

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

Sazzad Parwez

Centre for Studies in Economics and Planning, School of Social Sciences,
Central University of Gujarat, Gandhinagar, Gujarat, India

Abstract: This study 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 study 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 study 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 study 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 study 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.

Key words: Agriculture, infrastructure, food security, development, investment, socio-economic

INTRODUCTION

India has experienced a remarkable growth in the production of various agricultural commodities over the last 4 decade. 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, 2001). 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 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 Birthal, 2004; Pingali, 2000). 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 (Rao and Jeromi, 2006; Joshi *et al.*, 2007). To promote private participation in agribusiness and processing industry, most of the states in the countr 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 certainty 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.

OBJECTIVES OF THE STUDY

There is basically 2 most important objective of the study:

- To study current status of infrastructure in the context of information technology in Indian agriculture
- To assess the impact of inadequate agricultural infrastructure on supply chain and agriculture

RESEARCH METHODOLOGY

Literature review: The starting point of the research 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 studies 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.

Limitations for the study: The major limitations for the study are as follows:

- The study 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

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, 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 (Birthal *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.

Retailing in India is undergoing an unprecedented transformation with number of national and international organizations trying to capture the huge and exponentially growing consumer market. The Indian retail market estimated to be worth around US\$ 350 billion (Khanna, 2006), it is at the 13% per annum and food retailing constitute of major part of overall retailing business. The list of business houses that entered retail business or getting ready to do so includes Bharti (with Wal-Mart), Reliance industries Ltd., Mahindra Shublabh, the Birla's, the Munjals, HUL, ITC, Adani Retail, RPG Retail and Godrej Agrovet. The liberalization of government policy towards FDI in retailing has enhanced the process of modern retailing in the country. At present FDI is not allowed in food and grocery retailing since it is only allowed in single brand retailing where 51% FDI is allowed through the Foreign Investment Promotion Bureau (FIPB) route where 100% foreign investment is allowed through automatic route or they can enter in to technical tie-ups (Mittal and Mukherjee, 2008).

INFORMATION AND COMMUNICATION TECHNOLOGIES AND 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. 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 Rao (2007), the implementation of ICTs proposes three unique strategies; a close vertical supply chain network for agribusiness enterprises; an open chain network with dynamically evolving partners and supply chain situation for public, non-governmental and multilateral organization and 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 Lynch, 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. Some of these initiatives include e- Choupals by ITC, DCM Shriram Consolidated Limited (DSCIL), Hariyali Kissan Bazar, Drishti, AgMarknet, Gyaandoot, iKisan, Parry Kiosks by EID parry, etc.

All these ICT initiative share the common objective of empowering rural communities to take the right decisions related to their day-to-day activities and there by improve their performance. 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.

INTEGRATED KNOWLEDGE MODEL FOR AGRICULTURAL SUPPLY CHAIN IN INDIA

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; Ben-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, 2004; BIRTHAL *et 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).

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 (Fig. 1). Each participant in the chain acts as an independent agent with a very low level of business relationship.

Based on practical experiences, Grimsdell (1996) proposed 6 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).

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 Matopoulos *et al.* (2007), there are 2 major pillars of supply chain collaboration, the design and governance of supply chain activities and the establishment and maintenance of supply chain relationship (Fig. 2). 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. The physical structure and governance of conventional supply chains in India shows that these chains generally exclude the primary stakeholders of agriculture, i.e., the farmers, from the system (Eapen *et al.*, 2003; Sukhpal, 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.

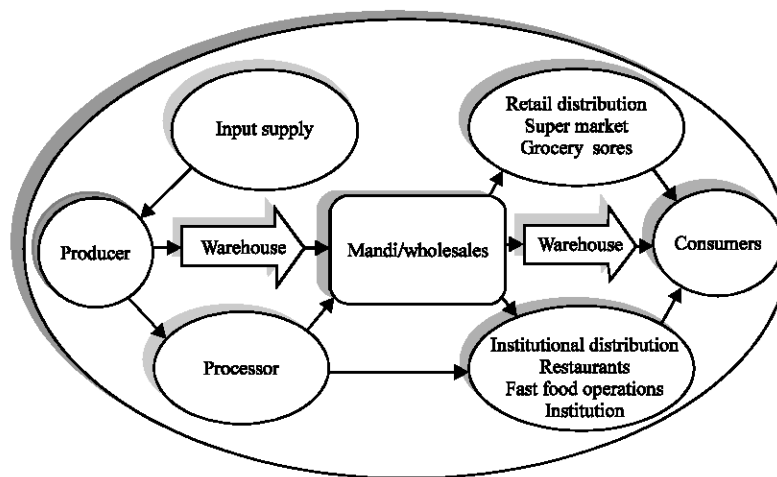


Fig. 1: Agricultural supply chain (Mittal and Mukherjee, 2008)

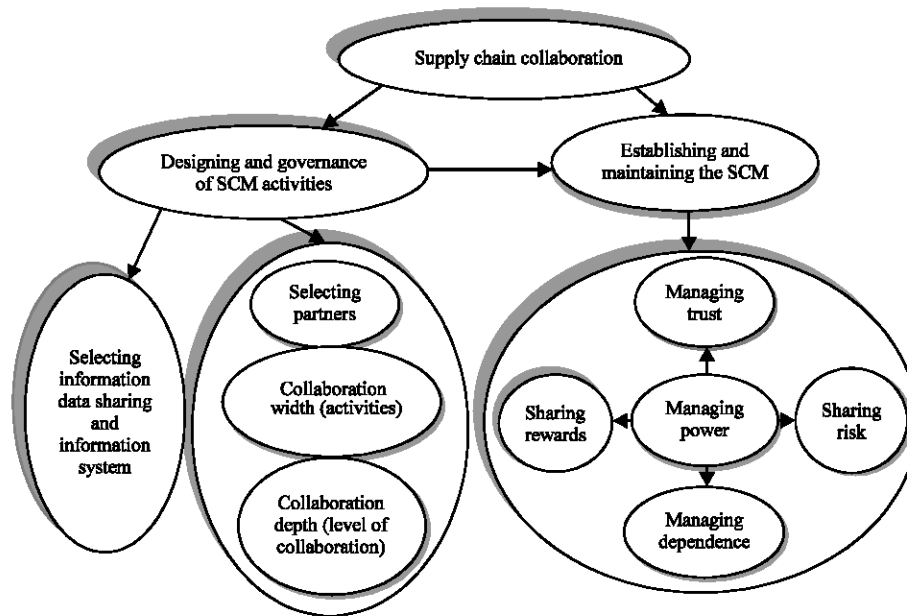


Fig. 2: Framework of supply chain collaboration (Matopolous *et al.*, 2007; Mittal and Mukharjee, 2008)

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 2 basic approaches behavioural and economic. A balance between risk and reward considered to be an important economic factor for enhancing relationship. 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.

CONCLUSION

Based on earliar assessment, this study 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. Thus, this study 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 study also covers the suggestion to improve efficiency at different levels in supply chain. 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 and to remove the fast growing digital devide.

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