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## Sustainable Paradigm for Artificial Intelligence powered Agribusiness Supply Chain

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### Abstract

Artificial Intelligence (AI) techniques propose important contributions to knowledge model's identification, service creation and the decision-making processes as support for the different Agri-Food's applications. AI offers formal general algorithms for prediction, accuracy and performance evaluation as well as pattern classification that might solve knowledge issues in the agricultural domain such as the pest's identifications and the correct treating methods. In addition, AI supports applications in farming techniques development, land allocation regarding the targeted activity, irrigation process analysis and control, robot guidance etc. in addition, Q.R. Code, Finger print, Bar Code, Card scanner, Biometric system, Tagging etc., provides accuracy and authenticity in supply chain.

**Keywords:** *Artificial Intelligence, Agri-Food, Supply Chain*

## Introduction

Supply Chain Management has to play a key role in rural market of India, contributing to improved relationship with suppliers and customers and income generation. Managing the supply chain has become a way of improving competitiveness by reducing uncertainty and improving service. Industry seeks to highlight the importance of managing the Supply Chain and logistics in Indian rural markets to deliver goods and services in a cost effective manner.

In India, approximately 60% of food quality is lost in the supply chain from the farm to the final consumer. Consumers actually end up paying approximately about 35 percent more than what they could be paying if the supply chain is improved, because of wastage as well as multiple margins in the current supply structure. The farmer in India gets around 30 percent of what the consumer pays at the retail store. Compare this with the situation in developed countries, where farmers may receive up to 70 percent of the final retail price and wastage levels are as low as 4 to 6 percent. One can easily understand the benefits that could be generated from emulating those practices and tapping that expertise for the supply chain in India.

Indian agriculture has the potential to dominate the global markets provided post-harvest losses are minimized and the link between farmers and other stakeholders can be established through ICTs. This paper describes the opportunities and challenges of agricultural supply chains in India, and explores how ICTs can facilitate the building of linkages between farmers and markets thereby increasing efficiency across supply chains. In addition, discussing the critical success factors (CSFs) which shall drive the ICT revolution in Indian farming.

Information Technology has revolutionized the farmers across rural areas all over the world. ICTs (Information & Communication technology) can also do wonders in empowering small and marginal farmers of developing countries, who have poor access to information, especially regarding customers and markets. In developing countries, the limiting factors for farmers wanting to maximize their farm incomes are poor market linkages, poor access to quality farm-inputs, services and technology, lack of information about Government resources, institutions and extension services. The farmers also lack real time

information about consumers, market demand and prices and hence are prone to more exploitation by existing intermediaries in the supply chain. With the growth of organized retailing and free global trade, farming is becoming highly knowledge intensive, commercialized, competitive and globalised, making it necessary to rebuild competitive and efficient agri-supply chains to benefit both the farmer as well as the consumer.

## Agricultural Supply Chain in India

Agricultural supply chains involve both backward as well as forward linkages among all the stakeholders i.e. input companies, government institutions, market intermediaries, consumers and farmers. At the back end of the supply chain are private sector and public sector companies that

manufacture, trade and export inputs like seeds, pesticides, fertilizers, farm machinery, etc. for the farmers' use. Information is also counted as an important input these days. Farmers need to have information on farming practices, weather, sowing and harvesting time, pest management, fertilizer use, etc. Farmers need information on new products and brands launched by these companies. Information is the most important input which can ensure the availability of all other required inputs at the right place and right time. Presently, due to the lack of proper information on inputs, advisory services, and weather and climate information services, farmers are unable to align the quality and price of their products to the market standards.

Marketing of agricultural products in India takes place through agricultural mandis, which are regulated by the Agricultural Produce Marketing Committee Act (APMC Act). The produce is brought to these mandis by farmers, where a long chain of intermediaries is involved. The price of the commodity is decided through behind-the-scene auctions by the aartiyas who function as intermediaries. During the peak season, the farmer sometimes has to wait for many days to get his produce unloaded. These mandis lack basic marketing infrastructure such as grading, standardization and storage facilities. In the process, the quality of the produce deteriorates. It has been found that post harvest losses in mandis occur primarily due to lack of marketing infrastructure and storage facilities. After

the produce gets unloaded, the farmer is at the mercy of the aartiyas, as they are the ones who decide the price of their produce. The farmer has to sell at whatever price is decided by these intermediaries. There is a lack of transparent weighing facilities in the mandis. All these constraints lead to inefficiencies in the value chain and result in a very small monetary share for the farmer. The efficiency of a supply chain depends upon the extent to which both our backward as well as forward linkages are integrated with all the functions in the supply chain so that all the stakeholders involved are benefitted.

To reap the benefits of the existing opportunities, there is a need to circumvent the agri supply chains by removing the inefficiencies in the marketing system. Government is taking steps to improve the system in the country by permitting contract farming and direct procurement from farmers through amendments of the APMC Act. Several schemes have been launched such as the marketing infrastructure scheme, Rural Godown scheme and AGMARKNET to empower the farmers. Besides Government efforts, corporate giants, which have entered into food retailing are also investing in supply chain and are trying to build up information network to facilitate the agricultural marketing trade in the country.

An overview and deployment of the present alignments of widely deployed IT tools like

#### **Radio-frequency identification (RFID)**

RFID uses electromagnetic fields to automatically identify and track tags attached to objects. An RFID tag consists of a tiny radio transponder; a radio receiver and transmitter. RFID can be used in the following applications such as monitoring the physical state of perishable goods, animal identification and tracking, tracking of goods.

#### **Precision farming/ Drone Irrigation technology**

In supporting precision farming, drones can do soil health scans, monitor crop health, assist in planning irrigation schedules, apply fertilizers, estimate yield data and provide valuable data for weather analysis.

#### **Low-cost Computer-Controlled Automated Irrigation System**

The development consisted of three distinctive steps: (1) Design of soil moisture sensor; (2) Design of suitable hardware to interface soil moisture sensors

with personal computer and to control water application; (3) Development of device driver programme and a user-friendly software interface that allows easy control of the system. The other tools are Electronic scanning of price and product at the Electronic point of sale (EPOS), Bar coding and Scanners, Enterprise Resource Planning (ERP) Systems (SAP, Baan, People soft)

#### **AI enabled Agri-Supply Chain**

Artificial Intelligence (AI) techniques propose important contributions to knowledge model's identification, service creation and the decision-making processes as support for the different Agri-Food's applications. AI offers formal general algorithms for prediction, accuracy and performance evaluation as well as pattern classification that might solve knowledge issues in the agricultural domain such as the pest's identifications and the correct treating methods. In addition, AI supports applications in farming techniques development, land allocation regarding the targeted activity, irrigation process analysis and control, robot guidance etc. in addition, Q.R. Code, Finger print, Bar Code, Card scanner, Biometric system, Tagging etc., provides accuracy and authenticity.

#### **Blockchain based traceability in agriculture supply chain**

According to Mayank Raikwar et al. Blockchain is a distributed ledger maintaining a continuously growing list of data records that are confirmed by all of the participating nodes

Every block that composes the blockchain contains at least four fields, namely:

1. The number of the block;
2. The stored data (or stored transactions);
3. The hash of the previous block;
4. The hash of the current block.

#### **AI techniques enable:**

**Functional impact:** to predict the categories of input data for e.g. weather attributes are sunny, windy, rainy etc., Regression: to predict numeric value e.g. price of stocks, Clustering: to organize similar items in-to groups, Association Analysis: to find interesting relationships between sets of variables, Graph

Analysis: to use graphic structure to find connections between entities, Decision Tree: To predict modelling insights of objective variables by learning simple decision rules inferred from the data features.

Above capabilities have been applied to: Crop Management (yield prediction, disease detection, weed detection, insect pests, biotic stress in crop, crop quality, species recognition, predict soil moisture), Water management (smart irrigation systems), Weather forecasting, Soil management, Monitoring faster and with greater accuracy than other monitoring systems, Grading and sorting, Fraud detection system at very high speed, efficiency and with huge scale, Livestock (animal welfare, livestock production), Environmental Protection, Production Planning

**Economic Impact:** Reduce employee training costs, Create efficiencies, improve problem solutions and reduce the time needed to solve problems.

**Social Impact:** Combine multiple human expert intelligences. Reduce the amount of human errors, Review transactions that human experts may overlook, Reduce human intervention enabling human expert to concentrate on more creative activities.

**Business Impact:** Automated decision-making, Expert system increases the probability, frequency and consistency of making good decisions, additive effect of knowledge of many

domain experts, facilitates real-time, low- cost expert-level decisions by the non-expert, enhance the utilization of most of the available data, Learning ability Artificial Intelligence, goes a step further by not simply applying preprogrammed decisions, but instead exhibiting some learning capabilities, Data transformation: ML and AI can help create value by providing enterprises with intelligent analysis of big data and capturing structured interpretations of the wide variety of unstructured data increasingly available.

**Technological Impact:** Advancement of ML with machine vision will make agricultural technologies accurate, robust and low cost, AI can be used to identify and clean dirty data or use dirty data as a means of establishing context knowledge for the data, AI contributes to the velocity of data, by facilitating rapid computer-based decisions that lead to other decisions, AI contributes to variety mitigation by

capturing, structuring, understanding unstructured data generating structure data, AI allows data analysis and decision making, From smart machines to clever computers and to Artificial Intelligence (AI) programs, Expert systems developed in regional languages to be more accessible.

**Innovations in ICT:** ICT helping to bridging the gap in the agri supply chain and offering a communication platform to link farmers to the markets. Both computer-based as well as mobile- based models have been adopted to spread the information in these countries. E-choupal, Warana, Grameen Sanchar Society (Grasso), Reuters Market Light, AGMARKNET and Lifelines are a few successful examples. Amongst the promoters are public sector, not-for-profit sector and private sector companies who are targeting the major stakeholder i.e. the farmer, with their unique information delivery systems.

Some agriculture supply chain decision-making methods are Radio Frequency Identification, Critical Control Points, Food Traceability System, ITC hubs, Production planning, five-point Likert scale, ANOVA, surveys, ORACLE database management, EDI, SAP etc.

Mobile companies are also targeting rural areas with their specific products and services. The Nokia Life Tools project is one such example along with the Airtel and Reuters Market Light project, both of which are marketing commodity-specific information packages to farmers. As many public sector and private sector models are being tried in an effort to link the farmers to markets, it becomes important to study these communication packages as a bundle of benefits to the farmers and other stakeholders. However, the success of these models depends on how

effectively and efficiently farmers are able to make use of these technologies. Some successful ICT applications in Indian agriculture are as follows: The communication model for rural areas

1. ITC e- Choupal
2. Gyandoot project
3. Tarahaat.com
4. Kisan Call Center (KCC)
5. National Agriculture market (e-Nam)

6. AgMarknet
7. Agricultural and processed food products export development authority (APEDA)

## 2). Problem statement

Lack of information about tracking and tracing, Difficulty to Identify actual shelf-life of produce, absence of planning when and where to send it, inaccurate visual inspection, facing unprecedented challenges with processing, transport and handling of product, lack of information about market (customer buying behavior/ Consumer need & preferences) and other problems are how to tackle pest attack, market linkages, demand forecasting, govt. schemes and subsidies, demand and price information, sources of agri inputs, packing and credit, scientific agri practices, value addition, insurance schemes, cold chain infrastructure etc. four types of crop- based uncertainty were identified: Product (shelf-life, deterioration rate, lack of homogeneity, food quality and food safety), Process (harvesting yield, supply lead time, resource needs, production), Market (demand, market prices) and Environment (weather, pests & diseases and regulations).

## 3). Need of the study

There is an ever increasing need for fully integrated supply chain management solutions which incorporate all the functionality of network strategy, configuration of supply chain, planning of demand, transportation for the farmers. Information quality enhanced by

eliminating human errors, Reduction of the costs of operational processes (manual work), Rapid transfer of information between producers, so there is adoption of new technologies requires rethinking and redesigning the whole business model.

A strong need has been felt regarding the informational needs of the farmers throughout agricultural value chain. The farmer lacks information regarding mandis, commodity prices at various mandis thus delinking him from markets and consumers and making him prone to exploitation in the hands of intermediaries. Information is needed by farmers at every stage, right from sowing the seeds to selling his produce in the mandis. Farmers lack awareness about domestic/international markets as well as alternative market channels. They must have information about what varieties are preferred by the consumers and how the agricultural as well as post harvest management practices can be employed in order to fetch better prices for their produce. They also need information on Government schemes and funds available to them for adopting new technologies/processes. Besides the needs to obtain information, farmers also have an inherent desire to interact with various peers and experts in order to discuss problems related to agriculture. This can be possible only when they are connected through an informational network specifically designed according to their needs. For a company marketing information through internet as well mobiles, there are a lot of opportunities existing at both the ends.

**Table 1: Informational Needs of Farmers**

Pre-sowing	Pre-harvest	Post-harvest	Market Information
Information on agri inputs such as seeds, fertilizers, pesticides Credit Weather Soil testing	Good agricultural practices, Pest management Time and techniques of harvesting Packaging	Post harvest management Storage Grading and standardization Logistics Market Information	Alternative market channels, Commodity prices Mandi information Consumer behavior

### Critical Success Factors for AI-based services

Despite the efforts of the information delivering agencies, these projects have a long way to go because of the challenges being faced at implementation level.

These challenges are mainly related to three areas as shown.

Institutional	Infrastructural / Operational	End-user Level
Revenue–cost sustainability	Technology & electricity availability	Product–service mix (user-friendly)
Collaborations	Power backup	Technologies / operations
Technology	Connectivity	User training
Leadership	Capacity building of stakeholders	Need identification for information delivery
—	Information collection, validation & dissemination	Mode of delivery
—	—	Value-added services
—	—	Awareness

### 3). Objective of the study

- 1). To identify gaps in existing agriculture supply chain
- 2). To evaluate adequacy of information and possible implication of AI in agriculture supply chain
- 3). To device an model for creating artificial intelligence in agriculture supply chain

### 4). Significance of the study

AI can be the best way for farmers to update themselves on information related to agri-inputs, credit, markets, weather, extension advisory and other e-governance services, etc. Both mobile as well as Internet based models can gain popularity among farmer folk as each of these offer advantages. Internet can provide a range of services through an interactive, web-based interface and multimedia to a large number of beneficiaries at a minimal cost; however Internet connectivity, electricity availability and capacity building are some of the challenges before it. Mobiles,

on the other hand are capable of providing customized services and ensure speedy and timely delivery of information. Hence the challenge is how both types of communication technologies can be used based on region, crop, type of infrastructure availability, and cost of infrastructure development. For empowering the farmers through AI, there is a need to first have infrastructural and operational modules, user friendly mode of delivery and right product-service mix. However, the most important strategic issue before these models is how these can be made sustainable on their own? Whether to charge farmers or have alternate source of income generation for sustainability remains the important question? Whether farmers are willing to pay and for what services also needs to be answered through further research studies in this area. Hypothesis

H0: There is no significant gaps in existing supply chain about information of particular commodity and transparency in financial transaction etc.

H1: There is huge gaps in existing supply chain about information of particular commodity and transparency in financial transaction etc.

H0: Information dose not adequate for implementation of AI in supply chain H1: Information adequate enough for implementation of AI in supply chain

### 5). Review of literature

**Kollia and Stevenson (2024)** studied in paper entitled “AI-enabled Efficient and Safe Food Supply Chain” researchers focused on emerging field in the food processing sector, referring to efficient and safe food supply chains, from ‘farm to fork’, as enabled by Artificial Intelligence (AI). Recent advances in machine and deep learning are used for effective food production, energy management and food labelling. Appropriate deep neural architectures are adopted and used for this purpose, including Fully Convolutional Networks, Long Short-Term Memories and Recurrent Neural Networks, Auto Encoders and Attention mechanisms, Latent Variable extraction and clustering, as well as Domain Adaptation. Three experimental studies are presented, illustrating the ability of these AI methodologies to produce state-of-the-art performance in the whole food supply chain. In particular, these concern: (i) predicting plant growth and tomato yield in greenhouses, thus matching food production to market needs and reducing food waste or food unavailability; (ii) optimizing energy consumption across large networks of food retail refrigeration systems, through optimal selection of systems that can get shut- down and through prediction of the respective food de-freezing times, during peaks of power demand load; (iii) optical recognition and verification of food consumption expiry date in automatic inspection of retail packaged food, thus ensuring safety of food and people’s health.

**Ayed and Hanana (2023)** studied in paper entitled “Artificial Intelligence to Improve the Food and Agriculture Sector”, researchers focused that the agriculture and food industries are one of the most vital fields for humanity. the first products of agriculture are used as inputs in several multi sector distributed supply chains, including four clusters or stages of the agriculture supply chain (preproduction, production, processing, and distribution) in order to reach the end user or consumer. Due to several challenges in the future for the agriculture and food sector and various factors such as climate change, population growth, technological progress, and the state of natural resources (water, etc.), it is urgent to use the digital technologies at different stages of

agriculture supply chain such as automation of farm machinery, use of sensors and remote satellite data, artificial intelligence, machine learning for improved monitoring of crops, and water, for agriculture food product traceability. In the present study, we demonstrate the main applications of the AI and ML algorithms in different clusters of the agriculture supply chain and the unquestionable growing tendency in the adoption of these algorithms to improve food industries

**Belhadi et al. (2022)** studied in paper entitled “Artificial intelligence-driven innovation for enhancing supply chain resilience and performance under the supply chain dynamism: an empirical investigation”, researchers evaluated Supply chain resilience and performance, digitalization, integration, and globalization of the supply chain has raised an increasing awareness of advanced information processing techniques such as Artificial Intelligence (AI) in building SCRes and improving supply chain performance (SCP). The present study investigates the direct and indirect of AI, SCR, and SCP under a context of dynamism and uncertainty of the supply chain. In doing so, we have conceptualized the use of AI in the supply chain on the organizational information process- ing theory (OIPT). The developed framework was evaluated using a structural equation modeling (SEM) approach. Survey data was collected from 279 representing sizes, operating in various sectors, and countries. Researchers suggested that while AI has a direct impact on SCP in the short-term, it is recommended to exploit its information processing capabilities to build SCR for long-lasting SCP. This study is among to provide empirical evidence on maximizing the benefits of AI capabilities to generate sustained SCP. The study could be further extended using a longitudinal investigation to explore more facets of the phenomenon

**Ramon et al. (2021)** studied in paper entitled “Best Practices of Artificial Intelligence In Supply Chain Management”, researchers analysed twenty (20) research articles, from 2010 to 2018 and are related to the topics of Smart Supply Chain Management, Digital Supply Chain, Internet of Things, Supply Chain, Blockchain, and IoT-Supply Chain, Market Intelligence, and Machine Learning. The findings of the research suggested that the incorporation of

artificial intelligence allows the coordination of logical processes that provide benefits and competitive advantage in the organizations. The

integration of algorithms and the efficiency in supply chain processes improves the flow of information, cost reduction, and optimal solutions. Smart capabilities in the supply chain increase efficiency in the interaction with suppliers to deliver the right product to the customer. The Internet of Things provides readings in real-time that facilitate data analysis. The Blockchain offers data transparency that leads to enhancing the level of information and coordination among the supply chain. Artificial Intelligence tool represents an alternative to resource conservation, extending the life expectancy of products and the reduction of waste to landfills. Smart manufacturing and market intelligence are strategies being used to develop a more intelligent and efficient supply chain. The integration of artificial neural intelligence in the supply chain is useful in the prediction, optimization, and classification process

**Toorajipour et al. (2021)** studied in paper entitled “Artificial intelligence in supply chain management: A systematic literature review”, researcher identified the contributions of artificial intelligence (AI) to supply chain management (SCM) through a systematic review of the existing literature. To address the current scientific gap of AI in SCM, this study aimed to determine the current and potential AI techniques that can enhance both the study and practice of SCM. Gaps in the literature that need to be addressed through scientific research were also identified. More specifically, the following four aspects were covered: (1) the most prevalent AI techniques in SCM; (2) the potential AI techniques for employment in SCM; (3) the current AI-improved SCM and (4) that have high potential to be enhanced by AI. A specific set of inclusion and exclusion criteria are used to identify and examine papers from four SCM. logistics, marketing, supply chain and production. This paper provides insights through systematic analysis and synthesis.

**Riahi et al. (2021)** studied in paper entitled “Artificial intelligence applications in supply chain: A descriptive bibliometric analysis and future research directions”, researchers reviewed 136 research papers published between 1996 and

2020 from the Scopus database and provided a classification of the research material according to four critical structural dimensions (level of analytics, AI algorithms or techniques, sector or industry of application, and supply chain processes). This study is the attempt to study the AI applications in SC from a process perspective and provides a decisional framework for adequate use of AI techniques in the different SC processes

**Devi N. and Paul V. (2020)** studied in paper entitled “Artificial Intelligence: Pertinence in Supply Chain and Logistics Management”, researchers explored the application of AI in the manufacturing and distribution process enables the organisations to reach the pinnacle in their business graph. Businesses are operating in the international market which is highly multifaceted and challenging to serve the world as a sole market for their products, services and their products and without the integration of technology into their business processes, they cannot assure the sustainable growth. The management of the process of transforming the raw materials into the final product is called Supply Chain Management (SCM) and the effective movement and storage of goods, services and information are called Logistics Management (LM). This article analyses the applications of Artificial Intelligence in Supply Chain and Logistics Management.

**Ranjan and Barge (2020)** studied in paper entitled “Impact of Artificial Intelligence on demand Forecasting in Supply chain Management during COVID-19”, researchers examine COVID -19 has brought in lot of damage to the supply chain as companies have not been able to respond to rapidly increasing consumer demand, limited products supplied and changes in workplace rules

.The war against COVID-19 has made us to come with innovative solutions. The application of AI in supply chain related task holds high potential for boosting top line and bottom line value. Companies today at even at the enterprise level have started implementing AI tech into every day supply chain tasks. It’s a lousy time for companies to start looking, but AI can help them to enable their efforts. If more Industry can adopt technology in their operation, Supply chain could become a green industry in no time.AI in these uncertain times will help to accurately forecast the demand and will help to meet those demands. What

this pandemic has shown us is that integration of Artificial intelligence and supply chain management applications helps automate decision-making, Improve efficiencies and better utilization of human resources.

**Singh, Goyal and Bedi (2020)** studied in paper entitled “The Role of Artificial Intelligence and Machine Learning in Supply Chain Management and its Task Model”, researcher evaluated that the optimization technique for feasibility in management operations based on AI to solve the causes of the issues in supply chain management. There are three fundamental types of AI which have overseen learning, pointless learning, and defence learning and all these have characterized in a hypothetical bit of this investigation. The deep-learning architecture will highly affect the preparing of the supply chain. This examination dependent on the supply chain the executives and explained the ideas of an item the board, stock administration and coordination. This examination found that the artificial intelligence is used in supply chain cycles and its current condition on the use of programming in the world of programming rationale in supply chain measure has demonstrated more captions of the sensible model from amazon and Amer sports. As the smart warehouse is more advanced in day to day activities, Amer sports is effectively utilizing false figuring out how to upgrade the administration and consistency of the supply chain. The strategies for subjective investigations like document analysis has implemented in this article. Electronic papers and these articles on computerized reasoning in the supply chain have studied also. This paper showed the two organizations benefited incredibly from the introduction of individual artificial intelligence requests. It has observed that automation has significantly enhanced with the implemented artificial intelligence model. Moreover, automation eliminates human intervention with a notable performance

**Demestichas, Peppes and Alexakis (2020)** elaborated on the applicability of blockchain technology in traceability systems of agri-food products. Food holds a major role in human beings’ lives and in human societies in general across the planet. The food and agriculture sector is considered to be a major employer

at a worldwide level. The large number and heterogeneity of the stakeholders involved from different sectors, such as farmers, distributors, retailers, consumers, etc., renders the agricultural supply chain management as one of the most complex and challenging tasks. It is the same vast complexity of the agriproducts supply chain that limits the development of global and efficient transparency and traceability solutions. The present paper provides an overview of the application of blockchain technologies for enabling traceability in the agri-food domain. Initially, the paper presents definitions, levels of adoption, tools and advantages of traceability, accompanied with a brief overview of the functionality and advantages of blockchain technology. It then conducts an extensive literature review on the integration of blockchain into traceability systems. It proceeds with discussing relevant existing commercial applications, highlighting the relevant challenges and future prospects of the application of blockchain technologies in the agri-food supply chain.

**Vaio, Boccia and Landriani (2020)** investigated the artificial intelligence (AI) function in agri- food industry, as well as the role of stakeholders in its supply chain. Above all, from the beginning of the new millennium, scholars and practitioners have paid an increasing attention to artificial intelligence (AI) technologies in operational processes management and challenges for new business models, in a sustainable and socially responsible perspective. Thus, the stakeholders can assume a proactive or marginal role in the value creation for business.

**Mirabelli and Solina (2020)** studied that the blockchain technology is still in its early stage. Although there are several proposals in the literature, still a limited number of applications have been put into use in the real context. From the point of view of scientific research, only some countries are investing in this technology: China and United States are among the most active, but Italy is also very involved in this phenomenon. Overall, the blockchain technology appears very promising, but still many efforts are needed to reach the maturation stage.

**Kumar and Sharma (2020)** evaluated Artificial Intelligence (AI) is one of the most useful technologies during COVID19 pandemic. In this current situation, AI played a vital role in various and different sector from an infected patient to the economy- wide. A wide

range of examples are available for how AI tackled with COVID19 and is helping during the pandemic around the world. During this pandemic time, large to small companies have been developing new AI approaches such as droids, machine, software and gadgets in embracing fight against COVID19 pandemic. The present study reviews application of AI and how it has supported in this pandemic.

**Manaware et al. (2020)** studied in paper entitled “Artificial Intelligence: A New Way to Improve Indian Agriculture”, researchers analysed that the Agriculture, with its allied sectors, is unquestionably the largest livelihood provider in India more so in the vast rural India, Agriculture plays a vital role in Indian economy. Government has set a target of doubling of farmer’s income by the year 2022 as well as Agriculture export policy has set a target to increase agricultural exports to over US\$ 60 billion by 2022. The digital technology can play a transformational role in modernizing and organizing how rural India performs its agricultural activities. The technologies include Artificial Intelligence, Big Data Analytics, Block Chain Technology, Internet of Things etc. Artificial Intelligence provides accurate and timely information regarding crops, weather and insect etc. to the farmers may improve the crop productivity, reduce the risk and improve the income of the farmers.

**Trong et al. (2020)** studied in paper entitled “Application of Information and Technology in Supply Chain Management: Case Study of Artificial Intelligence – A Mini Review”, researchers evaluated Industry 4.0 technologies. One of the most prominent of these technologies (including Block Chain, Internet of Things, Cloud Computing, Big Data, etc.) is Artificial Intelligence (AI), was introduced to develop and create “thinking machines” that are capable of mimicking, learning, and replacing human intelligence. However, its widespread acceptance as a decision-aid tool, AI has seen limited application in supply chain management (SCM). The purpose of this work is to identify the contributions of AI to SCM through a brief review of the existing literature. Besides, this paper reviews the past record of success in AI applications to SCM and identifies the most subfields of SCM in which to apply AI.

**Jain et al. (2019)** studied in paper entitled “Artificial Intelligence (AI) for Supply Chain Industries and the Future It Holds”, researchers focused on Machine Learning and applications of AI in use, its advantages and disadvantages, How Industrial Revolution 4.0 is getting impacted with the AI Evolution, Industrial Use cases and what Industry experts think about the AI Evolution on the global level.

**Aguezzoul and Pires (2019)** studied in paper entitled “Use of Artificial Intelligence in Supply Chain Management Practices and 3PL Selection” researchers focused on discuss the application of Artificial Intelligence (AI) techniques in the general case of SCM practices, on the one hand, and in the particular case of the 3PL selection process, on the other hand. Concerning the SCM, the main purpose is to identify how current knowledge in AI could contribute to and be used effectively in SCM, especially in the conduction of its more dynamic managerial practices. In the case of 3PL selection process, the objective is to identify the proposed AI techniques used, taking into account the business sector of the company, and the logistics services that the company plans to outsource.

**Mario and Jorge (2019)** evaluated the term “Agri-Food 4.0” the use of the right methods and methodologies for enhancing agriculture supply chains performance is still a challenge, thus the concept of Industry 4.0 has evolved and adapted to agriculture 4.0 in order analyse the behaviours and performance in this specific domain. Thus, the question mark on how agriculture 4.0 support a better supply chain decision-making process, or how can help to save time to farmer to make effective decision based on objective data, remains open. Further they analyzed all dimension of improving agriculture supply chain.

**Mudda, Giddi and Murthy (2017)** studied on the digitization of supply chains in agriculture, they focused information-driven, integrated supply chains are enabling organizations to reduce inventory and costs, add product value, extend resources, accelerate time to market, and retain customers. Information Technology has started its dent in certain rural livelihoods especially the farmers in developing countries like India. IT can also do wonders in empowering small and marginal farmers who are operating in a complex, diverse and risk prone environment, who have poor access to information,

especially regarding the production systems, customers and markets. In India, the limiting factors for farmers wanting to maximize their farm incomes are poor market linkages, poor access to quality farm-inputs, services and technology, lack of information about Government resources, institutions and extension services. ICT systems have pivotal role to play in market led extension activities. ICT s can connect the producers with buyers to initiate and sustain long term, mutually beneficial and sustainable professional relationships.

**Hussain, Ahmed and Jafar (2016)** Investigated integration of the supply chain and marketing of agricultural products in Fujian and Taiwan, Fujian and Taiwan agricultural supply chain management innovation and technology to build a modern agricultural products circulation system between Fujian and Taiwan-based supply chain management. As the main research purposes, through the strait between Fujian and existing agricultural marketing and management techniques to investigate patterns and comparative analysis of the factors affecting the performance of the supply chain management of agricultural products between Fujian and Taiwan.

**Jadhav et al. (2015)** evaluated information Technology revolution changed the world and all aspects of business processes. The developments in Information technology has resulted in many possible alternative solutions for managing the supply chain effectively. Supply chain management is information driven function. Information Technology enabled supply chain management will provide a competitive advantage to an organization over rest of the competitors in market place. IT plays a vital role in decision making process. IT is beneficial for cooperation and coordination within the supply chain. This paper highlights the overview of information technology for effective supply chain management, software focused supply chain characteristics as well as IT tools used in IT enabled supply chain management.

**Mor, Singh and Bhardwaj (2015)** addressed 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.

### 7). Tools

An appropriate software (software/ mobile application) and algorithms were developed for analysis and AI based system. Q.R. Code, Finger print device, Bar Code reader, Card reader, Biometric system, Tagging etc. were used as a tools. The data was analyzed using regression analysis, factor analysis, statistical package for social science (SPSS version 22).

### 8). Research Methodology

Haridwar and Dehradun districts were selected (convenient sampling). Two blocks in each district and two villages in each block will be randomly selected. Based on feedback, pilot testing, testing, validation and confirmatory analysis, model was developed.

Primary data was collected through questionnaire, online forms, Interview (direct discussion) and secondary data was collected from National Co-operative. Development Corporation (NCDC), New Delhi, Agricultural & Processed Food Products Export Development Authority (APEDA), New Delhi. National Horticulture Board (NHB), New Delhi. Directorate of agriculture Uttarakhand.

#### Sampling method:

Individuals – 62

**Tools and Techniques:** Dependent and Independent Variables

**Sources of data:** Primary and secondary

Primary: Questioner and structured interview schedule  
Secondary: Literature- Govt. publication, Govt. website

### Factor affecting Supply chain: result of multiple regression analysis

S.No.	Explanatory variable	N=62
	Intercept (b0)	26.94 (17.287)
1.	Use of software & app (X1)	0.539 (0.049)
2.	Use of AI based system. Q.R. Code, Finger print device, Bar Code reader, Card reader, Biometric system, Tagging etc (X2)	0.721* (1.372)
3.	Quality (X3)	0.248 (1.243)
4.	Quantity (X4)	0.083 (0.070)
5.	Price (X5)	0.428* (0.024)
6.	Time (X6)	-2.141 (0.526)
	<b>R<sup>2</sup></b>	<b>0.71</b>
	<b>F value</b>	<b>22.72</b>

Note : Figure in parenthesis indicate standard error of coefficient, \*indicate highly significant, significant at 5 percent level.

Factor (X2) Use of AI based system. Q.R. Code, Finger print device, Bar Code reader, Card reader, Biometric system, tagging etc fall effect on supply chain.

#### Factor Analysis:

**Table: KMO and Bartlett's test**

Kaiser-Meyer-Oklin Measure of Sampling Adequacy	<b>0.608</b>
Bartlett's Test of Sphericity Approx. Chi- Square	<b>588.661</b>

Df	120
Significant	.000

**Table: Result of factor analysis**

	Factors	Eigen value	% of variance	Cumulative %	Alpha
X2	Use of AI based system. Q.R. Code, Finger print device, Bar Code reader, Card reader, Biometric system, Tagging etc	4.883	30.517	30.517	.801
X1	Use of software & app	2.114	13.210	43.728	
X5	Price	1.904	11.901	55.629	
X3	Quality	1.371	8.569	64.198	
X4	Quantity	.980	7.534	71.732	
X6	Time	.871	6.124	77.856	

Kaiser-Meyer-Okin Measure of Sampling Adequacy was 0.608, it means it was a good test for the given population. Chi- Square test result was 588.66 at degree of freedom 120 significant 0.00. Factor (X2) Use of AI based system. Q.R. Code, Finger print device, Bar Code reader, Card reader, Biometric system, Tagging etc represent with 30.517% of variance followed by Use of software & app, Price, Quality, Quantity and time.

### 9). Conclusion

The future of the agriculture domain is in the creation of a resilient and sustainable farming system. On the four types of crop-based uncertainty that have been identified: Product, Process, Market and Environment the core problem is the management. Poor management of these sources of uncertainty have a negative

impact on safety, quality, quantity and waste of products as well as human, technological and natural resources.

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