

# Agri-food Supply Chain Management: Literature Review

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## Abstract

The purpose of this paper is to present a critical review of prior literature relating to agri-food supply chain management. An in-depth analysis has been carried out to identify the influential information from the literature. This paper has identified gaps to be explored about agricultural supply chain management (SCM) practices which may be used by researchers to enrich theory construction and practitioners may concentrate on establishing the extent and frontiers of agri-food SCM. This research work is the first attempt to make a critical literature review of available literature on agri-food SCM practices for developing countries like India. The research articles and other materials related to the agri-food supply chain management were collected from online data bases like Scopus, EBSCO and Google Scholar for the period of 10 years (2006-2016). The study performs content analysis and is followed by descriptive analysis. In the next phase, the literature in the field of agri-food supply chain management is classified into four broad categories viz. general literature review of agri-food supply chain, policies affecting the segments of agri-food supply chain, individual segments of agri-food SCM (structure of supply chain segments and conduct of supply chain segments) and performance of supply chain segments. These four categories are comprehensively reviewed and elaborated the research gap in the literature based on agri-food supply chain management. Finally, potato supply chain of India is considered as a case example for comprehensive analysis and elaborated in detail.

## Keywords

Agri-Food, Supply Chain Management, Literature Review, Nvivo, Perishable Food

## 1. Introduction

India is an agro-based economy with the agriculture sector providing employment for more than half of the country's massive population. However, the sector contributes only 18% to the nation's Gross Domestic Product (GDP) [1]. Though the sector is employing huge proportion of the country's population, economic contribution of the sector is declining for every year. India has got very good numbers as far as agriculture is concerned. However, these numbers are very discouraging if compared with other countries. For instance, India ranks second in the world in production of agro-based food items. These stats are highly encouraging. However, India's share in trading of food products at the world level is a mere 0.2%, which is astonishingly lower than the proportion of world trade accounted for by other developing countries such as Vietnam and Brazil [2]. The sector plays a significant part in socio-economic development of under-privileged masses of the country. The sector plays a decisive role in the progress of other sectors of the economy, particularly the manufacturing sector. However, it is a regrettable fact that India's first five year plan (1951-1956) alone placed utmost prominence on agriculture while all other plans and the economic reforms which followed, emphasized largely on non-agricultural sectors, disregarding agriculture. This paramount shift in policy-making resulted in colossal poverty and massive discrepancy and inequality distribution of wealth and income [3]. Despite the immense utility of agricultural sector to Indian economy, researches on India's agro-food industry in general and supply chain issues of Indian agriculture in particular, are very limited due to the vastly unorganized characteristic of the sector, complicating the process of primary data collection for researchers and policy-formulators. Hence, the task of data-driven decision-making regarding improvements in the total supply chain process of agro-food industry has assumed immense complexities [4].

The major food crops cultivated globally are rice, maize, wheat and potato. India occupies top positions in all these four crops. India is second largest cultivator of potato, next to China (FAO, 2011). Agri-food like potatoes is seed-based crops. It is indispensable to provide sophisticated warehousing with effective refrigeration facilities to store the vegetables for long term to fetch remunerative returns for farmers. Hence, agri-food supply chain management needs to be effective for adequate farmer remuneration. Hence, research on supply chain management will be of huge interest for the farming community and the country as a whole. This paper has attempted to review the studies on concerns regarding agri-food supply chain taken holistically and throw light on important findings discussed relating to supply chain policy like financial issues, mode of organizing/ performance of different components of supply chain. It represents all intermediate functions involved in the process of transforming inputs into output. Agricultural supply chain management engulfs set of value activities resulting in transforming agricultural commodities from their raw stage to consumption phase. These activities may embrace acquisition or procurement of agricultural raw materials, production course of agricultural commodities and the process of

marketing, storing and dispensation of agricultural commodities. Important agencies partaking in this process are agriculturists and consumers, suppliers of raw inputs (farmers), processors and human resources engaged in transporting and storage activities, etc. [5].

Over the few decades, lot of research work on the issues in supply chain management has been carried out in manufacturing and service sectors but little attention given to agriculture sector and the flip side agriculture sector contributing major part of human livelihood in the country like India and raw material for other industry. Among the agricultural commodity, food item has least explored in the context of supply chain management (Samuel *et al.*, 2012) and there is not structured literature in supply chain management of food sector in the context of what has been explored and not explored in agri-food supply chain management so this literature review paper will address this limitation through structured review of agri-food supply chain management. This paper aims at critically appraising studies conducted on agricultural supply chain. To put on a nutshell, this paper shall discuss previous studies conducted pertinent to principles and policies regarding potato supply chain. Prior literature studying comprehensive agri-food supply chain analysis and various issues concerning individual components of agri-food supply chain shall be thoroughly and critically reviewed and appraised. Hence, this paper shall take a holistic look at issues relevant to agri-food like potato supply chain which includes economic and financial aspects of all its components. Further the rest of the paper is organized as follows. In the next section we brief the data collection procedure and filtering conditions. In the Section 3, the design of content and descriptive analysis is explored via word cloud to identify the frequency of the words present in the collected literature, pie-chart shows the distribution of source of materials, heat map defines the authors list with research domain, and finally word cluster analysis is implemented to identify the relationship between the words in the collected literature. The content and descriptive analysis is done by Nvivo software. Section 4 devoted to four broad categories viz. general literature review of agri-food supply chain, policies affecting the segments of agri-food supply chain, individual segments of agri-food SCM (structure of supply chain segments and conduct of supply chain segments) and performance of supply chain segments [6]. Section 5 presents a case example of potato supply chain in India and followed by Section 6 research gap. Finally, Section 7 provides the insights for future research and conclusion.

## 2. Review Methodology

Literature review is a sum up of available research studies with the motive of exploring the focal point, developments and issues concerning the subject covered [7]. The process comprise of assessing contents utilizing both quantitative and qualitative. A critical evaluation of prior work conducted on specific subject shall divulge interesting issues which might not be well captured or noticed.

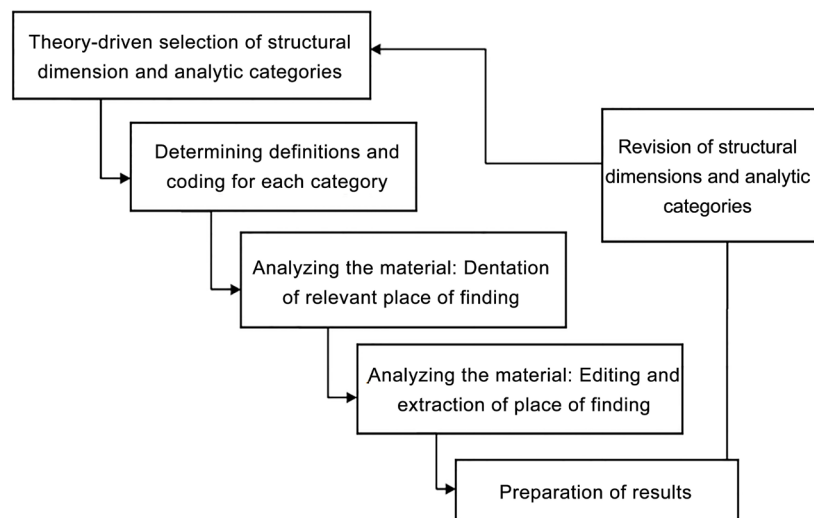
The process of literature data collection began very broadly with searching for

the keywords of supply chain management and agriculture and the process gradually assumed to specificity. Hence, this paper uses a blend of deductive and inductive approaches. First, literature like published peer-reviewed journal papers, white papers, MS and Ph.D. thesis reports, presentations made in conferences and industry manuals pertinent were collected from online and offline resources. The preliminary stage of data consists of more than thousands of research articles and other material. However, the primary motive is to review literature relevant to agri-food supply chain management are considered, many studies relating to agriculture and supply chains were collected.

In the next stage to identify the exact articles (materials) from the preliminary data collection a three way filtering conditions are adapted. First is based on period, the study considered papers published on agriculture supply chain management during the period of 2005-2015. Next is based on keywords used for searching articles and papers for the purpose include Supply Chain Management (SCM), Agri-food supply chain, agriculture supply chain, vegetable supply chain, fresh supply chain, perishable agriculture products, food products and potato supply chain. Final filter is carried out based on reputed publications available in three databases viz. Scopus, EBSCO and Google Scholar. Based on this conditions totally 116 articles are selected for the critical literature review.

The procedure suggested by [8] (Figure 1) has been utilized to conduct content validity of the articles collected. The four steps followed in this process were:

- 1) Material Collection: All papers satisfying the three criteria laid down as limiting factors were taken for scrutiny;
- 2) Descriptive Analysis: We segregated the selected papers using Nvivo 11 based on source of material and based on authors;
- 3) Category selection: We then categorized the papers like general literature review of agri-food supply chain, policies affecting the segments of agri-food supply chain, individual segments of agri-food SCM and performance of supply chain segments;



**Figure 1.** Process of content analysis.





classified into four broad categories as listed below:

- 1) General literature review of agri-food supply chain;
- 2) Policies affecting the segments of agri-food supply chain;
- 3) Individual segments of agri-food SCM;
- 4) Structure of supply chain segments;
- 5) Conduct of supply chain segments;
- 6) Performance of supply chain segments.

#### **4.1. General Literature Review of Agri-Food Supply Chain**

Cunningham [11] Scrutinized 123 peer reviewed journal articles published during 1987-2000 in seven commercial databases on the theme of agri-food supply chain management and exposed the possibility of conducting additional studies on all agri-food supply chain processes, particularly the fishery sector. Vasileiou and Morris [12] conducted a descriptive research based on primary data collected through exploratory interview of 240 potato cultivators, 17 potato merchants and 4 potato retailers and analyzed the data using non-parametric statistical tools. Results reveal that all participants of the supply chain were immensely concerned about sustaining their respective businesses and gaining comparative advantages and economic, market, social and environmental factors have great bearing on these endeavors. Vorst, *et al.* [13] conducted a simulation based study to explore SCM's effect on logistical performance indicators in food supply chain and found that uncertainty minimization drastically boosts service level. Frick, *et al.* [14] studied issues pertinent to supply chain of potatoes, lambs by interviewing cultivators and supply chain intermediaries. They found that entrepreneurship prospects were bright in supply chain of these commodities. However, they have cautioned that such prospects are highly dependent on efficient utilization of fuel and relationships between the components of the supply chain.

Taylor [15] conducted action research and used value stream analysis (VCA) involving farmers and a key processor and retailer and unearthed through a close scrutiny of lean supply chain mechanism that supply chain performance, efficiency, profitability and relationship between components of supply chain have got immense scope for improvement. Batt [16] studied potato supply chain issues in Vietnam by interviewing 60 potato cultivators, 10 traders and 25 retailers and used one-way ANOVA to explore the impact of various supply chain issues using transaction cost analysis and gap analysis. Results reveal that good inter-relationship between different components of supply chain makes a significant positive contribution to enhance chances of innovation, thereby boosting probability of competitiveness and competence. Further, the author has pointed out that SCM and product diversification has been necessitated in developing countries due to the following reasons 1) Attainment of food security, 2) Increased urbanization, 3) Rise in standard of living and d) Preference for traditional food. These developments have enhanced farmers' income. .

Deshingkar, *et al.* [5] attempted to detect changes in cultivation pattern of Andhra Pradesh farmers. They found that larger farmers are engaged in cultivation

of conventional vegetables such as onions, tomatoes, brinjals and cabbages while some of them have undertaken cultivation of hybrid vegetables of coriander and potatoes. The study also exposed the presence of small and marginal farmers making significant contribution to vegetable cultivation. Chandrashekar [17] analyzed fruits and vegetables SCM practices of Karnataka SAFAL market and exposed the prevalence of scope for better utilization of SCM concept to enhance productivity and efficiency. Hobbs [18] analyzed the current trends and future prospects of SCM of agri-food sector and established that enhanced attention on food security, free foreign trade reign, flow of foreign investments, heterogeneity of consumer choice and advancements in technology are important determinants driving modifications in SCM practices of agri-food sector. Moazzem and Fujita [19] analyzed the Bangladeshi potato SCM with a special emphasis on the marketing system. They found that time and finance constraints, too little productivity of potato cultivation, inadequate skill-level and shrinking rate of return from potato refrigerated warehousing business restricted the agriculturists and warehouse owners from undertaking trading activities. Despite these problems, investment in warehousing potatoes has been on the rise due to liberal credit offered by traders engaged in refrigerated warehousing.

Shukla and Jharkharia [10] undertook a review of 20 years (1989-2009) literature on fresh-produce-SCM. They classified the available literature based on problem milieu, methodology, product and other structural attributes. Their study revealed that fresh-produce-SCM papers have concentrated on maximizing revenue, customer satisfaction and minimization of post-harvest wastage. The other issues researched were disparity between demand and supply and inefficient demand predictions and the review revealed that majority of the articles available on fresh produce SCM is fragmented.

Fuglie [20] conducted an inter-country study on economics of potato warehousing in India, USA and Tunisia. This paper found that agriculturists might be exposed to lesser degree of market risk if a) they had access to market prices and stock details in time and b) forward and futures pricing mechanism existed. Beck and Demirguc-Kunt [21] analyzed research relating to access of finance for small and medium enterprises (SMEs) and suggested that factoring and leasing can play a significant role in providing finance for these enterprises in economies where financial institutions have not been well established. Sagheer, *et al.* [4] analyzed efficiency of agri-SCM of India at industrial and firm levels using Porter's Diamond and Momaya's Asset Process Performance (APP) Models respectively. Their study has revealed that human components (processors, government, producers, etc.) and non-human components (governing setup, food quality, etc.) significantly influence SCM competence. Minten, *et al.* [22] surveyed branding of agriculture commodities and SCM issues in Bihar. They found that brand materialization in agriculture commodities results in enhanced delineation in retailing segments. The authors have revealed shocking information for consumers that quality of branded commodities sold in packed materials are inferior when compared with those available in the market in loose lots. Hellin and



Meijer [23] scrutinized Ecuador SCM practices and found that consumer market requirements for processed potatoes is on the increase. They also found that increasing role of retailers and processors in potato SCM have successfully countered this demand spurt.

Punjabi [24] studied problems confronting SCM practices of fresh food and vegetable items in India by obtaining responses from corporate managers involved in the process. Her study exposed issues like insufficient refrigerated warehousing facilities, excessive competition among traders in conventional markets, contractual obligations of agriculturists and agro-business firms, dearth of standardization in agricultural commodities, non-compliance with APMC Act while procuring agricultural produce from agriculturists and improper handling of the postharvest produce due to lack of training. Ghai [25] conducted a descriptive research on financial aspects of components of agro supply chain using secondary data. The study has advocated that all components of supply chain should be interrelated and cooperate by ethically sharing benefits equally among themselves in order to sustain in the business through mutual coexistence. Bala Subrahmanya [26] conducted a research to expose various problems confronting the Indian small scale sector in the light of globalized scenario. His study has revealed that inefficient infrastructure, insufficient financial support due to low flow of formalized credit and outmoded technologies resulting in substandard quality and poor productivity and capacity utilization are the major issues adversely bothering Indian small-scale units.

Shilpa [27] analyzed the vegetables SCM practices in Bangalore and identified that inefficient recording of sales managed by agriculturists, procurement managed by middlemen, quantum sold to consumers and quantity remaining unsold and intra-day price variations are the major restrictions of vegetable SCM. KhairulIslam [28] analyzed Bangladeshi potato SCM through desk research and interviews and unearthed that Information Communication Technology (ICT) is the permanent solution to enable agriculturists in identifying various sources of qualitative inputs and enforcement of regulatory mechanism to check sale of substandard inputs in the market. Singh [29] analyzed potato SCM practices in Bihar and highlighted the major problem of agriculturists being exploited by middlemen who eat away lion's share of price paid by consumers, leaving the farmers a very little share. [30] conducted a descriptive study on financial aspects involved in SCM of rural entrepreneurship and advocated that financing SCM implies establishing link between financial institutions and all stakeholders in supply chain management. The author suggested that providing finance to facilitate flow of products and establishing relationships among different stakeholders of supply chain should immensely contribute to boost the efficiency of SCM practices.

#### **4.2. Policies Affecting the Segments of Agri-Food Supply Chain**

Driessen and Glasbergen [31] have compared efficiency of organic and generic farming. They have exposed some limitations of organic farming such as complex-

ities associated with it and squat desire among consumers to use eco-friendly commodities. The study has revealed that governmental policies exert slender impact on potato SCM practices.

Cromme, *et al.* [32] endeavored to study ways of amplifying efficacy of potato SCM practices in developing countries by analyzing secondary data provided by UN's FAO (Food and Agriculture Organization) and exposed important problems confronted by potato SCM as dearth in support from both public and private parties, production initiatives, diversified fabrication clusters and market integration. Nations with minimum assortment in diet practices and those with high imports and exports are immensely benefitted by potato SCM.

Wei and Yanrong [33] have analyzed SCM practices of Melons and established that despite institutional scenario being supportive of SCM practices, social infrastructure has been the major cause of concern. Wheatley and Peters [34] analyzed the means and modes of enhancing efficacy of Agri-food SCM practices of Asian farm sector and recommended that innovation, supply chain intermediaries diversifying their activities to participate in other supply chains, precise consideration of different stakeholders in the supply chain and the mechanism of apportionment of cost and utility to these stakeholders shall enhance the efficiency of SCM practices.

Kumar, *et al.* [35] scrutinized 76 presentations made during eighteenth conference organized by NAARM covering SCM practices of agriculture items and its contribution to accomplishing food safety and eliminating poverty. Their study revealed that institutional framework comprising professional societies and national institutes might shoulder the responsibility of taking initiatives to develop sound theoretical concepts to strengthen SCM issues of agricultural food items.

Basu and Dinda [36] collected price movements of potatoes in West Bengal and applied co-integration test to highlight even transmission of trends in prices throughout. Basu [37] evaluated efficacy of Bengali potato SCM based on secondary data during July 2000 to December 2001 and has advocated intervention of private corporate in potato SCM to boost its efficacy. Rais, *et al.* [38] have conducted an in-depth scrutiny of India's food processing segment and its capacity to generate jobs. They stressed the importance of better government policies to institute proper infrastructure support for developing the industry that is engaging predominantly lesser skilled laborers. Jha, *et al.* [39] studied monthly data of 55 Indian wholesale commodity market segments during January 1970-December 1999 to test prevalence of integration among these segments. Their study has revealed the incompleteness of market integration among the segments due to excessive governmental intervention.

Joshi, *et al.* [40] examined trends of revenue from crops cultivation during 1980-1981 to 1999-2000 and have suggested better investment in agricultural R& encouraging marginal farmers to diversify into cultivation of high value crops through assistive institutional framework. Popkin [41] analyzed the trends of living pattern of developing countries and found that globalization has drastically altered pattern of energy usage and food habits of people in developing na-

tions, leading to many health complexities. Sharma [3] has scrutinized trends in growth of India's sectors including agriculture and has established that despite the strong impact exerted by agriculture on progress of other sectors of economy and effectively addressing the menace of poverty, the sector has not been accorded due importance in the country's planning process, resulting in vast disparities of income and wealth distribution. U. Kleih [42] analyzed issues pertinent to providing financial assistance to small and medium agriculturists and fishermen and advocated that banks and financial institutions should educate these marginal sections of society about managing finance which will enhance their accessibility to finance. Rao, *et al.* [43] analyzed the nature of credit extended by 97 banks to SSI (Small-Scale Industry) sector and concluded that non-repayment of loans obtained by SSI units resulted in banks being reluctant to accord credit to the sector. Tchale and Keyser [44] found that high farm prices in other nations, exploitation by middlemen, shrinking productivity and rising cost of inputs adversely affected the competitiveness of agricultural items such as rice, maize, cotton and tobacco in the international market. Smith [45] has suggested that those engaged in agro-based business can prosper only if consumers are educated about healthy food habits and encouraged to consume food harvested and preserved in their respective localities and accomplish a good and well sustained SCM practices in the agricultural sector. Trilochansastry [46] has suggested that effective SCM will lead to maximization of income and wealth for small and trivial farmers. A well-designed SCM warrants sufficient financing all components of supply chain, rendering modern technologies such as internet and cellular networks affordable and accessible to the intermediaries of supply chain, establishing agriculturists associations and providing expertise in all components of supply chain.

Swinnen and Maertens [47] have evaluated the influence of privatizing and globalizing the economy on agri-food SCM of Latin American and Central European nations in transitional stage of economic development and found that the process has resulted in privatization and global integration of agri-food SCM practices of these nations. Gandhi and Namboodiri [48] studied the Ahmedabad's wholesale price and cost components of vegetables and fruits and found that marketing cost constituted nearly 8% of price paid by end-user in the case of former and 11% - 15% for the latter. Transportation and commission expenses constitute the bulk part of price paid by end-users while the agriculturists get only 48% and 37% of price paid by consumers in the case of vegetables and fruits respectively. Pal, *et al.* [49] scrutinized the Indian potatoes and groundnuts SCM practices and exposed the diversity of cultivation environment prevalent among states and within a state at some instances. Hence, they have advocated that regulations in seed legislations pertaining to compulsory registration or private participation might not hold valid for the entire nation. Naik and Jain [50] analyzed shift in the role of institutional infrastructure in farming sector of India and highlighted private sector, acting in coalition with public sector, gaining predominance in effecting growth of the agricultural sector at better pace, by

better utilization of natural resources and knowledge. Reardon and Minten [51] have highlighted revolutionary changes drastically transforming Indian food SCM practices during past twenty years. Role of retailers is assuming immense significance with retail sales witnessing a whopping annual growth of 49%, penetrating both urban and rural markets, transforming lives of agriculturists.

Cromme, *et al.* [32] have studied the potato SCM practices in developing nations and advocated that effective private-public support, improving production process through formation of producer groups and integrating markets can strengthen potato SCM practices. Miller and Jones [52] analyzed issues pertinent to financing agri-food SCM practices. They suggested that financial institutions should carefully consider SCM dynamics while deciding about granting agricultural credit. Ghosh and Ganguly [2] have identified stumpy productivity as the key problem of Indian agriculture due to fragmented land holdings, irrational resources utilization, shrinking demand for food items, diminishing investments in the agri sector and inaccessible farm credit for petty and trivial agriculturists. Mancero [53] has hinted that rapid variance in requirements of agricultural sector due to fast changing economic conditions warrant petty agriculturists to adopt innovative SCM model by taking a consorted and coordinated approach. Gaiha and Thapa [54] have analyzed the comparative strengths and future opportunities for supermarkets and small players in Asian agri SCM practices and points out that the small players will not be affected by supermarkets if their constrictions are adequately addressed. They advocate that supermarkets and petty players can mutually benefit through partnership arrangements and strategic alliances.

### **4.3. Individual Segments of Agri-Food SCM**

The individual segments of Agri-food SCM are classified into two categories viz. structure of supply chain segments and conduct of supply chain segments. These two categories are elaborated in this section.

#### **4.3.1. Structure of Supply Chain Segments**

Loader [55] analyzed Egyptian potato SCM practices and established that supply chain comprising of numerous processing players will result in complexity of inadequate intra-firm relationship. This might lead to businesses adopting vertical integration as growth strategy which can be managed by adequate dissemination of information among different SCM segments. Narrod, *et al.* [56] talks about petty Indian and Kenyan fruit and vegetable producers coping up with pressures of their profession and have advocated that effective SCM practices shall be the best solution. However, they have suggested that government has to play a facilitative role in correcting supply chain problems and not trying to control it. Beck and Demirguc-Kunt [21] have analyzed the problem of accessing finance for SMEs and have advocated conduct of more research at both micro and macro levels to arrive at better solution to this problem of enabling SMEs access to external finance. Howorth and Westhead [57] have established through

their study that small firms concentrate much on managing their working capital for the goal of improving their returns.

Solér, *et al.* [58] analyzed the Swedish food SCM practices and found that consumers perceive information about the environment relating to food SCM distinctly and this distinct perception is affected by their location in the supply chain in relation to other stakeholders. Vorley [59] established that agricultural markets have undergone tremendous changes with wholesale markets replaced by closer SCM participants comprising of food processors, retailers and servicing personnel. Markelova, *et al.* [60] have recommended that petty agriculturists have to implement drastic alterations in organizing their producing and marketing mechanism to enhance their productivity and efficiency. Some of such initiatives may be adoption of sophisticated technology like spreading out producing processes, utilizing innovative means, enhancement of quality in processes, utilizing micro-irrigation mechanism and maintaining schedules of plantation and record of such schedule, quantum of plantation and expected productivity and likely date of harvesting. Ardic, *et al.* [61] analyzed the global flow of credit to SME sector and found that a total of 10 trillion \$ credit is extended to SME sector in the world and OECD nations account for 70% of such credit. The study has revealed that credit to SMEs work out to 3% and 13% of GDP of developing and developed nations respectively. Pingali [62] has traced changes in Indian food habits during the preceding two decades and found that economic growth has transformed dietary habits of Indians which will adversely injure the interests of petty farmers engaged in subsistence agriculture. Adequate incentives and rational policies are needed to be provided for maintaining the livelihood of these agriculturists, integrating them to the world's food market. Bhalla [63] have highlighted the positive changes effected by sophisticated technology in Punjab agriculture in enhancing productivity of rice and wheat cultivation. Utilization of upgraded technologies in the agricultural sector has increased deployment of non-agricultural inputs in the sector, leading to intersectoral linkage.

McCullough, *et al.* [64] reported problems encountered by the stakeholders in agricultural SCM such as farmers, middlemen and consumers in Madhya Pradesh. The agriculturists encounter difficulties in production process of insufficient availability of human and financial resources, raw materials and other inputs, fertilizers and pesticides, information sharing and possibilities of burglary while they encounter difficulties in marketing such as deficient refrigerated warehousing, transporting and other infrastructure facilities, weak negotiating power, unjust share in consumer price and lack of grading and homogeneity. Intermediaries encounter complexities such as lack of warehousing, grading and homogeneity, poor quality and highly perishable nature of agricultural produce, lack of consistency in demand and supply for agricultural produce and knowledge about prevalent consumer price. Complexities for consumers consist of low quality, poor warehousing causing seasonal fluctuations of supply resulting

in abnormal swinging of prices, lack of standardization of agricultural commodities, deceitful weight measurements and weak bargaining power.

#### 4.3.2. Conduct of Supply Chain Segments

Viator, *et al.* [65] conducted a study based on Philippines and Thailand to explore importance of business dealings and cold chain in food exports. They established that pricing of exports is significantly influenced by quality while opportunistic character of consumers may discourage flow of investment in cold chain segment that can be addressed only by winning assurance of the chain stakeholders for a longer period. Bertazzoli, *et al.* [66] conducted a research on 189 firms engaged in potato SCM, 187 in fruit SCM and 203 in cheese SCM and established that distribution creates 35% value in the cases of potato and fruit SCM while the contribution is a mere 13.6% in the case of cheese SCM. The study also revealed that over a five-year period, the value diminishes by 5% in the case of fruits and potatoes while the percent of diminishing is at a faster rate of 9%. Lack of effective coalition among all stakeholders of the supply chain of these three commodities has resulted in retailers gaining immense power at the cost of others.

McCluskey and O Rourke [67] evaluated the difficulties of SME agricultural firms of US and established that demands of retailers in the chain such as registration charges, utilization of upgraded technologies and food security examination complicates the survival of these SMEs. Rademakers and McKnight [68] have studied the Dutch potato SCM and established that globalization has resulted in a paramount change in preference of consumers towards better superiority and assortment of agricultural commodities and fair pricing. SCM practices of US agricultural firms have led to retailers gaining immense authority in European markets. Mmasa and Msuya [69] have analyzed the Tanzanian potato SCM practices by studying 150 intermediaries and established that agriculturists sell either directly to end-users or through retailing merchants or village petty sellers. They have also found that a shade above half of the agriculturists (50.7%) consider feedback from co-agriculturists to take pricing decisions while 44% of them adopt direct selling to consumers.

Singh [29] evaluated the effective usage of concept of CF (Contract Farming) by three Indian companies in raising three crops of potatoes, organic basmati paddy and mint. His study has revealed that the CF arrangement shall yield fruits for agriculturists and the economy in the very short and medium run if the arrangement is clear on contract expenses and promotes innovation and coordination. Birthal, *et al.* [70] have established the growing contribution of CF to small agriculturists gaining immense benefits by engaging in high value agricultural commodities by way of declining transaction expenses, enhanced market efficacy and higher reward for produce. Singgih and Woods [71] tried to explore the impact of culture on Indonesian and Australian SCM practices of bananas and established an adverse relation between the intermediaries of supply chains of these two countries. Indonesian rural areas were dominated by conventional

systems while Australian villagers enjoyed more equity, amity and democracy. Nature of these relationships significantly influenced the mechanism of fixing prices and negotiating proclivity of farmers. Concepcion, *et al.* [72] surveyed all intermediaries in vegetables SCM of Philippines and established that agriculturists possess very little alertness about requirements of the vegetables market, resulting in them wrongly perceiving about demand characteristics and quality requirements of their commodities, leading to unavoidable wastage in SCM. Driessen and Glasbergen [31] explored the role of traders in linking Indonesian cocoa farmers and consumers and established that traders provide useful information to rectify quality issues. Hingley [73] analyzed nature of power politics existent in UK among fresh food SCM intermediaries comprising of supplying institutions, retailers and consumers. The study revealed that power politics always exist among the SCM components and such prevalence does not always result in adverse scenario. Relations-building may lead to power unevenness and weaker intermediaries are insensitive to such disparities.

Sohal and Perry [74] examined practices of comprehensive SCM of cereals in Australia. They found that factors such as pattern of demand influenced by globalization, complexities associated with nature of business, pricing mechanism, authority relations, vitality of timely and prompt deliveries, supply chain human resource needs, environmental situations affecting agricultural productivity, flow of useful and timely information and responsibility needs of industry significantly impact the environmental conditions of Indian agriculture. Fafchamps and Minten [75] assessed the utility derived by Maharashtrian agriculturists from RML (Reuters Market Light) providing agriculture-related information to their cell phones and came out that transmission of information through mobile services failed to make any impact on price managed by agriculturists for their produce, rational modification in agricultural practices or variety of crops and minimization of losses due to natural calamities. Minten, *et al.* [76] found in Delhi that organised contemporary retail outlets sell food items at price in par with or lower than the conventional retailers and hence, the former may play a decisive role in accomplishing food safety. Ramakrishnan [77] conducted a research on 605 retail grocery establishments in 2 Indian cities and found that even smaller retailers adopt unique operational tactics to boost efficiency and profitability. Banker and Mitra [78] studied an e-auction of coffee beans in India and established that e-selling of agricultural items may be successful under certain scenario only and state authorities can play a vital role in facilitating e-trade by enhancing negotiating skills of farmers and enhance confidence among consumers to buy directly from farmers.

Rodger [79] describes the structure of a Bayesian network from a real-world supply chain data set and then determines a posterior probability distribution for backorders using a stochastic simulation based on Markov blankets. Akoijam [80] established the positive contribution made by NABARD's micro finance programme implemented through self-help group linkage model in addressing rural poverty. He established the contribution of micro finance providing rural

credit, which has provided an opportunity of sustained living for huge rural masses. Yogisha [81] conducted a study on Karnataka commodities market and established that in the case of all crops studied (Groundnuts, onions, potatoes and Ragi) market price was shrinking during peak seasons and the prices of these crops displayed an inverse association.

Sikkel [82] explored the possibility of SMEs getting integrated with SCM practices at local and world levels and established that efficient utilisation of SCM practices and formation of association of small agriculturists lead to optimum capability utilisation and declining transaction expenses through economies of large scale operations, which capacitates even small agriculturists to access international markets. Fan [83] have established the role played by government spending on rural India in eradicating poverty. Such expenditure directly generates more jobs in villages while enhanced investment on education, infrastructure, health and R&D in villages results in stimulation of overall growth of the villages, resulting in more jobs and enhanced income of rural masses. HarbirSingh [84] have established that potatoes SCM suffer from irregularity in provision of timely information delinking public-private partnerships, warranting the necessity of effective R & D reconciliation to precisely study requirements and demand of market. Atre [85] established that existence of numerous intermediaries in agricultural supply chain drastically diminishes the agriculturists' share of price paid by the end-user.

#### **4.4. Performance of Supply Chain Segments**

Adetonah, *et al.* [86] surveyed 235 growers of good rice variety and vegetables in Benin and Mali and concluded that difficulties associated with accessing product market, poor availability of inputs comprising of seeds, fertilizers and petty tools, exorbitant cost of transportation, massive after-harvest loss and insufficient refrigerated warehousing facilities were complexities encountered by these agriculturists. Esterhuizen and Van Rooyen [87] have analyzed the efficacy of South African agro-business to venture into international markets and established that the comprehensive SCM of South African agro-business is not adequately qualitative to participate in global competition and quality of produce sold in local markets is so poor, disabling global participation. Gandhi and Namboodiri [88] analyzed the complexities confronting the wholesale vegetables and fruits markets of Ahmedabad, Chennai And Kolkata. They established that improvement in marketing infrastructure by enhancing quality of road transportation, refrigerated warehousing, convenient weight measurement and loading amenities made available and lucidity of operations will go a long way in boosting efficacy of these markets.

Ghezán, *et al.* [89] have examined the influence of MNCs on potato SCM by surveying managerial personnel of processing organizations and potato agriculturists. They have identified developments in potato SCM due to arrival of MNCs such as importance of wholesalers shrinking due to emerging supermarkets, novel SCM intermediaries such as expert wholesalers integrating with su-



permarkets gaining importance, advanced technologies and innovative strategies executed by SCM intermediaries shrinking the role of petty agriculturists. Mitra, *et al.* [90] established that Bengali middlemen in potatoes market swallowed 34%-89% of consumer price during 2008. Their study also revealed that information flow had no impact on margin levels but did exert an impact on traded volume. The traded volume had a direct relationship with information gained by agriculturists about wholesale price. Pocock [91] studied supply elasticity of Idaho potatoes and impact of contractual obligations on such potato cultivators. His study revealed that during the last three decades, supply elasticity of these potatoes has remained unaltered. The study has also established that price of potatoes which prevailed recently determine quantum of land used by agriculturists for potato cultivation. The study also revealed that potato cultivation had 3 - 3.5 year cycle. Sahadevan [92] studied the acuity of potato and mentha cultivators about commodities futures market and suggested that establishing agriculturists associations alone can improve efficiency of agricultural SCM and enhance partaking of petty agriculturists in commodities futures market. Thorne [93] assessed the impact of market factors on the volatile potato prices and applying ARCH technique. The study revealed that elasticity of demand for potatoes is high and increased demand for potatoes enhances their price while enhanced supply diminishes price. Morgan, *et al.* [94] have scrutinized the role of Indonesian vegetable supply chain intermediaries in serving interests of agriculturists in the light of food security and satisfying consumer aspirations. They established that supermarkets assist agriculturists by granting them steady orders well in advance, enabling them in scheduling their output.

Grigg and Walls [95] assessed the role of SQC (Statistical Quality Control) in assisting enhancement of quality of manufacture of food and drinks. Their study revealed that SQC resulted in good quality manufacturing process while this quality gradually diminishes due to interior and exterior environmental conditions [96] tried to assess the influence of cellular services on Niger's food grain prices. Utilizing time-series data and applying Linear Regression technique, the study established that cellular services during 2001-06 reduced grain prices dispersal by 10%-16%. Kinsey [97] assessed impact of market concentration and price movements on profits of US retail traders in food grain industry. His study revealed that price of dry groceries is on the upswing while that of refrigerated food items are witnessing a downward trend. The study further indicates that wholesale market concentration results in price decline while profit surges. Bardhan, *et al.* [98] evaluated the Heckscher-Ohlin model of North-South trade in benefitting intermediaries of agricultural SCM and overcoming problem of hazardous products. Their study has revealed that liberalized trading practices have disproportionately benefitted agricultural traders.

Thampy [99] assessed the benefits which shall accrue to Indian agriculturists in designing their products due to flow of information and established that cellular services can significantly influence rural economy by prospering agriculturists. Ghosh [100] evaluated the effect of reforming agriculture practices on

spatially integrating agricultural markets. He applied the Optimum Likelihood technique of Co-Integration in this endeavour and established that reforms succeeded in strongly integrating the regional markets, satisfying the principle of uniform pricing throughout the region. Kuruvilla and Joshi [101] examined profile of some 3026 mall customers spread over 8 Indian cities. Their study revealed prevalence of significant difference in socio-demographic attributes, behavior, attitude and shopping preferences among heavy-shoppers. Ali and Kumar [102] have endeavoured to assess the decision-making competence of agriculturists and found that information flow to agriculturists through measures such as ITC (Indian Tobacco Company) sponsored e-Choupal can improve their decision-making skill and aptitude. However, such skill will also be affected by the socio-economic profile of agriculturists such as education, category, income and pattern of land ownership. Shilpi and Umali Deininger [103] surveyed 400 retailers and agriculturists spread over 40 villages and 20 wholesale markets in the year 2005 to assess the impact on marketing decisions of agriculturists and established that provision of facilities such as improved marketing infrastructure diminishing cost for agriculturists by way of declining travelling time to markets from residence, motivates agriculturists to boost their sales.

Kopparthi and Kagabo [104] have stressed the significant impact exerted by accessibility to supply chain financing on output and profitability of petty agriculturists based on surveying 122 agriculturists and personnel of Micro-finance institutions. Joshi, *et al.* [105] used FISM (Fuzzy Interpretive Structure Modeling) technique to arrive at two categories of that exists a group of inhibitors, one with dominant authority, maximum strategic dominance, attracting utmost attention and stumpy reliance while another group with exactly the opposite features.

Roy and Thorat [106] evaluated the performance of Mahagrapes agriculturists and they found that these agriculturists manage high returns due to enhanced qualitative output enabling them to access external markets also. Pingali and Khwaja [107] analyzed the impact of westernizing dietary trends in Asian countries on petty agriculturists and propagated that linking rural with urban economy through efficient infrastructural facilities such as effective transporting and communicating facilities, enhanced investments in rural market on R&D which shall lead to optimal utilization of resources and enhance output and foresighted strategy facilitating these petty agriculturists in getting transformed to commercial world shall enable them to sustain the assault of changing pattern of consumers. Gangadharappa [108] endeavored to analyze fluctuations in pricing potatoes in Karnataka commodities market by analyzing monthly arrival prices collected from KSAMB (Karnataka State Agricultural Marketing Board). He established the prevalence of fluctuating prices in all markets excepting Kolar market. Similarly, the trend in fluctuating prices is dissimilar among the different markets. Bhagat and Dhar [109] have scrutinized the SCM practices of agriculture and established that belief, dedication and transparency prevalent amidst SCM intermediaries determine the success of agriculture SCM by way of gaining

good knowledge about uncertainties of agriculture, serving the rights of farmers and all stakeholders in supply chain, boosting responsibility and importance of petty players in SCM, inter-personal relations among intermediaries of supply chain resulting in lucidity and belief among them and SCM practices assuming consumer orientation.

Ramaswami, *et al.* [110] have found that though intermediaries in SCM of poultry business in Andhra Pradesh corner major portion of consumer price, CF practices have enabled poultry farmers to gain immensely due to low risk element and enhanced profitability. Khan [111] have found that production volume of Indian food grains segment is lower when compared with commercial crops such as sugar, oilseeds, vegetables and fruits. He has pointed out that agro-food industry is positively influenced by yield of agriculture, improved infrastructural facilities, modified pattern of consumption, foreign markets becoming accessible for agricultural commodities and assistive governmental policies. Naik and Jain [50] studied the efficiency of 6 Indian commodity futures markets and established that improper managing of risks and pricing mechanism have rendered these markets under-developed.

## **5. A Comprehensive Analysis of Agri-Food Like Potato Supply Chain in India**

Upstream-Farm: 30% of medium sized cultivated farm lands in India account for almost 70% of potato cultivated farm lands. Rent and lease charges of farm lands are galloping at rapid rates making payment of rent for land equally strenuous like acquiring capital and paying interest for the same. Labor dearth is assuming significant proportions in India, hampering agriculture growth in the country and this problem has become more acute even in small farm lands. Government efforts of providing irrigation subsidies for potato cultivators is largely eaten away by the large farmers, incapacitating the small and marginal farmers from utilizing irrigation facilities for their small sized land holdings. Further, these small farmers do not have access to markets and are not aware about the remunerative prices prevalent in the market for their produce. As a result, they often end up being exploited by unscrupulous middlemen who acquire the potatoes at cheap rates from the farmers and sell at exorbitant prices in towns and cities. This problem can be solved only if farmers are made responsive to latest technologies in cultivation and market information for which the agriculturists should be facilitated to remain connected through the mobile technology.

### **5.1. Midstream-Refrigerated Warehousing and Traders**

Providing easily accessible refrigerated warehousing facilities for potato farmers will contribute immensely to them from being exploited by middlemen and getting sizeable proportion of price paid by consumers for the potatoes. In short, a well accessible warehousing can almost eliminate the wholesale market for potatoes which will be highly rewarding for farmers. Enhanced logistics support to

farmers in the form of improved transport and warehousing facilities will contribute significantly to improve the lives of potato farmers. The main problem in providing effective warehouse facilities is in shortage of power warranting enhanced investment in electricity generation. Further, farmers can also be saved from traders delaying or defaulting payment for their produce.

### **5.2. Downstream-Retailers**

Though retailers have contributed to quality enhancement of potatoes, packaging and branding of potatoes have not yet developed at all. Modern retail outlets have uprooted in both rural and urban areas, posing severe threat to the traditional retail traders. Government's initiative of getting directly involved in aiding potato retailing by establishing cooperative form in the retailing sector has started penetrating the potato retail market, which is a positive sign.

### **5.3. Performance of the Potato Supply Chain-Rewards, Costs, and Margins**

A whopping 71% of refrigerated warehousing cost is occupied by energy implying that almost 21% of the total supply chain cost and 11% of market price of potatoes is directly accounted for by energy cost. Almost two-third of potatoes cultivated is stored in refrigerated warehouses and hence, cost of power highly influences potato price. Further, prevalence of market cost for marketing potatoes at the rate of 5% of total cost exerts almost 2% impact on potato price. Another constituent of cost of potatoes is cost of transportation, which accounts for 8% of total cost during harvest times and 11% during off-times. Considering the different cost elements involved in potato supply chain, it can be said that potato cultivators may get 57% of the retail price during harvest season and 52% during off season. Since power occupy a significant proportion of cost and price of potatoes, rational utilization of power or rise in power tariff will exert a telling impact on potato prices, leading to inflation.

Recent efforts of government to develop refrigerated warehousing facilities, investing more on research and development in rural areas, distribution of quality seeds at subsidized rates, providing irrigation and extension facilities, improving transportation facilities via road and rail, establishment of power grids and provision of mobile services have contributed positively to enhancement of economic standard of living of potato cultivators. Farmers have started utilizing the refrigerated warehousing facilities for storing their produce, enabling them to get remunerative prices while consumers can get potatoes perennially without seasonal fluctuations. A Delhi-based potato supply chain study has revealed that importance of wholesale market is shrinking drastically as almost farmers have moved towards refrigerated warehousing, enabling them to sell in the open market during any part of the year. Investors felt it highly remunerative to invest in refrigerated warehouses, farmers felt it immensely beneficial to store their potato produce in these warehouses, traders used these warehouses to buy their stock directly from farmers while consumers enjoyed perennial availability of

potatoes irrespective of season or off-season. Hence, a rational combination of all logistics support at various stages of potato supply chain has yielded fruits for all sections. In addition to provision of effective logistics support, if government efforts to provide agricultural subsidies reach the intended beneficiaries, all components of supply chain of agricultural commodities including that of potatoes, will flourish in the near future.

## 6. Research Gap

A close scrutiny of prior literature on agricultural supply chain management has revealed that lot of research literature exist on SCM practices of different agricultural commodities [112]. However, these studies have focused on problems encountered by different components of the supply chain management. Not much work has been conducted on examining the financial and energy aspects of all components comprising the entire supply chain management. Similarly, very few studies have been conducted on important aspects concerning the fresh food supply chain like potato under Indian context [6]. Furthermore, negligible quantum of studies have been conducted exploring problems confronted by different participants of potato supply chain, particularly the finance delivery mechanism available for agriculturists, agro-food processors and medium, small and micro enterprises (MSMEs). In the backdrop of this scenario, it shall be significantly important to conduct a research work on exploring the problem of accessing finance and energy aspects of each segment of agri-food supply chain management and arrive at concrete solution to assuage this serious problem [113].

## 7. Conclusions and Future Directions

The paper has identified gaps and issues in agricultural supply chain management (SCM) practices. A thorough scrutiny of the literature suggests that Indian agriculturists suffer seriously from the following problems: Stumpy bargaining capacity of farmers, putting them under the mercy of selfish traders and middlemen, who invariably exploit them to the core; very little fragmented land holdings; very little marketable surplus; exorbitant cost of cultivation and marketing; informal sector dominating the marketing process of agricultural produce; fragmented agricultural supply chain; poor marketing infrastructure installed for agricultural produce; imperfect market conditions for agricultural commodities; massive wastage of agricultural produce to the tune of 30% - 60%, due to ineffective warehousing and storing facilities; rapid perishability nature of high value commodities; non-availability of effective packaging, branding and certification; lack of adequate market information about remunerative returns available for cultivating particular crops; poor price-discovery means available to farmers, incapacitating them from getting the lion's share of price paid by consumers for their produce; soaring of risk ingredient to the tune of 60%-70%, associated with agricultural production and marketing process; low productivity yield resulting in truncated quantum of output; difficulty in accessing finance,

particularly for working capital; inefficient crop insurance programmers; agrofirms existing for long period acquiring monophony; inadequate availability of information incapacitating farmers to comply with food security issues; non-availability of knowhow to utilize fertilizers and pesticides; lack of proficiency on the part of farmers in asset management, incapacitating them from effecting suitable portfolio modifications in the production process; lack of sophisticated technology reducing capacity utilization, leading to meager raising of output from inputs; excessive usage of chemical fertilizers having ruined land fertility; stumpy quality of produce; inadequate availability of power [114].

Combinations of majority of these problems magnify the inefficient functioning of agricultural sector in India. Variety of measures may be adopted to overcome these problems of Indian agriculture. Some of such measures may be: Farmers may be encouraged to form associations, consortiums, cooperatives and self-help groups which will enhance efficient utilization of resources. Contract farming is a good development towards this direction; marketing facilities for agricultural commodities should be improved; market for agricultural commodities needs to be improved; processing centers should be made more efficient; cautious execution of the model act; formulating and executing effective and relentless agricultural policies to establish favorable environment for rapid development of agriculture; sophisticated warehousing with effectual refrigeration facilities should be established to minimize wastage of agricultural produce; transportation needs to be developed vastly, particularly in rural areas; power shortages have to be urgently addressed by exploring generation of power through non-conventional sources such as solar, wind, etc. Banks and financial institutions should be encouraged to provide financial support to farmers by way of incentives to them for making investments in rural infrastructure and agriculture [115]. These measures may contribute to catalyze agricultural growth in India by improving the supply chain process. Agri-food supply chain management is an initiative towards this direction, which might serve a lot in overcoming problems encountered by Indian agriculture. The problems engulfing Indian agriculture are unique, complex and tough due to presence of majority of them among bulk of Indian agriculturists. Hence, advanced techniques need to be device to address these problems which warrant rapidly changing methodologies, technologies and management practices in the supply chain mechanism [116].

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