A System for Direct Market Linkage and Post-Harvest Loss Prevention

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ABSTRACT

Background: Food supply chains and farmers' profits are significantly impacted by post-harvest losses, which are caused by poor storage, transportation, and market connectivity. A Post-Harvest Loss Prevention & Immediate Market Linkage System is a Java-based localhost application designed to lower post-harvest losses and enable direct connection between farmer and consumers.

Methods: Through the digital platform of the system, farmers may register, submit harvest statistics, monitor storage conditions, and receive real-time market price notifications. Buyers can examine product listings, place orders, and communicate with farmers directly by eliminating middlemen and ensuring fair pricing. To improve the efficiency of the supply chain and transparency, the program integrates order tracking, the administration of stocks, and notification modules.

Results: By reducing delays, expanding market access, and enhancing decision-making, the approach reduces waste, increases farmer profitability, and ensures that fresh fruit reaches consumers efficiently. This project demonstrates how a full-stack Java solution installed on localhost may enhance farm-to-market relationships and advance sustainable agriculture.

Discussion: The use of digital technology to avoid and/or reduce food loss and waste throughout the agri-food supply chain is still being studied, despite the advantages that come with the application of technologies associated with Industry in the agri-food sector. Actually, without effective FLW prevention and reduction measures, improving and optimizing agriculture, food production, supply chain processes through digital technologies would only be a partial effort. Businesses are beginning to use digital technology to eradicate FLW from their operations, but there is still a lack of practical direction and a shallow presentation of the implementation process and results.

Conclusion: By creating a framework for evaluating the current state of adoption of each Industry technology throughout the agri-food supply chain and offering a research agenda organized around the primary themes of research architecture, digital technologies, historical differences, governance, and sustainability, this systematic literature review advances theory. The study ultimately provides management in the agri-food sector with information regarding the possible use of digital technologies to stop and lessen FLW throughout the supply chain for agri-food products.

Keywords: Food waste, supply networks, industries, the fourth industrial revolution, sustainable development, product traceability, blockchain, agri-food safety, supply chain monitoring, profit optimization

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I. INTRODUCTION

Agriculture is the primary source of income and food security for millions of farmers worldwide. However, a significant amount of the agricultural produce is wasted after harvest as a result of inadequate supply chain management, inadequate storage facilities, inefficient transportation, and non-direct market access. These post-harvest losses contribute to shortages in food and unstable economies in addition to decreasing farmers' earnings. Traditional marketing strategies sometimes involve a number of middlemen, which increases costs, delays delivery, and reduces farmers' profit share. Addressing these problems is increasingly going to require a centered around technology solution that can effectively lower losses and offer direct market links. A Java-based localhost program called the planned Post-Harvest Prevention of Loss & Direct Exchange Linkage System was created to give administrators, buyers, and farmers a unified platform. Farmers are able to oversee gathered produce, keep an eye on inventories and storage, and communicate with buyers directly for prompt sales thanks to the technology. Administrators can monitor the system's operations user activities, and transactions, while buyers can effortlessly browse fresh fruit, compare prices, place orders, and track deliveries. Through a dependable and scalable digital solution, the system seeks to decrease waste, increase farmers' profitability, and advance sustainable agriculture practices by enhancing honesty, efficacy and communication throughout the agricultural supply chain.

II. LITERATURE REVIEW

[1]. Traditional issues with the Agri-Food supply chains (AFSC) include a variety of issues related to product quality, traceability, transparency, and integration. The emergence of a number of digital technologies in recent years indicates that most of these issues may be resolved. The goal of this chapter is to create a digitalized vision for the agri-food supply chain's future. The chapter primarily discusses three technologies: blockchain, artificial intelligence (AI), and the World Wide Web of things (IoT). A review of the literature and a primary poll were used to determine the various difficulties that participants in the agri-food supply chain perceived when putting digital technology into practice. The availability of cash, a skilled labor force, and a clear understanding of the financial benefits of digitalization are the main obstacles. Finally, a few approaches to integrating digital technologies into agri-food supply chains are explored.

[2].The use of digitization to solve the problem of food loss and waste (FWL) occurrences has become a developing area of academic research due to the increased concern regarding the availability of food in recent years. However, the majority of recent FWL research is dispersed and fragmented, concentrating solely on particular digital technologies used in the food the supply chain (FSC). 4277 summaries and titles, as well as 129 full-text papers (111 papers were ultimately included) on the subject from 2014 to 2024, are analyzed in this study using an organized review of the literature (SLR) methodology. It offers a cohesive and thorough summary of how the FSC is addressing complicated FWL occurrences using cutting-edge digital technologies. The potential of sixteen digital technologies is identified and integrated in this review, which also looks at the associated FWL events and implementation phases within the FSC (i.e., Production, Handling & Distribution, Processing & wrapping, Distribution & Retail, and Consumption). A framework for managing digital FWL networks is created based on the review's conclusions. In order to replicate the real-world process of how digitalization might solve complicated FWL events, this framework explains the relationships between drivers, actors, causes, actions, time, and places involved in addressing FWL. The study trend, sustainable benefit, possible disadvantages, and deployment challenges of technological innovations in lowering FWL are also examined in this review, which then suggests future research avenues. All things considered, this study takes a promising multiple-technology approach to systematically show how various digital technologies can handle FWL events at different stages of the FSC.

[3]. The worldwide modernization of agriculture has made the digital evolution of supply networks for agricultural products a key direction that cannot be ignored. Using a narrative review guidelines based on the "Technology–Collaboration–Sustainability"

perspective, this paper summarizes the factors driving digital transformation, the use of digital technologies, mechanisms for multi-stakeholder collaboration, and avenues for sustainable development in supply chains for agricultural products. According to the study, the main forces behind the digital transformation of supply chains for agricultural products are internal demand drivers like industrial upgrading and heightened corporate competition, as well as external environmental factors like population growth, dietary changes, and food waste. The use of digital technologies like blockchain, artificial intelligence (AI), and the Internet of Things, or IoT for short, has greatly increased the supply chains' resilience, efficiency, and transparency. Furthermore, several kinds of multi-stakeholder cooperative systems have improved supply chain stability and streamlined resource allocation. The study closes by outlining a strategy for the digital transformation-centered sustainable growth of supply chains for agricultural products and offering proposals for further study and application.

[4]. In the digital age, the supply chain for agricultural products is changing. There are still few empirical studies looking at the adoption of electronic devices within AFSC, despite the increased interest in these technologies. In order to uncover new trends and theoretical frameworks pertaining to digital technology in AFSC, this comprehensive review of the literature synthesizes state-of-the-art research spanning 2015 to 2024. This study examined 26 articles that used SEM, or structural equation modeling, using the PRISMA process. Five primary clusters were found in this review: operation, performance, sustainability, behavior intention, and risk management. The findings indicate a growing trend in the AFSC's empirical research on digital technologies, with blockchain emerging as the most often referenced technology. Theories like Resource-Based View, Natural Resource- Based View, Technology Acceptance Model, the Unified Theory of Acceptance and Use of Technology, and Dynamic Capabilities View are often used. The evaluation emphasizes how crucial it is to include digital technology into AFSCs in order to improve sustainability, efficiency, and transparency. It highlights IoT's contribution to increased operational efficiency and blockchain's potential for traceability. It also emphasizes how important it is for managers to provide training and investments in digital infrastructure a priority in order to fully utilize new technologies. To guarantee that digital technologies can fulfill their potential of improving performance and long-term vi in the AFSC, future research should concentrate on examining gaps, especially in the context of emerging economies.

[5]. The difficulties and structural flaws of conventional cross-border agro-food supply chains are brought to light by the growing significance of the effects of climate change geopolitical crises, and the global economic slump. Consequently, there is increasing agreement that digital technology must be used to reconstruct and invent a secure, stable, and ecological global food system. The knowledge advancement and development changes in the sustainable growth of digitally enabled cross-border agro-food supply chains were evaluated in this study. For examination, 352 reputable articles in all were chosen from the main Web of Science database. Research components were visually examined using the Citespace program. The results show that there was a notable period of substantial development in research achievements in this area, especially after 2020.The nations and academic institutions with the most publications in this area are China and the French National Institute. Food safety, supply chain system model innovation, and the use of digital technology are the primary research hotspots. Three phases of study have emerged in this field over the last 10 years: model predictability, intelligent strategic decision-making, and precise timeliness. We also develop the "antecedent–practice–performance" conceptual framework for the sustainability of the cross-border agricultural and food supply chain facilitated by digital technologies. The research technique, research mechanism, research topic, and research frontier are the four main areas of attention for this paper's final presentation of possible research directions in this field.

III. RESEARCH METHODOLOGY

The proposed Post-Harvest Prevention of Loss & Direct Market Connection System is a Java-based localhost application designed to circumvent the limitations of traditional agricultural supply networks. This technology enables efficient management of produced commodities and timely market access by establishing a direct connection between farmers and buyers via a single digital platform. Farmers may register, upload crop details, manage inventory, monitor storage conditions, and receive real-time pricing updates to help them make better decisions

and reduce post-harvest losses. Customers can browse the available products, compare prices, place orders, and keep track of their purchases to guarantee transparency and expedite transactions. The system also contains a management module that can manage user authentication, track operations, analyze data, and generate reports to enhance system control and performance evaluation. Order monitoring, automated notifications, and inventory alerts are examples of integrated features that minimize delays, stop spoiling, and improve logistics. By eliminating middlemen, the strategy ensures fair pricing for farmers and affordable prices for consumers. The proposed system, which makes use of modern Java-based technology, offers a reliable and scalable way to reduce post-harvest losses and strengthen direct market links while simultaneously enhancing sustainability, efficiency, and accountability across the agricultural supply chain.

IV. SYSTEMARCHITECTURE

The system design of the Post-Harvest Prevention of Loss & Direct Market Linkage System is built using a three-tiered, role-based JVM web application framework that operates in a localhost environment. The architecture supports three primary modules—Admin, User, and Farmer—to provide efficient system operation and seamless stakeholder participation. Every module serves a distinct purpose. Users may safely log in, access features, and do tasks in accordance with their assigned duties with the use of the presentation layer's simple web interfaces made with HTML, CSS, JavaScript, and JSP. At the application layer, Java Servlets and other crucial Java components govern the system's session management, business logic, authentication, and request processing. With the aid of the Admin module, administrators may securely log in, review and manage all users who are registered, track order transactions, keep an eye on uploaded food plus vegetable details, and maintain overall system management. The User module allows users to register, manage their profiles, peruse the available food and vegetable items, place orders, submit requests to farmers, and track the progress of their purchases. The Farmer module allows farmers to register, post information about food and vegetables, view uploaded commodities, and efficiently manage their listings. This layer ensures safe data processing, smooth module interaction, and real-time system upgrades. User passwords, farmer knowledge, product listings, order details, request logs, and records of transactions are all securely stored via MySQL, which is used to create the database layer. The JDBC connection ensures dependable communication between the database's and application layers. The integrated design ensures data integrity, system security, scalability, and efficient workflow management, enabling effective post-harvest avoiding losses and direct market linkage through a dependable Java-based localhost implementation.

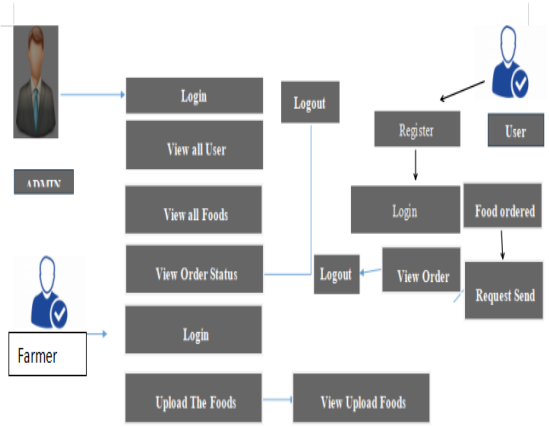

Fig1: System architecture

V. MODULES

A.User

B.Admin

C.Farmer

A.User

The user establishes an account by supplying the required basic information. After registering, the user can view their profile information and confirm the food items they have ordered. The user can then request the distribution of fruits and vegetables and monitor the status of their order. Once all tasks have been completed, the user safely signs out of the machine.

B. Admin

To access the account, the user inputs a functional username and password. After successfully completing the authentication procedure, the user is presented with a list of all users who have registered in the system. The user can also view and read detailed information about the available food items, as well as verify the details of customer orders. After doing all required actions, the user safely logs out of the system.

C.Farmer

By supplying the necessary basic information, the user creates an account. The user can browse the list of uploaded food products after successfully registering and uploading food details into the system. After that, the user transmits the access order to their

registered email address so that it may be processed further. The user safely logs off of the machine after finishing all tasks.

VI.ALGORITHM

Deep Reinforcement Learning

The core of the management system uses deep reinforcement learning to generate intelligent, adaptable judgments. DRL agents are trained to optimize supply chain processes by interacting with encrypted data and accounting for various constraints, like transportation capacity, demand forecasts, and inventory levels. The DRL model uses trial and error to determine the optimal policies for many scenarios, such as when to ship products, which routes to take, how much inventory to store, and when to place fresh orders. It continues to improve as more data and practical experiences are gathered.

VII.RESULT

A Java-based localhost application can reduce post-harvest losses and improve direct communication between farmers and buyers, as demonstrated by the implementation of the Post-Harvest Loss Prevention & Direct Market Linkage System. The system makes it simple for administrators, farmers, and users to register and log in, ensuring secure and role-based access. Customers may easily browse products, place orders, send requests to farmers, and track the status of their orders in real time, while farmers can efficiently upload and manage information on food and vegetables. The complete control over user administration, product monitoring, and order tracking provided by the admin module guarantees transparency and smooth system operation.

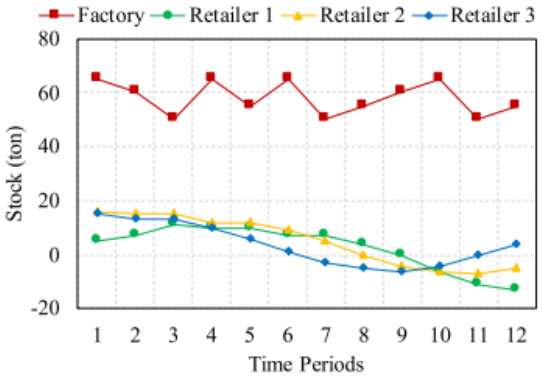

Fig2: Sales Monitor

The technology effectively optimizes the agricultural supply chain by eliminating middlemen, reducing transaction times, and lowering product waste. Order tracking, inventory control, and real-time updates are among the features that enhance operational effectiveness and decision-making. The experiment's results demonstrate improved stakeholder cooperation, reduced manual labor, expedited order processing, and increased farmer profitability.

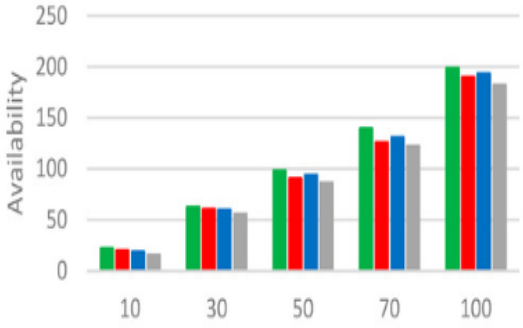

Fig3: Availability of stock

Finally, we compare All things considered, the project provides a reliable, secure, and scalable digital solution that strengthens direct market connections and enhances post-harvest management, promoting sustainable agricultural development.

VIII.FUTURE DISCUSSION

In the future, to further optimize the agricultural supply chain, the system can be improved by including intelligent logistics management and real-time map tracking. The system can facilitate real-time tracking of delivery status, expected arrival timings, and transportation routes by integrating GPS-based tracking and interactive map services. This tool will increase transparency, trust, and delivery efficiency by enabling farmers, purchasers, and administrators to monitor product flow from farm to customer. Additionally, to cut down on fuel usage, minimize travel time, and stop perishable items from spoiling, traffic-aware navigation and route optimization algorithms can be used. Product quality and safety can be further guaranteed by integrating IoT-based sensors for temperature and humidity monitoring during transit. AgroLink will become a smart, data-driven logistics platform as a result of these developments, improving supply chain visibility, lowering post-harvest losses, and encouraging sustainable farming methods.

IX. CONCLUSION

the Post-Harvest Loss Prevention & Direct Market Linkage System successfully provides a technology-driven solution to lower agricultural waste and improve direct communication between farmers and buyers. The system guarantees effective inventory management, transparent transactions, real-time order monitoring, and smooth communication by incorporating role-based access for administrators, farmers, and users. This strategy contributes to a more sustainable, effective, and dependable agricultural

supply chain by reducing delays, doing away with middlemen, increasing farmers' revenue, and giving consumers access to fresh produce at reasonable costs.

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