relationship between private dealers and farmers, beyond direct government intervention (Deshingkar et al., 2003; Rao and Jeromi, 2006; Joshi et al., 2007). To promote private participation in agribusiness and processing industry, most of the states in the country already initiated amendments in the existing APMC act as per the model Act on agricultural marketing suggested by central

government to encourage direct marketing and contract farming programmes, to facilitate the process by which industries and large trading companies undertake procurement of agricultural commodities directly from farmers, and to establish effective linkage between farmers and retail chain.

For strengthening agricultural production and productivity, the governments had taken various initiatives, most of which were on the production side to ensure food security in the country. As a result, agricultural production in India experienced a remarkable growth after the mid-1960s with adoption green revolution technologies. This growth certainly led the country to being food deficit country to food surplus country, but at the cost of excessive utilization of natural resources and further, raised issues of sustainability in agriculture. The other crucial problem that constraints the growth of the agricultural sector is that public investment in agriculture as a percentage of GDP has been declining gradually. A policy analysis of agricultural system shows that there is multiplicity and duplicity of rules and regulations dealing with various components of supply chain in agriculture. Lack of coordination among these, again, leads to the poor alliance and collaboration supply chain, which in turn leads to the inefficient product and information flow.

2.0 Objectives of the Study

There is basically two most important objective of the study:

1. To study current status of infrastructure in the context of Information technology in Indian Agriculture.
2. To assess the impact of inadequate Agricultural infrastructure on supply chain and Agriculture.

3.0 Research Methodology- Literature Review Method

The starting point of our research work has been literature review to understand the fundamental of subject. 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.

4.0 Limitations for the Study

The major limitations for the study are as follows

- The paper has been prepared based on the data collected from the published and unpublished secondary sources.
- The study findings are based on the limited coverage of selected literature and data available.
- Poor availability of secondary sources of data.

5.0 Revolution in the Agricultural Supply chain

The economic reforms and liberalization in the agriculture sector have emphasized the need for transforming Indian agriculture by designing a comprehensive supply chain model covering innovations at farming level which can help farmers regain profitability in a sustainable manner under changing conditions with proper assurance of market arrangement (Rao and Punwar, 2004). In recent decades, the government has introduced a number of initiatives to strengthen market linkage and diversification in the agricultural production system (Rao and Jeromi, 2006; Joshi et al., 2007). Reform in agricultural marketing system to ensure private 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 trading by establishing commodity exchanges are some important areas of interventions, but changes are taking place at very slow pace. A close look at flow of agricultural commodities in India suggests that there are multiple routes, most of which are not recorded. The organized procurement or flows of agricultural commodities are quite low and primarily takes place in form of government market intervention scheme coupled with

few special procurement licenses to private organisations and contract farming arrangements (Landes et al., 2004).

Different models of supply chain management government, cooperatives, corporate houses and MNCs have been initiated to improve production, strengthen linkage with farmers and market efficiency, particularly in high value commodities (Brithal et al., 2005). The inclination of leading corporate organizations in India towards investing in Agribusiness chain is very vibrant, and number of organisations, for example, Hindustan Unilever Limited (HUL) and ITC, have already entered or are planning to entre agribusiness activities. This trend is creating a new business environment for agribusiness operations. In traditional business model, the flow of agricultural commodities is influenced by number of intermediaries who added costs but no value to the agricultural commodity chain. The new corporate entries are not just participating in chain to source their required raw material (mainly indirectly from the farming community), but are more focusing in the primary source of agricultural produce. In this context, the development of direct linkages with farmers will attain greater importance. It has been very well realized by these corporate participants in the agribusiness chain the leadership in food business requires a keen understanding of supply chain for agricultural produce. The participants should have clear strategies for sourcing raw material and distributing the final products to potential consumers efficiently and effectively.

6.0 Information and communication Technologies and Indian Agriculture

There are various reason for inefficiency in agricultural production and supply system, but the that has attracted the major attention of policy maker in last decade has to do with lack of appropriate information and services related to agricultural practices (Adhiguru and Mruthyunjaya, 2004; Rao, 2007). With the emergence of globalization, liberalization and privatization of agricultural economy and increasingly complex agribusiness environment, traditional models of information dissemination and service provision have failed to meet the growing information and service demand of the farming community (Kumar and Ali, 2007). Modern Agriculture is knowledge intensive and increasingly information driven; each participant on supply chain thrives on timely and accurate information for various decisions. According to the Rao (2007), the implementation of ICTs proposes three unique strategies – (1) a close vertical supply chain network for agribusiness enterprises; (2) an open chain network with dynamically evolving partners and supply chain situation for public, non-governmental and multilateral organization; and (3) a spatial data services network to address

the natural resource management and its sustainability concerns. Therefore, knowledge and information are important factors for accelerating agricultural development by increasing agricultural production and improving marketing and distribution efficiencies (Poole and Kenny, 2003; Bertolini, 1999; Lio and Liu, 2006). In addition to connecting small farmers and artisans to markets, ICTs also facilitate most agricultural decisions- what to cultivate, how to cultivate and harvest, when and where to sell and what price to maximize the returns. Effective decision making related to all these aspects ultimately determines efficiency in supply chain (Rao, 2007).

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.

In order to disseminate information and provide different services in a cost effective manner, numerous ICT initiatives are being made in many countries. The developing world is looking towards ICT systems for solving their numerous information related problems. Literature argues that use of ICT facilities free flow of information and makes available the services even to the most marginalised section of the society. Many public and private sector ICTs – enabled initiatives have been undertaken in India in the last decade especially to cater the needs of agricultural or overall rural sector development butt one need to understand to reach over 110 million farmers, spread over 500 districts & over 6000 blocks is an uphill task. Some of these initiatives include e- Choupals by ITC, DCM Shriram Consolidated Limited (DSCL), Hariyali Kissan Bazar, Drishti, AgMarknet, Gyaandoot, iKisan, Reliance Fresh, Parry Kiosks by EID parry etc.

6.1 Integrated Supply Chain Model: ITC e-Choupal (India)

ITC e-Choupal is a virtual market place where farmers can transact directly with a processor and can realize better price for their produce. Geographical distances do not restrict participation in the e-Choupal. The main disadvantage of conventional market is that information asymmetry is inherent in the market where as e-Choupal provides for transparent transactions. This enables the participation of smaller as well as larger players. The main attractiveness of e-Choupal is that it can be used for connecting large producers/small producers and small users/large users, thereby eliminating the need for hierarchy of brokers. Internet is used as a low transaction cost backbone for communication.

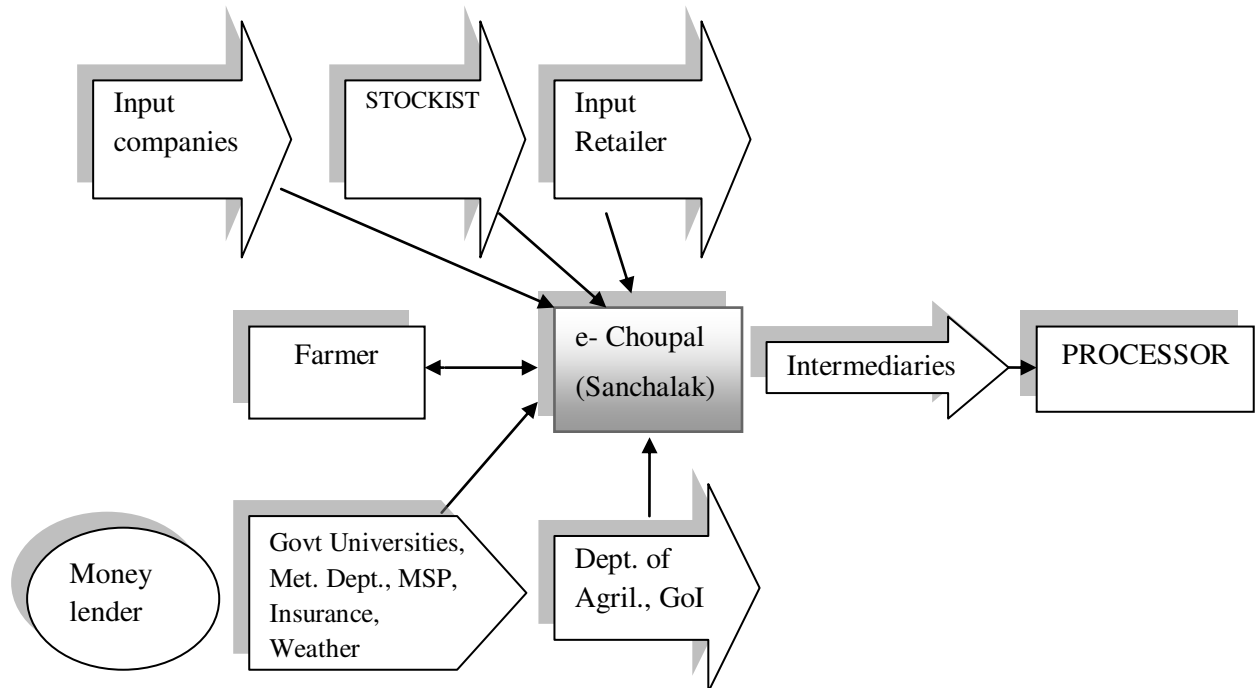
Initially e-Choupal came up, as an experimental business model. But now e-Choupal presence is there in different states like Madhya Pradesh, Uttaranchal, Haryana, Andhra Pradesh, Karnataka, Uttar Pradesh, Rajasthan, Maharashtra and Kerela and in different commodities like soyabean, wheat, coffee, aquaculture etc. ITC firstly launches e-Choupal at the pilot stage in a state, this amount to 50 to 100 e-Choupals. ITC e-Choupal' services today straighten to more than 3.5 million farmers cultivating a range of crops - soyabean, coffee, rice, wheat, pulses, shrimp - in more than 38,000 villages through nearly 6500 kiosks across the states in India.

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 disinter mediating 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.

Figure 1: ITC e-Choupal supply chain model



Source: Conceptualise by Author

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.

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. The success of e-Choupal has given new lessons to the government agencies and corporates in the country. By embarking on this initiative, ITC has shown that ICT platforms can benefit even if the farmers and rural India.

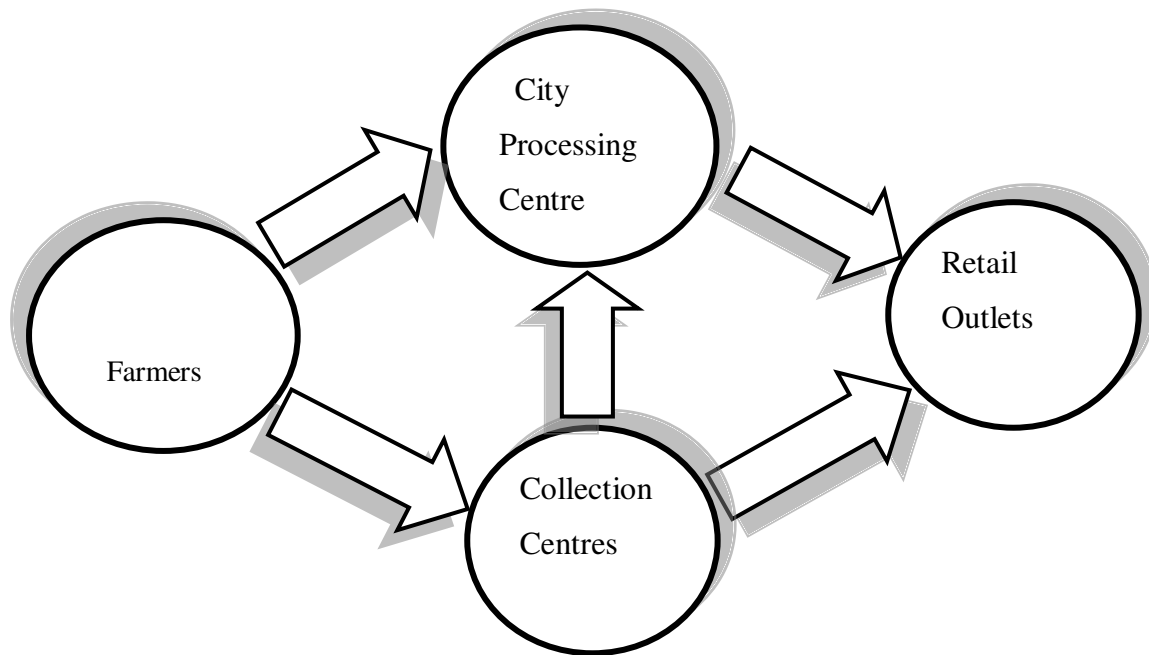
6.2 Supply Chain Framework of Reliance Fresh (India)

Reliance Fresh was the first foray into retailing by behemoth known as Reliance Industries Limited. 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 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 (RIL) 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.

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.

Figure 2: Reliance Fresh Supply Chain Framework



Source: Conceptualise by Author

As above (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. It reduces their market risks, and enhances supply chain efficiencies by providing both knowledge and material inputs. Reliance Fresh model operates on a very small scale, and is able to meet the administrative and infrastructural constraints to turn out to be a successful model. 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.

Since the rural economy in India or, for that matter, in any developing country, has very strong linkage with agricultural economy, the major thrust of these initiatives has been the agriculture and allied sectors. But integration between these models lacking due to lack of

proper coordination among various sub-system in supply chain. The Government of India (GOI) has formulated an ambitious National e- governance plan (NeGP) which identifies 25 mission mode projects including agriculture to be implemented through different ministries at the centre well state level. All these supply chain initiative share the common objective of empowering Indian agriculture to take the right decisions related enhancement of productivity, realisation of revenue and improvement in their overall performance.

6.3 ICT Initiative in Indian Agriculture

To promote ITC based e-governance in agriculture at the centre and provide support to states/UTs for the same, the National e- governance plan (NeGP) is also implementing a central sector scheme, 'Strengthening/Promoting Agricultural Information Systems' during the Tenth Plan with a budgetary provision of Rs 100.00 crore. The scheme has the following components: (i) development of agricultural informatics and communication; (ii) strengthening of IT apparatus in agriculture and cooperation in states and UTs (AGRISNET); (iii) IT apparatus at Department headquarters and its field offices; (iv) Agricultural Resources Information Systems (AgRIS); and (v) Kisan Call Centres to accomplish the objective.

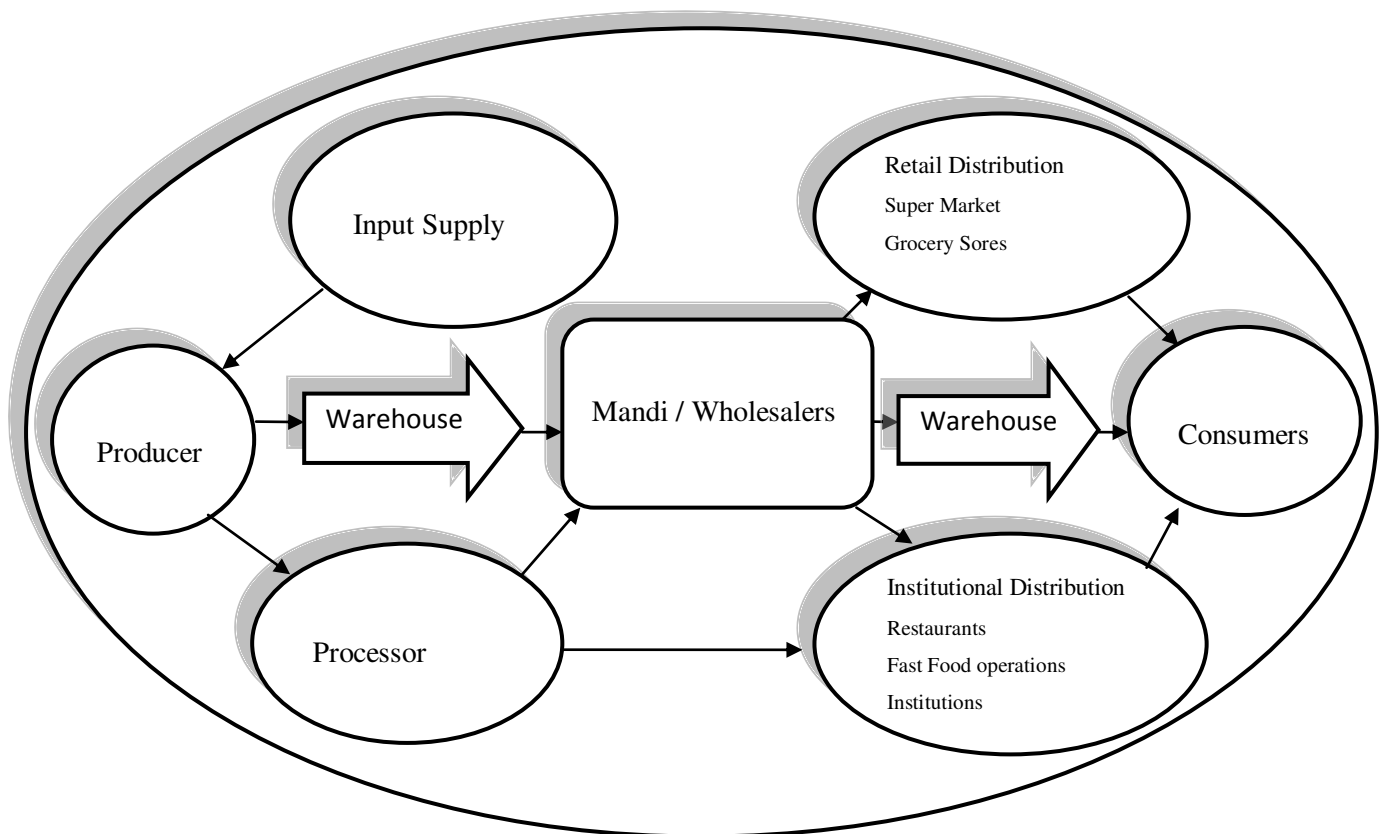
There have been some initiatives already taken in India, by using ICT in agriculture but in most of these projects impact on agriculture has been negligible so far mainly due to inefficient and ineffective implementation mechanism. Indian experiences with IT projects are there with project such as : (i) Gyandoot project in Madhya Pradesh (ii) Warana Wired Village project in Maharashtra; (iii) Information Village project of the M S Swaminathan Research Foundation (MSSRF) in Pondicherry; (iv) i-Kisan project of the Nagarjuna group of companies in Andhra Pradesh (v) Automated Milk Collection Centres of Amul dairy cooperatives in Gujarat; (vi) Online Marketing and CAD in Northern Karnataka; (vii) Knowledge Network for Grass Root Innovations-Society for Research and Initiatives (SRISTI) in Gujarat; (viii) Application of Satellite Communication for Training Field Extension Workers in Rural Areas by Indian Space Research Organisation; (ix) Tarahaat.com by Development Alternatives in Uttar Pradesh and Punjab and many more are working toward utilisation of information technology and better knowledge management for development of effective supply chain and improvement in socio-economic condition of rural people in India.

7.0 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). 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 Agribusiness 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.

Figure 3: Agricultural Supply Chain Network

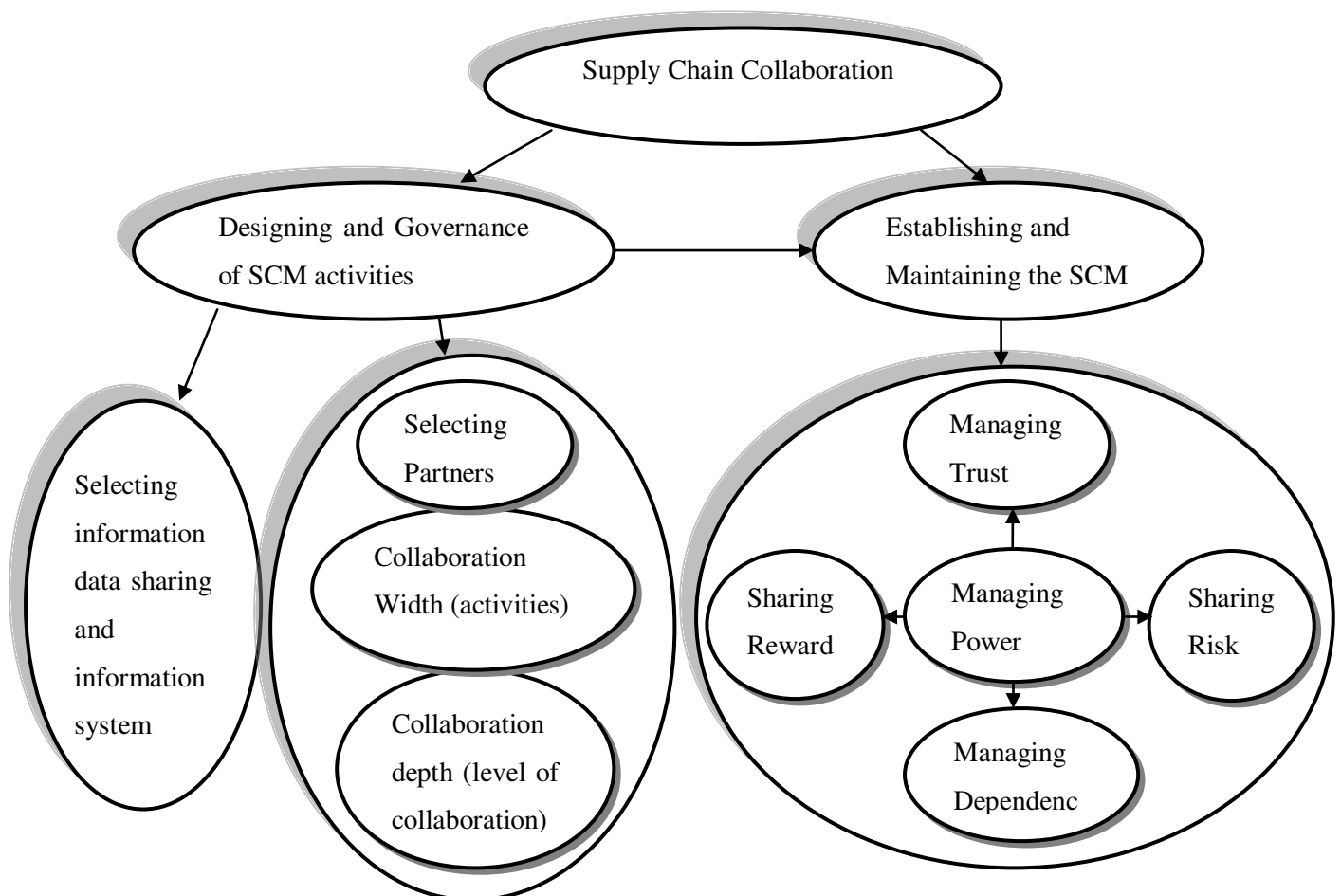


Source: Adapted from Matopoulos et al., 2007.

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).

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. An efficient physical flow system needs a governance mechanism for organizing and controlling the activities as per design.

Figure 4: Framework of supply Chain Collaboration



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

The physical structure and governance of conventional supply chains in India shows that these chains generally exclude the primary stakeholders of agriculture, ie. the farmers, from the system (Eapen et al., 2003; Deshingkar et al, 2003; Singh, 2006) and the supply chain of agribusiness firm start from the raw material sourcing from the traders and wholesalers of agriculture commodities. One of the major reasons of this kind of arrangement may be government regulation or direct procurement from the farming community (Mittal and Mukherjee, 2008).

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.

8. Conclusion

Based on above assessment, this paper examines the critical issues at each sub-system of agriculture supply chain, starting from the input to the consumer, with a view to integrating them in efficient and effective manner. As proper flow of information across the chain constitutes an integral part, the role of information and communication technologies (ICTs) in improving supply chain efficiency in agriculture discussed in detail. Technical intervention

and policy issues have also been discussed for suggesting appropriate ways for the integration of each sub-system of the agricultural supply chain.

Information Technology and efficient knowledge management should be used for maintaining an updated and enriched database of region specific agricultural information and timely dissemination of technological information pertaining to soil enrichment, seed selection, actions relating to arrival of monsoon etc. to the farmers from in the field and reporting from farmers' feedback to the research system is one of the critical inputs in transfer of agriculture technology and also need of hour. In addition, information regarding agricultural products, demand-supply status in respect of different products and the current price should be made available on-line to the farmers for taking timely decisions on crop product diversification strategies and positioning of the same in right market to get optimum revenue. The educational and professional IT based institutions should take up the responsibility for guiding the use of IT as a tool and make it available to the farmers.

The quality of rural life and effective supply chain can also be improved by quality information inputs which provide better decision making abilities. Information technology and knowledge management can play a major role in facilitating the processes of integration and transformation of rural India to meet these challenges.

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