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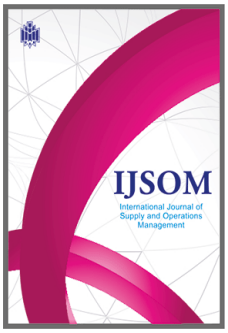

Technological Implications of Supply Chain Practices in Agri-Food Sector- A Review

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Abstract

In the present era, business is in a global environment that compels the enterprises to consider rest of the world in their competitive strategy analysis, despite of location or principal market base. The firms cannot isolate themselves or ignore external factors such as economic trends, competitive positions or technology advancement in other countries. While going truly global with supply chain management, a company develops product in the United States, produce in India and trade in Europe, and they have changed the traditional operation management & logistical activities. This change in trade and the modernization of transport infrastructures have elevated the importance of flow management to new levels. Manufacturers and researchers have noticed many problems concerning supply chain activities. Usually either a system or subcomponent in supply chains is discussed in the literature, but they fails to answer the rational (why, what, how) behind them. An attempt has been made in this paper addressing a review of the principles, bottlenecks and strategies of supply chain practices for organizations to sustain in the global market, with an emphasis on the implications of Indian agri-food sector. Findings of this review reveal that the associated economic benefits in sustainable agri-food supply chains can be achieved through innovation, supply chain collaboration, elimination of uncertainties and introducing global supply chain practices into green and lean initiatives.

Keywords: agri-food; supply chains; sustainability; wastage.

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1. Introduction

Supply Chain Management (SCM) is an integrating philosophy that manages the total flow of a distribution channel from supplier to final consumer. It is a set of activities that promotes an effective management of supplier partnership, meeting customer demands, movement of goods and information sharing throughout the supply network of an industry. Key SCM and logistics practices are related to the managing customer needs, effective delivery of goods, integration, sharing information across the supply chain (Srivastava, 2006). The fundamental difference between food supply chains and others is the continuous and significant changes in the quality of food products throughout the supply chain network (Sloof, Tijskens and Wilkinson, 1996; Van der Vorst, 2000*)*. SCM activities like service, delivery, information etc. are still challenge in the agri-food sector. Furthermore, competitiveness in supply chains has been a key issue for organizations and 'mapping the competitiveness of an organization helps to form a sound basis for business strategies development (Li *et al.*, 2009). Supply chains entail different stakeholders and it is essential to assess them individually so as to measure the performance of entire system. Each stakeholder should intend to turn out in a productive, highly viable and efficient way to produce safe goods and protect the environment. Agri-food industries have to deal with government rules, customer and stakeholders' interest. Reduced costs, wastage elimination and integration in all processes are the fundamentals of their success (Rahul *et al.*, 2013). Alternatively, the diverse characteristics of the sector including the need for short time distribution makes it challenging to establish a unique way of managing supply chains (SCs) in this context (Bourlakis and Weightman, 2007). Strategically, rather than competing within low costs market segments, many agri-food producers are following a differentiation strategy that targets niche market segments like organic foods. Studies have identified that stakeholders such as consumers, retailers, suppliers and regulators are the influential force driving the firms to deem environmental aspects of their business with the financial performance. This has led many agri-food industries to implement a range of sustainable tools like pollution prevention, local sourcing, reuse, recycling, and green purchasing. The research suggests an ever more significant and central role of supply chain management in response to ecological pressures. Kumar *et al. (2013)* recognized the challenges in Indian Dairy Industry supply chain and prospects for govt. organizations to offer standard infrastructures so as to improve dairy SCs efficiency.

However, India is at a juncture where further reforms are urgently required to achieve better efficiency in agri-food processing sector for sustaining growth. There is need to have consistent policies where markets can play a deserving role and private investment in infrastructure may be stepped up. Indian agriculture is broadly a story of success and despite of weather & price shocks, India stands 1st in the production of milk, pulses, jute and jute-like fibres, 2nd in wheat, rice, sugarcane, vegetables, groundnuts, fruits and cotton production, and the leading producer of spices and plantation crops, livestock, poultry and fisheries. But with world's second largest fruit and vegetable producer encounter the wastage of close to 18% worth 7 million US Dollar of its produce. The *DIPP* article on Foreign Direct Investment *(FDI)* in retail projected that against the production of 180 million metric tons a year of fruits, vegetables and perishables; India has the storing capacity of only 23.6 million metric tons in 5386 cold storages in the country. The *Saumitra Chaudhuri Committee* in 2012 indicated that there need 61.3 million tonnes of cold storage space in the country

against the present capacity of around 29 million tons. The country has lost 7.2 million US Dollar worth of food grain in the past 5 years *(Hindustan Times).* Reports by the Institution of Mechanical Engineers reveal that each year 21 million tons of wheat, equivalent to Australia's annual grain production is wasted. Food Corporation of India *(FCI)* reports prove that food grain worth 19.2 million US Dollar was lost in storage, while 17 million US Dollar worth of grain was lost in transit and remaining 1.5 million US Dollar value of food grains were not fit for human consumption *(Business Line).*

As the food chains provides link between primary producers and consumer through intermediaries, so the chain analysis may propose solution to an immense loss of economy in Indian agri-food supply chain (AF-SCs). A typical AF-SC is considered as a complex network of many entities linked from 'Farm to Fork' that compel supply chain actors towards the conflicting goals. It is clear that a lot of awareness exists in narrow-functional segments like purchasing, IT, logistics, marketing, and there appears to be little consent on the conceptual/research methodological bases contributing a lot of gaps in knowledge base of the field. Singh *et al.* (2011) recommended that the use of IT-enabled services by unorganized retailers would make them competitive and strengthen the capabilities to sustain business.

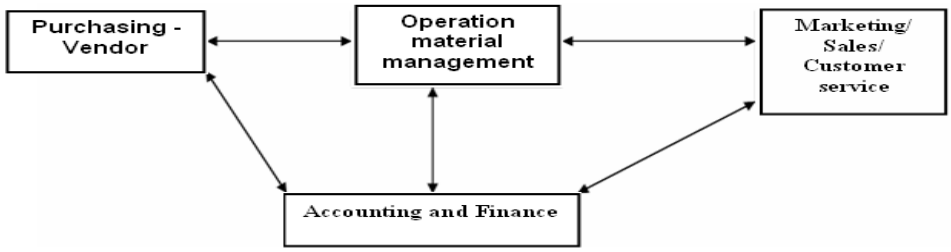

Figure 1. Supply Chain System Integration

Authors have explored the supply chain management in diverse means, and an attempt has been made in this paper to find out the leading conceptual and research methodological dimensions in AF-SCs that can help to trim down the above said food wastage and loss of economy by categorizing the articles, starting from latest (till the paper submission for review) to the nineties. We have selected the review of last 20 years because of two main reasons. Firstly, the economic reforms were initiated in the 1990s in India, and now we want to assess its development, implementation and affects in agri-food sector after twenty years. Secondly, the White Revolution was initiated in 1970s in India with the intension to develop a broad based Cooperative offering technological support to the farmers as well as linking them up with rural and urban markets. But still there exist inefficiencies in food supply chains in India, and we want to assess the focus areas where India lacks.

Section 1 of this paper provides the comprehensive background of SCM detailing the emergence of subject; while Section 2 is the review methodology stating the grouping of previous findings and core principles of the subject along with justification. Section 3 is analysis part including the classification of reviewed articles detailed in preceding chapter with a view to generate common perspective. Section 4 confers to the discussion part of the paper including inter-connections in

the articles, while also recognizing the suggestions to improve agri-food chain development practices. Section 5 presents the conclusion part from the review. Further, an Appendix- I is also given at the end of this paper to list down the details of all the reviewed articles.

2. Review Methodology

Literature review is a research methodology, and content analysis of the historical papers/literature has been applied in this paper so as to create replicable and valid implications from the contents for their application (Krippendorff, 2004). Content analysis is a scientific method for briefing, quantitative analysis of messages, many words of text into fewer content groupings based on explicit coding rules (GAO, 1996; Weber, 1990). Holsti (1969) defines content analysis as a technique for building inferences by objectively and scientifically identifying specific characteristics of messages. Thus, content analysis is a research tool that determines the presence of certain words or theories within texts or a set of texts. In this paper, the target population is the published articles on various databases, followed by the sampling procedure.

In order to facilitate a clear line-of-sight of information basis and outline of the previous research findings and methodologies, a sample size of 145 articles has been taken followed by the deductive approach in selecting and evaluating the body of literature on AF-SCM. The search for publications within the defined boundaries has been executed on the scientific databases like Springer, Taylor & Francis, Web of Science, Open access Journals, Emerald, Science direct and Scopus using the article title, abstract fields and keywords field. The database search offered numerous articles that have been reduced to 145 by applying the limiting criteria such as the year of publication, subject areas, Journals and document type (Mor *et al.*, 2016). All the selected articles were further integrated into the defined framework of four categories of variables i.e. descriptive features, definitional issues, theoretical concerns, and research approaches (Table-1) for the conceptualization and methodological analysis.

2.1 Coding and Categorization

Categorization of the content is very important in content analysis, which is defined by Sarantakos (2005) as a set of criteria or standard that is incorporated about a theme or value. Categories used in the content analysis are supposed to be very clear and should enable other researchers to have identical outcomes while re-examining the same data with defined categories (Fraenkel and Wallen, 2005). The four categories in this paper are determined by probing the literature, reviews and researches in AF-SCM. After accumulating the research topic categories from the study of Burgess *et al.* (2006), a codebook has been developed to employ as a coding instrument. Codebook is an instrument that includes all of the operational definitions of variables (Neuendorf, 2002). All the selected articles were further integrated into the defined framework of four categories of variables i.e. descriptive features, definitional issues, theoretical concerns and research approaches for the conceptualization and methodological analysis (Table1).

Table1. Literature Review Classification Framework

Sr. No.	Grouping	Content covered	Basis
1.	Descriptive Features	Title, country, industry, year, sector, Journal	Express the features of sample articles
2.	Definitional Issues	Approaches, conceptual framing, constructs, discipline, process	Discover stability or variation in SCM definitions to various dimensions. Classify the area that researchers argue falls in SCM.
3.	Theoretical Concerns	Purpose, strategy, range, application, function	Establish the range of theories used to enlighten SCM and their applications.
4.	Research Approaches	Modelling, hypothesis, case study, research methods	Determine the assumptions and research methods used to define SCM.

Reference: Burgess, Singh and Koroglu (2006).

Particularly, the grouping 1 provides an examination of the sample articles/theories expressing its features and trends in literature like title, year of publication, industry/sector to which the study is applied etc. Grouping 2 discovers the area of supply chains covered by researchers from a range of perspective using either new or existing organizing designs, processes employed etc. Grouping 3 also illuminates the literature dealing with the issues more or less related to the theoretical bases such as strategies applied or the purpose of study, application of research and its scope etc. Finally, Grouping 4 examines the issues associated with research methodology and assumptions, hypothesis, modelling etc.

2.2 Validity and Reliability

Validity may be stated as the degree to which a measuring method represents the intentional or it is the quality of research results that directs us to suppose them as realistic. External validity is associated to whether the sample of study corresponds to the population or not (Neuendorf, 2002; Krippendorff, 2004). In this paper all the population i.e. articles integrating agri-food supply chain practices in diverse continents is included and hence the external validity is assured. Next, the face validity is confirmed that whether the instrument measures exactly what it is planned to assess or not, and agrees with the results if reasonable (Neuendorf, 2002; Krippendorff, 2004). The category table has been checked by the experts, researchers whether it is sufficient to assess the intended figures, and content validity is controlled. An instrument has content validity if it covers all aspects of the subject which it is intended to assess, and hence the defined categories' content validity has been checked by an academician.

Weber (1990) confirms that the categorization procedure must be reliable to make valid inferences from the wordings, and reliability issues occur due to the ambiguity of word meanings or category definitions. It is also required to measure the intercoder reliability of content analysis i.e. the amount of concurrence among two or more coders, and a reliability subsample must be assessed randomly to assess it (Lombard *et al.,* 2002; Neuendorf, 2002). Then, coders have to code the documents as indicated in the categories, and also the level of agreement between them needs to be measured. Some measurement techniques for intercoder reliability are Percent agreement, Scott's pi, Holsti's method, Krippendorff's alpha and Cohen's kappa (Uysal and

Madenoglu, 2015). Percent agreement method has been used in this paper to measure the intercoder reliability, by simply adding up the coded cases in the same way by the three raters and dividing by the total number (Mor *et al.*, 2016). Finally, the intercoder reliability obtained in this paper is 86% and thus the data can be deemed as reliable.

3. Analysis

The selected articles were integrated into a framework based on various dimensions which classify them into four discrete, yet rationally ordered, groupings initiating with least complex perceptions and advanced research issues, and categorized in the following way:

3.1 Grouping 1: Descriptive Features

The articles review shows that over hundred Journals covering various disciplines were captured and out of them the Supply Chain Management: An International Journal (16), European Journal of Operational Research (8), International Journal production economics (5) and International Conferences on supply chain management (7), accounted for 35% of the total studies with 54% studies having special emphasis on agri-food. Whereas, the remaining literature appears to be focused in other sectors like consumer goods retailing, manufacturing, computer and information technology (IT), service sectors etc. and based on these explanatory feature the reviewed studies are categorized as below:

Ehlers *et al.* [25] intended the supply chain orientation in small & medium enterprises (SMEs) as a general attitude and common goal orientation to cooperate the conflicting goals; Fischl *et al.* [29] viewed the existing knowledge of price risks management in manufacturing companies to protect both stable prices and access to natural resources; Fleming *et al.* [30] examined the stakeholder perceptions in climate change impacts and adaptations in Australian aquaculture sectors which typically occurs at the isolated links in supply chains. Kassahun *et al.* [61] identified the technological needs for meat SC transparency systems via a reference software architecture (EPCIS cloud-based recognition of transparency methods & principle of tracking/tracing); Lee *et al.* [70] studied the partial least square-structural equation modelling (PLS-SEM) for green SC practices in correlation with technological innovation in manufacturing; Tsolakis *et al.* [125] offered a natural hierarchy of decision-making for AF-SCs focusing on developing integrated approaches for SC optimization. Arabatzis *et al.* [6] suggested an environment-oriented production model of forests via mixed integer linear programming and Lagrangian relaxation algorithm where the extreme fuel-wood demand may increase more expected rate than the traditional; Boudahri and Sari [16] offered an approach for poultry products SC planning, redesigning and optimizing the distribution to improve total cost and ecology. Kaloxylos *et al.* [60] presented the smart agri-food architecture for building an integrated food chain by a software modules called ‘generic enablers’; Lu and Bowles [72] suggested that nanotechnology can address the complex technical issues of AF-SCs like serious ethical arguments, human/environmental issues, food quality and security.

Sharma *et al.* [109] recommended the strategies for sourcing, collaboration, procurement and distribution of SC of rice in India; Verdouw *et al.* [129] assessed the floricultural sector to contribute the gaps & future challenges concerning SC virtualization; Bao *et al.* [10] proposed a

strategy based on e-commerce service platform to harmonize production & circulation of fruits/vegetables. Pachouri [89] studied the inefficiencies in Indian agri.-value-chains to ensure food availability and sustaining rural livelihood that leads to low income to farmers & high inflation in food-prices; Rong *et al.* [97] provided a methodology to model food quality degradation integrated in a mixed-integer linear programming model of production/distribution. Akkerman *et al.* [4] reviewed the quantitative operations management approaches to food distribution in three decision levels: strategic network design, planning and effective transportation planning. Figure 2 categorizes the percentage of reviewed studies with respect to the year of publishing.

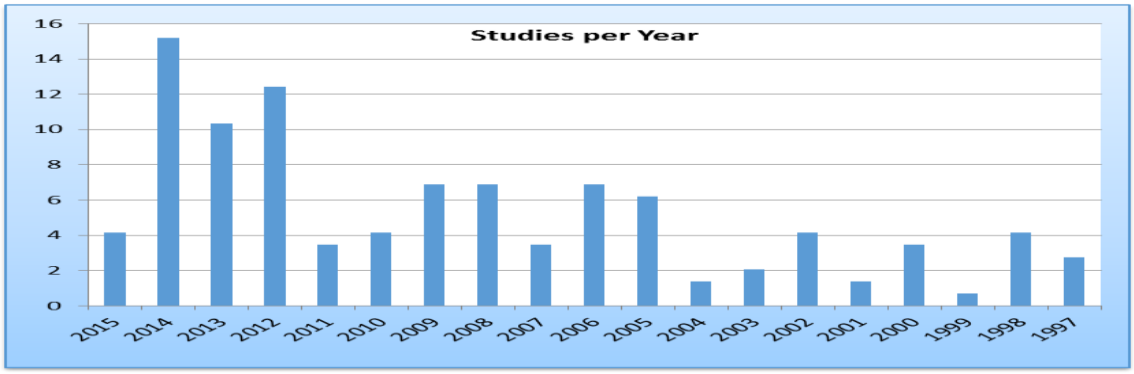

Figure 2. Classification for Year-wise studies

Sastry [103] studied the implications of nanotechnology for agri-food sector in India to enable a rational assessment of its potential applications; Verdouw *et al.* [130] presented a reference model for designing business process in demand-driven supply chain of fruit with reuse of generic knowledge in cross-industry standards. Ahumada and Villalobos [3] reviewed the agri-food in production and distribution planning which often fails to incorporate realistic stochastic and shelf life features; Blengini and Busto [15] analyzed the life cycle approach in Italian AF-SCs and the organic farming characterized by heavier impacts (þ20% of GWP) due to lower production yield. Frentrup and Theuvsen [34] considered the information systems in implementing infrastructure, transparency and their interplay with behavioural aspects for AF-SCs; XiangyuGuo [137] stated that the govt, enterprises and international trends should aim at 'Quality First, Credit Best' and strengthen the mechanism construction to implement scalization & standardization. Sagheer *et al.* [100] analyzed the competitiveness of India's agri-food chain and the role of human & non-human components exploring the synergy of value chain analysis (VCA); Verloop [132] described 'the living lab approach' for organizing the information integration in agri-food chains as fundamental ingredient; Hanf [48] offered a review of verticalisation where retailers can be regarded as drivers of AF-SC integration (Figure1). Figure 3 categorizes the percentage of reviewed studies with respect to continents.

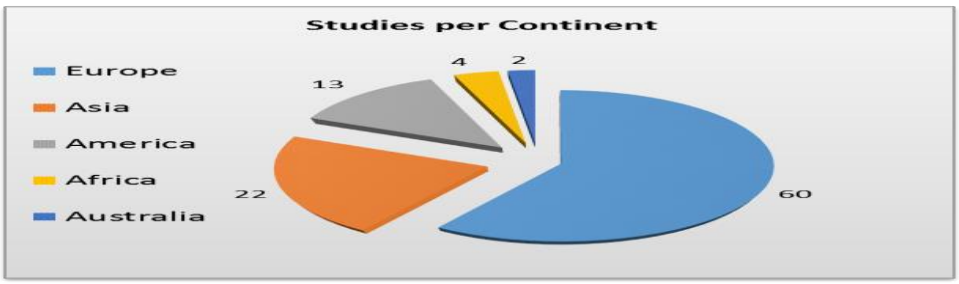

Figure 3. Classification for Continent-wise studies

Niederhauser *et al.* [84] illustrated an internet-based coffee information system (CINFO) that enable farmers to demonstrate the variation in coffee quality due to distinct management; Mariani [75] emphasized on environmental pollution and climate change that threaten agri. productivity and food produced in this way is transport-intensive involving high energy processing and relies on high-tech retailing system; Matopoulos *et al.* [76] analyzed supply chain collaboration and its importance for agri-food industry irrespective of products & structure constraints. Aramyan *et al. (2005)* presented a conceptual framework for the selection of AF-SCs performance measurement indicators as efficiency, flexibility, responsiveness and food quality; Opara [88] highlighted the technological challenges in implementing traceable AF-SCs and developed the measurement tools for food product labelling and identification; Trienekens *et al.* [123] discussed the AF-SCs in developing countries as a challenge to investigate innovation and its effects on social economic-environmental-technological development. Barjolle [11] proposed a methodology for optimizing AF-SCs and concluded that specific supply chain can lead firms towards success; Jarosz [57] indicated the role of actor network theory & SCM theory for understanding the social relations of trust and cooperation in regional agri-food systems in United States; Rademakers [94] showed that in spite of the ongoing internationalization of agri-food markets, nationally distinct ways of facilitating trust development continues to exist. Figure 4 categorizes the percentage of reviewed studies with respect to the sector/area.

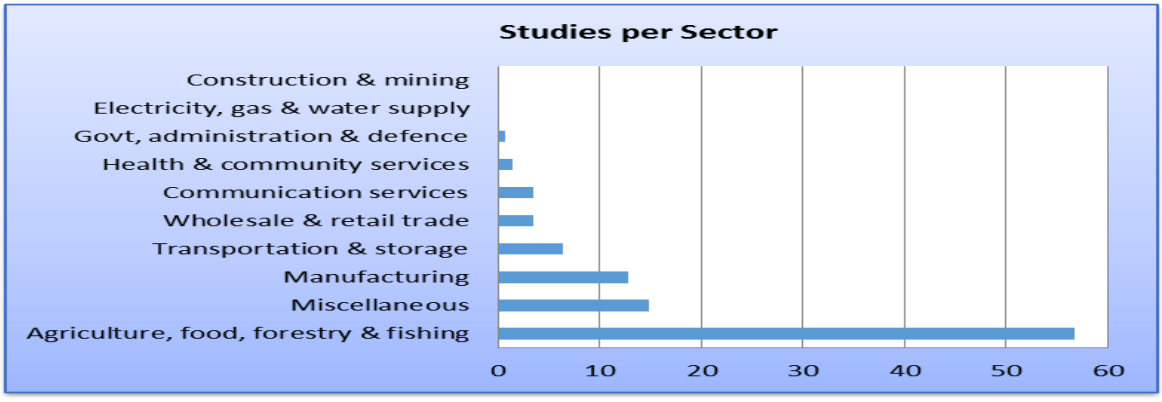

Figure 4. Classification for Sector-wise studies

Lambert and Cooper [65] suggested that the structure of activities within and between companies is vital for creating superior competitiveness and profitability; Leat *et al.* [68] summarized how Scottish agri-food industry develops farm and quality assurance activities of 'insights from

industry' to assure if products are produced in welfare friendly system. Vorst *et al.* [135] investigated the impact of AF-SCM on logistical performance indicators in conjunction with optimizing its internal control design and eliminating uncertainties; Folkerts and Koehorst [33] focussed on the vertical coordination of SCs to improve the competitiveness of European agribusiness and the need to redesign SCs; and Loader [73] expressed the implications of transaction costs for agri. marketing, integration and diagnostic investigation of individual relationships.

3.2 Grouping 2: Definitional Issues

There appears a little compromise on various supply chain management definitions with either a broad view that are perceptible and further classified in this review. A more precise investigation of the relationships in SCM definitions exposed that about 50% of the articles have surrounded within the definitions, key concepts concerning the flow of information and material across associations (Figure 5). Out of the publications, three definition were proposed by Taylor; three by Leat and Giha [66], [67], [68] for collaborative agri-food supply chains; three by Verdouw, Beulens and Vorst [129], [130], [131] relating the virtualization of floricultural supply chains; two by Aramyan, Lansink and Kooten [7], [8] for performance measurement framework; two by Gunasekaran and Ngai [45], [46] linking the information systems in SCs; and two by Hobbs concerning the competitiveness in supply chains, and others proposed avoiding reference to other sources. A conceptual framework was also developed to classify these reviews, which show that 37 percent of the articles framed SCM as a process, 18 percent as a system and 9 percent as a simple activity, and based on definitional issues, the reviewed studies are categorized as:

Drohomeretski and Lima [23] identified the motivating factors and difficulties in implementing green SCM that are directly linked to cost reduction, meeting demands & supplier's resistance; Hoejmose *et al.* [53] argued that institutions are significant predictor of the tendency to implement 'green' practices while coercive & cooperative practices are driven by substantially different factors. Hudnurkar *et al.* [54] reviewed the SC collaboration, identified 28 factors affecting information sharing and addressed the research gap for reduction in bullwhip effect; Iakovou *et al.* [56] presented a methodological agenda to increase farmers' income and reduction of operational cost through optimizing farming operations. Pereira *et al.* [91] studied the role of procurement in identifying the inter-organizational issues affecting SC resilience and integration; Shokri *et al.* [111] investigated the level of concern, practices and policy failure of AF-SCs sustainability and found significant differences among policy makers, consumers and SC partners. Caniels *et al.* [19] presented a framework for supplier participation in green ideas by examining the customer needs, supplier willingness and relational norms; Jarzebowski *et al.* [58] focused on the theoretical background showing foundations and emerging evidence of a positive relationship between SC integration and performance of company. Jraisat [59] explored the drivers of information sharing between producers and exporters that revealed the linkages between both to extend the extant theory; Li *et al.* [71] analyzed the double marginalization effect in a decentralized SC and developed coordination schemes for deterministic & random demand case of supply insufficiencies; Mutingi [81] explored the empirical green SC activities through a taxonomic framework and categorized GSC strategies into compliance-based, eco-efficient, innovation-centred and closed-loop; Abbasi and Nilsson [1] explored the challenges in making

SCs environmentally sustainable where social issues should be treated in same way as revenues and costs are today.

Fayezi *et al.* [26] highlighted the status of agency theory applications that provides valuable insights for relationship engineering within SCs where social, political, legal and behavioural dynamics dominate; Giha *et al.* [41] discussed the effects that supply chain organization might bring on innovation and sustainability where farmers have the possibility to build in risk management within SC collaboration; Gimenez and Tachizawa [42] concluded that the firms must devote the resources, management support and performance measurement to extend sustainability along supply network. Gold [43] concluded that conducting business operations at the base of pyramid (BoP) have necessitated the multinational corporations to involve poor communities in production processes for sustainability; Lee *et al.* [69] deliberated the rise of private food standards as a barrier for smallholders in the developing countries and impact of lead firms to strike an equilibrium among economic, social & environmental well-being of farm-to-fork chains. Odeh and Smallwood [86] discussed the effects of sustainable supply chain management (SSCM) and the barriers to clarify ambiguity along with the importance of technology systems; Ojha [87] implemented the real life demand SC to observe the product usage model, discovered high demand zones and drawn out supplier reliability factors along with the product cost to benefit ratio. Seman *et al.* [106] focussed on green SCM development in developed and developing countries for environmental and social sustainability of implementation including drivers, practices and performance; Tompkins and Eakin [122] reviewed the actors supplying adaptation services for under-explored case of adaptation and defining the features of the public goods.

Nie *et al.* [85] provided an overview of opportunities and challenges for implementing SSCM in order to reduce carbon footprint and ensure collaboration and transparency throughout the chain; Rota *et al.* [98] extended the scope of food chain life cycle analysis and collaboration as the organizational pillar of sustainability assessment; Gunasekaran and Ngai [45] reviewed the build-to-order (BTO) and make-to-order (MTO) supply chains for providing motivation to design, develop and manage them effectively. Hammoudi *et al.* [47] directed the theoretical models of industrial organization and international trade, as well as quantitative analysis to understand markets functions and stakeholders interaction; Monteiro and Anders [80] developed a framework to tackle firm size, certifier effort & cost difference issues in credible third-party certification services of vertical food supply chains, where quality of certification may be affected by the number of heterogeneous standards. Nereng *et al.* [82] aimed at creating more efficient supply chains through increased information exchange and redesign of planning/controlling models to mend embodied greenhouse gas (GHG) emissions originating from LCA over transport; Reynolds *et al.* [95] suggested that the relationship sustainability can be negatively affected by abusing more powerful market positions in German AF-SCs, as the significance of determinants differ across chain stages; Lakhal *et al.* [64] concluded that switching to organic production may offer potential advantages over conventional like low expenses, varied sources of returns and improved soil.

Smith [113] reviewed the opportunities for food businesses towards nutritious diets, invest in sustainable systems and develop procurement systems; Tummala and Schoenherr [126] proposed

the conceptual integrated implementation-decision framework for SCM consisting of goals, enablers and the defining operational activities. Bijman *et al.* [14] presented the practical insights for issues of governance, role of power and interaction between horizontal and vertical collaboration in international SC as hybrid chain governance structures; Burgess *et al.* [18] identified the characteristics of SCM, research methodological bases and describing from knowledge perspective. Mentzer *et al.* [78] provided the comprehensive assessment of GSCM, emerging developments and their significance where 'understanding global supply chains' provides general insights into green issues; Storey et al. [115] critically assessed the SCM developments and identified the key barriers and enablers to supply management; Taylor and Fearne [118] focussed on improving demand management in retail AF-SCs for reducing the variability of final & linking demand data more directly with production decisions. Burch and Lawrence [17] explained the issues of private regulation like supermarket in any re-formulation of food regime dynamics representing a shift to third-food regime; Helms and Sarkis [49] clarified the GSCM performance measurement issues for organizations to explicitly consider the ecosystem in their strategic planning.

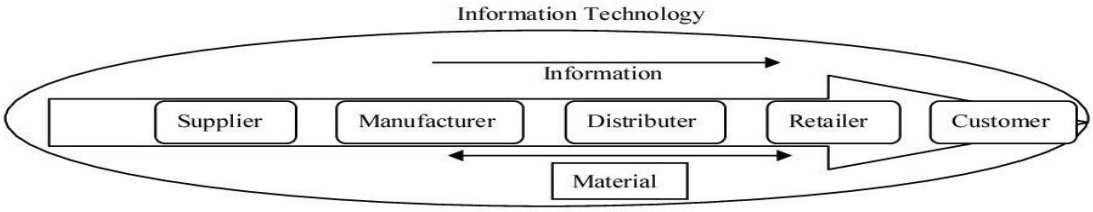

Figure 5. Transforming Supply Chain Flow

Stadtler [114] aimed at extracting the essence of SCM and advanced planning for interdisciplinary research incorporating computer science, accounting and organizational theory. Croom *et al.* [21] laid down a framework for SC categorization where theoretical development is critical to establish and literature is empirical-descriptive of a cognate SCM discipline; Hobbs and Young [52] explored the shift towards closer vertical coordination in AF-SCs focussing on contracting & impact of supply chain drivers on transaction costs; Andersen *et al.* [5] represented an edition to enable industrial partners to learn from best practice and analyze their own processes; Salin [101] discussed the differences between supply chains of functional V/s innovative products where the challenge for management is to decide how to classify their product and economic concentration and to accommodate multi-food businesses via good information systems. Singh [112] examined the performance of contract farming and vertical SC Coordination across crops and suggested the supports of contract arrangement like Coordination, motivation, transaction costs and contract design; and Verdouw *et al.* [131] discussed the process modelling framework to enhance the interoperability & agility of information systems required in dynamic SCs.

3.3 Grouping 3: Theoretical Concerns

Popper *et al.* believed that theory development is a crucial constraint for the development of any field; however some researchers propose that theories should be built upon existing ones. In order to comprehend SCM, the articles were analysed to ascertain whether the theories existed or new ones. Comprehensive list of reviews with existing theories were offered in diverse aspects such as

economics, application, information, strategy, strategic management, CSR, sustainability, psychology, sociology and physiology, functions etc. Based on these theoretical concerns the reviewed studies are categorized as below:

Dabbene *et al.* [22] analyzed how traceability influences the modern supply chains in subsequent optimization principles; Garg *et al.* [37] conferred the integration of trade and technology through ERP implementation Indian AF-SCs focusing on communication for quality assurance and tracking or tracing capability; Gava [38] investigated the contribution of supply chains for economic, social, health, environmental and ethical performance as well as their reliability in assessing food-chain sustainability. Parwez *et al.* [90] explored the SC dynamics of Indian agriculture, highlighted the current status of infrastructure and examined the critical issues at each sub-system; Tseng *et al.* [124] explored the differences between close-loop and open hierarchical structures used in analytical network process (ANP) analysis of GSCM under uncertainty. Dües *et al.* [24] confirmed that lean is helpful for green practices and its implementation consecutively also has a positive control over lean business traditions; Sharma *et al.* [108] recognized the conceptual link between SCM & quality management; Netland *et al.* [83] proposed an integrated manufacturing planning to coordinate with customers & suppliers to achieve end-to-end integration across chains and argued that the true lean AF-SC discussed by Taylor is yet to be realized. Vaart and Donk [128] analyzed the survey-based research for SC integration and its impact on performance which should be focused on the buyer-supplier relationship itself, not on focal firm.

Hugg and Katajajuuri [55] analyzed the corporate social responsibility (CSR) of food supply chains for environmental issues where companies seems committed to goals and provide product specific information on CSR issues. Schulze *et al.* [105] developed a measurement scale for relationship quality in procurement via cross-industry comparison to improve collaboration where relationship quality must be conceptualized as a construct of agreement, trust and dedication; Taylor [117] highlighted the opportunities for strategic change in AF-SCs and concluded that the value chain analysis along with lean principles can improve the efficiency of pork chains both operationally & strategically. Gaffney [35] supposed that lean can optimize the supply chains performance as it makes the SCs to move optimally, reduce inventory and increase sale; Manthou *et al.* [74] identified the company's perception of perceived benefits, constrained and motivation factors towards internet-based applications, however they still use traditional ways; and Meixell and Gargeya [77] reviewed the decision support models & practical issues of global SC design where a few models addresses the problems which need emphasis on multiple production and distribution tiers. Gunasekaran and Ngai [46] identified the importance and recommendations to develop a framework for studying the applications of IT in supply chains; Peterson [93] synthesized SC and knowledge management in order to suggest the possible evolutionary step in supply chain integration; Roekel *et al.* [96] reviewed the SC development in developing countries and indicated that food safety and social accountability touch upon the responsibility and mandates for public-private-partnership (PPP) models.

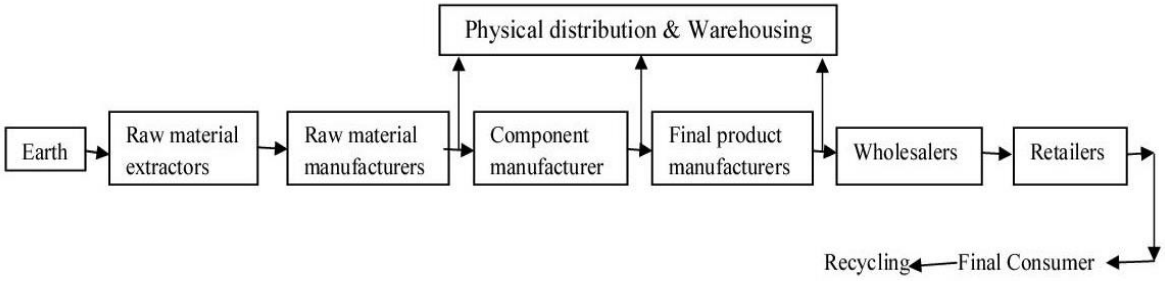

Figure 6. Supply Chain Process

Schiefer [104] incorporated the environment and principal management loop of integrated processes for implementation in SCs with a lower level of Coordination intensity along with environmental, economic and quality assurance objectives (Figure 6); Subburaj *et al.* [115a] studied the issues in improving the operational efficiency of the dairy supply chain in Tamilnadu, and emphasized the role of Policy makers to create special dairy zone and implementing dynamic milk procurement methods;Vorst *et al.* [134] presented a qualitative research approach to supply chain redesign where uncertainties in decision-making can result in non-value adding activities; Tan [116] reviewed the development of SCM from of eventually merged strategic approach to operations, materials and logistics management. Beamon [12] paid attention on the performance, design and analysis of supply chain as a whole due to rising costs, shrinking resources, shortened product life cycles and globalization of market economies; Wilson and Clarke [136] illustrated the possible mechanism for developing a software system to become 'de-facto' industry standard for collation dissemination of traceability data through Coordination and Rationalization.

3.4 Grouping 4: Research Approaches

Studies can be tested using the shape and form of the subsequent knowledge generated assuming scientific method, empiricism, views, phenomena, relationships and modernism. For this study, the framework consisting functionalism, radical humanism and radical structuralism was employed, and based on these research approaches the reviewed studies are categorized as below:

Accorsi *et al.* [2] emphasized on the sustainability and compared a multi-use system to traditional single-use packaging system to quantify the economic returns and ecological impacts of reusable plastic container (RPC); Chandel *et al.* [19a] determined the competitiveness and power exercised by different players, and to understand the complexity of inter-linkages in the value chain through VCA; Cosimato *et al.* [19b] investigated the role of emergent green technologies in making logistics organizations finally green and competitive through SEM technique; García *et al.* [36] considered the site selection problem in manufacturing and agribusiness using multi-attribute methods to evaluate optimal locations of new warehouses by analytic hierarchy process (AHP). Gualandris and Kalchschmidt [44] investigated the relationships among sustainable process and SCM, customer pressure and innovativeness through partial least squares (PLS) and showed that customer pressure is an essential driver that motivates firms to begin and sustain SSCM; Kumar [63] examined the relationship between dairy supply chain management (DSCM) and operational performance via paired samples 't-test' to find out the difference in agreement & adoption level and multiple regression analysis; Todorovic *et al.* [121] presented an initiative to recurring

problems in shipping perishable goods through RFID technology alongside integrated sensors for building the system from routine customs inspections to robust transfer procedures between producer and customer. Costa *et al.* [20] provided an outline of opportunities and constraints for RFID adoption in agri-food with an analysis on its development for diverse product typologies; Folinas *et al.* [31] presented a systematic approach for determining wastage in AF-SCs through value stream mapping (VSM), where global SCM in green and lean equation increases the potential conflict across organizational boundaries; Teimoury *et al.* [120] investigated the perishable SC where the best import policy helps to reduce undesired price changes in case of different scenarios for demand and supply.

Filcek and Józefczyk [27] presented a heuristic algorithm solving joint problems of allocation and transportation in a three-stage supply network of sugar beets processing that minimizes production time; Seuring and Gold [107] elaborated the content analysis as an effective tool for conducting literature reviews neglecting the detailed description of data gathering; Usuga *et al.* [127] suggested the Coordination of chains based on shared information as vendor-managed inventory strategy for farmer-buyer relationship. Zhang and Li [139] analyzed application strategies of RFID and AF-SCs that typically starts on farms involving many facilities producing value for the customer; Mercer [79] identified the challenges facing development within agri-food sector and found that the inadequate education and poorly developed local technologies contributes plenty of barriers, and food processing activities are often found to be labour-intensive and time-consuming. Lemma *et al.* [70a] investigate the determinants of supply chain coordination of milk and dairy industries by employing the Confirmatory Factor Model; Shekari *et al.* [110] studied the GSCM issue in an alloy steel industry through questionnaire to gather decision maker's opinions for environmental activities for a six-factor measurement model; Zarei *et al.* [138] directed the FSC to identify the viable lean-enablers in increasing the leanness of food chain and employed the fuzzy logic to deal with linguistic judgments expressing correlations in QFD.

Bigliardi and Bottani [13] developed a balanced scorecard (BSC) model for performance measurement in FSCs that could serve as a reference for food industries in establishing applicable performance appraisal indicators; Hennet and Arda [50] evaluated the efficiency of contracts between industrial SC partners and believed that decentralized decisions are generally less efficient in enterprise networks than centralized mechanisms maximizing the global utility function. Leat and Giha [67] explored the AF-SCs integration issues through structural equation model (SEM) and an in-depth case study in eastern England; Aramyan *et al.* [8] engaged on SC performance measurement which allows for 'tracking & tracing' of efficacy and efficiency failures, and identified the performance measures as efficiency, flexibility, responsiveness & food quality; Banker and Mitra [9] provided a case study of an online coffee auction in India to increase price obtained by planters and allowing the commodity to sell directly to buyers resulting a reduction in planters transaction cost. Sarmah *et al.* [102] reviewed the buyer-vendor models as a Coordination mechanism under deterministic settings that leads to savings in the system and SC performance upgrading; Taylor [119] presented a value chain analysis with an assessment of the validity of research followed by suggestions for improving demand management in AFCs; Georgiadis *et al.* [39] offered guidelines for strategic modelling methodology of single and

multi-echelon FSCs and analyzed the key issue together with the capacity planning policies and transient flows due to market constraints. Sachan and Datta [99] demonstrated the rise in direct observation methods like Case Studies to expand the limited set of worn out paradigms that contribute substantially in advancing the logistics theory.

Pereira and Csillag [92] verified the established system of poultry SC in Brazil and showed that the productive SCM model used by large industrialized poultry products producers seems to have a significant impact; Filho *et al.* [28] derived a model through postal survey of supply chain partnerships in UK fresh produce industries to assess the intangible pre-requisites, tangible enablers and benefits from the factors that enable successful SC partnerships. Gigler et al. [40] offered a methodology for the optimization of AF-SCs by dynamic programming (DP) dealing with the appearance and quality of products and stated that the models describing quality development can be included into DP methodology as a function of process conditions; Kuei and Madu [62] identified the critical success factors of SC quality management in Taiwan's Computer & Electronics Industries and showed that firms emphasizes on supplier relationship & IT driven changes. Hobbs *et al.* [51] made an assessment of the competitive weaknesses, strengths & opportunities facing Danish pork supply chains where success is achieved by a direct approach to manufacture high quality products tailored to market needs; Vidal and Goetschalckx [133] offered reviews on strategic production-distribution models along with the virtual logistics that benefits the current advances in IT & rapid changes in global economy leading to homogenization of international scenario.

4. Discussion

Based on the comprehensive review, it is likely to discuss the issues of conceptualization, research and development of the field, and evaluate the impact of the varying trends in supply chain. The reviewed strategies can assist in smoothening the agri-food supply chain practices, and their applicability in Indian context is discussed below.

4.1 Comparison of the Studies and Applicability in Indian context

From comparison viewpoint of the reviewed articles, it is clear that:

- European authors have directed on the sustainability and green supply chain issues through achieving coordination, competitiveness and transparency in conjunction with the application of effective information technology in supply chains. Out of the reviewed articles, majority of the studies are Europeans, contributing about 60%.

- Asian authors shows that the economic inefficiencies and quality in AF-SCs can be improved by means of innovation, integration and collaboration of supply chains along with better farmer contact programs and an e-commerce platform with an advanced technology like RFID. Out of the reviewed articles, Asian studies are contributing about 22% in this paper.

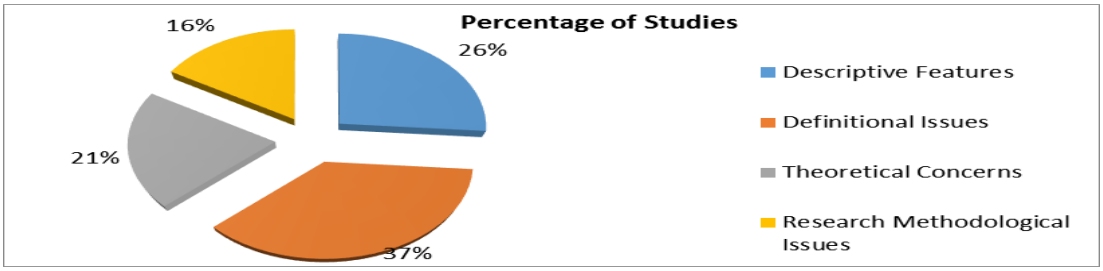

Figure 7. Percentage of Reviewed Studies Grouping-wise

- American authors have directed towards global value chains & standards, design & planning models and vertical coordination of supply chains. Figure 7 shows the percentage number of studies reviewed as per the four classification frameworks considered in this paper. Out of the reviewed articles, American studies are contributing about 13% in this paper.
- African authors concentrate on the organizational issues and challenges for developing green supply chains and the benefits of organic farming over the conventional. Out of the reviewed articles, a few are from African studies, about 4% in this paper.
- Australian authors have intended the climate change risks and adoption of green supply chain practices highlighting the status of agency theory applications. Out of the reviewed articles, very few are from Australian studies i.e. about 2% in this paper.

All the reviewed articles points towards the development of efficient, sustainable and productive supply chain practices, and there are inter-connections in the studies. Out of the reviewed articles, three were proposed by Taylor and three by Leat and Giha for collaborative agri-food supply chains; three by Verdouw, Beulens and Vorst relating the virtualization of floricultural supply chains. Two studies are explored by Aramyan, Lansink and Kooten for performance measurement framework; two by Gunasekaran and Ngai linking the information systems in SCs; and two by Hobbs concerning the competitiveness in supply chains, and others proposed avoiding reference to other sources. The conceptual framework developed to classify the articles shows that 37 percent of the articles framed SCM as a process, 18 percent as a system and 9 percent as a simple activity, and based on definitional issues. Further, we have come to wrap up with some solutions to the issues of wastage and an enormous loss of economy, in conjunction with the role of govt. in developing the efficient agri-food supply chain in India, as below.

4.1.1. Problems with India's Agri-Food Supply System

India's agri-food supply chains could uncover the reasons why agri-food grown in the country goes to wastage. Figure 8 shows the broad picture of agri-food supply chains against a required level in India to be more productive and achieve leanness.

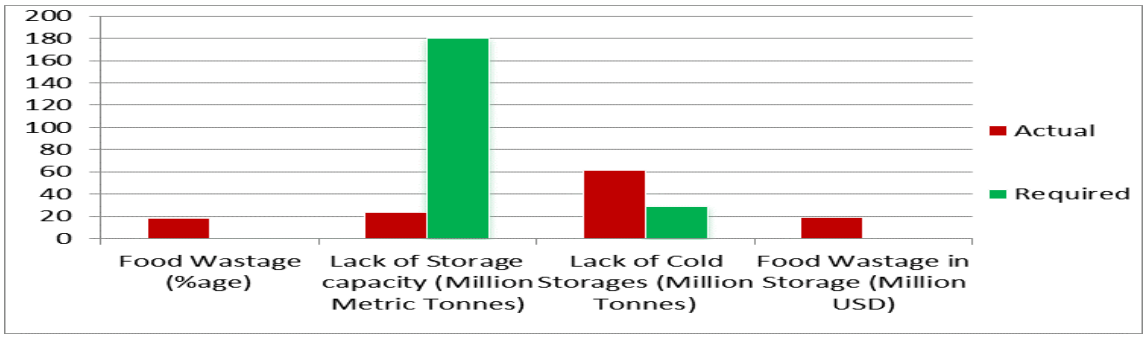

Figure 8. Agri-Food Supply System in India (Source: Reports)

The significant contributing factors to agri-food spoilage problem in India may be the:

- Infrastructure,
- Purchase and Distribution Schemes,
- Middlemen and Bargaining Power,
- Price Volatility etc.

Further, the technological solutions and innovative entrepreneurial policies may escort the possible impacts on current supply chain practices to develop:

- Low-cost Infrastructure,
- Affordable methods to Process and Protect Food,
- Enhanced Transparency of Information Systems.

4.1.2 Role of Government

Governments can add the sustainability factors and improve the environment for agri-food supply chain development through:

- Organizing the platform for public-private actors for information exchange,
- Investing in communication, transportation,
- Offering incentive schemes for the sustainable use of resources and high risk investments
- Ensuring the availability of information (production, price, industry) and statistics so as to monitor the market progress.

5. Conclusion

From the comprehensive literature assessment, it is concluded that the safety, quality and associated economic benefits in sustainable agri-food supply chains can be achieved through innovation, supply chain collaboration, elimination of uncertainties, introducing global supply chain practices into lean and green initiatives. An integrated supply chain with the aim of bringing excellence and professionalism in decision making can considerably improve the effectiveness of agri-food sector. Although SCM is a more generic term applicable in all sectors; but seasonality, variability, perishability, traceability and small-scale production are the concerns that distinguish the agri-food supply chains from others.

In the above context, the managers in agri-food sector need to develop a thorough supply chain responsiveness focusing on skill building and information required for meeting the emerging challenges. Further, the regulations and public policies also have a considerable role in influencing agri-food supply chains. Finally, the research methodological approaches revealed in the reviewed studies can also assist Indian agri-food supply chains to attain a level of competitiveness and leanness.

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