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INTERGRATIVE REVIEW OF IOT IMPLEMENTATION IN AGRI-FOOD SUPPLY CHAIN: FINDINGS AND ANALYSIS

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Abstract:

This study focuses on the implementation of the Internet of Things (IoT) in the agri-food supply chain in this industry. Traditional farming methods are unable to meet the demand, resulting in the use of fertilizers that can have a negative impact on agricultural productivity. During the Covid-19 pandemic, there are examples of unprecedented risks in the global agri-food supply chain around the world. The industrial landscape is being transformed by Industry 4.0, and in particular, the evolving technologies associated with it have the potential to improve the agri-food supply chain at every level. The paper examines the various research related with components of smart farming (IoT, smart farming, technologies, wireless communication technology, sensors, and hardware), highlights the need for careful selection of these technologies in different agricultural practices to increase mechanization. The study also provides an extensive review of the implications of automation in agriculture and the benefits of digital transformation, coordinating and production system, modern sensors, wireless communication technologies, and hardware. The objective of this article is to present a comprehensive overview of the enabling technologies in IoT implementation with smart and sustainable agriculture and discuss potential avenues for improvement in the future. By exploring the possibilities offered by IoT, this research adds valuable insights to the existing body of knowledge in agri-food value chain management. It uncovers the potential of IoT technology and its impact on enhancing various aspects of agri-food value chain performance, including food safety, quality, and traceability.

Keywords:

IoT, Agri-Food, Supply Chain Management, Block Chain, Smart Agri-Cultural

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Introduction

Agriculture remains one of the important sectors to be emphasized due to current environmental needs, especially post-COVID-19 disease and movement restrictions around the world. The frequent research themes on the agricultural sector were food supply chain, food waste, sustainability, food safety, supply chain management, food industry, and food security. However, there is new research themes in these research field, such as blockchain; Internet of Things (IoT); contract; resilience; short food supply chain; life cycle assessment; environmental impact; packaging; water use; food waste; and carbon footprint (Barbosa, M. W., 2021). In terms of IoT technologies, there are six IoT technologies and their applications in the context of the agriculture supply chain (Luthra, S. et al, 2018). These technologies were radio-frequency identification, vibrational spectroscopy, bio/wireless sensors/ mechanisms, traceability, artificial intelligence, and high-pressure processing. However, there are certain issues with adopting IoT technologies in the agriculture supply chain towards developing countries. The issues related to employability and knowledge of technological terms, high costs, low level of research and development facilities and equipment, and low standards of industries. Furthermore, as internet technologies continue to rapidly advance in the realm of value chain management, numerous emerging technologies like advanced ICT and the IoT have been integrated into the agri-food value chain (Tian, 2017). Nevertheless, most of the systems implemented within this value chain are centralized, monopolistic, asymmetric, and lacking transparency, which poses significant trust issues. Consequently, consumers' trust in food safety has been shattered following a string of food safety risks and scandals witnessed in previous decades (Tian, 2017).

To sustain the agri-food supply chain and industries, government interference also plays a significant role. It is also related to top management support, especially for training, awareness of environmental regulations, and pollutant reduction; IoT-based infrastructure to provide important data about global demand; quality standards, and logistics; cold chain to control the quality of the products; education and training especially towards the farmers; information sharing among the multi-tier suppliers; and smart packaging of agri-products (Yadav, S. et al., 2021).

Considering the above arguments, the main objective of this study is to fill this gap by offering an integrative literature review of the recent contributions of these issues in the agri-food value chain management, highlighting the research that has been developed over time, and identifying the challenges of applying IoT technology to the agri-food value chain management, and proposing the most promising research directions for the future. The remainder of this paper is organized as follows. The data and methodology adopted in this paper are described in the next section, and then the application of the research methodology in the discussion section. Finally, conclusions in the last section.

Data and Methods

This study explores the literature on the IoT (Internet of Things) implementation in Agri-Food supply chain, related to the blockchain system by employing integrative literature analysis methods. This method can reduce any potential biases by searching specific words and examining the trends in this article (Denyer, D. & Tranfifield, D., 2009). The papers were selected only from 2018 until 2022 because blockchain technology adopted since 2017 in supply chain management.

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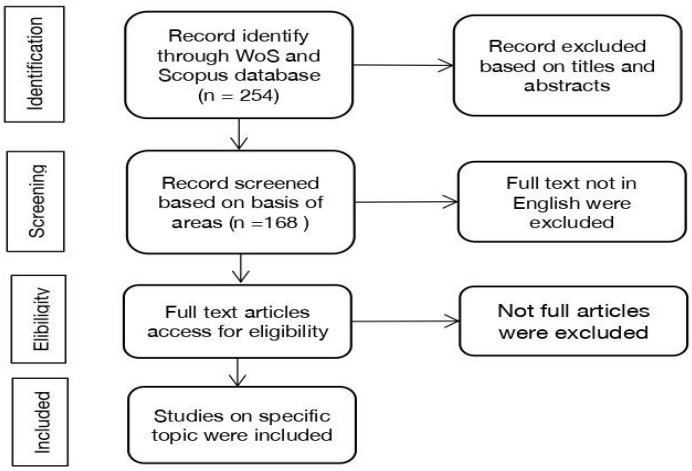

Figure 1: PRISMA Diagram for Inclusion

Firstly, the most relevant studies by keyword searching in the Google Scholar database were collected. The final keywords include blockchain, 'supply chain management', 'Agri-Food', 'Internet of Things (IoT) Based System', "Artificial Intelligence' and 'Food and Technology'. The papers were considered peer-reviewed journal articles through Google Scholar (www.scholar.google.com) and Web Of Sciences from June 2022 until September 2023. The first search of articles resulted in 254 papers related to these research areas. However, after refining specific issues, a total of 26 references were refined.

Table 1 indicates a literature summary of these 26 references. As in the table, the most common words were 'IoT Based System', 'Block Chain', and 'Supply Chain Management'. A previous study examined IoT implementation (Xie, J. et al, 2022) in the Agri-food supply chain with discussion through the case studies or literature review (Yadav, S. et al., 2021; Dadi, V. et al, 2021) bringing the gaps in traceability system (Tagaris et al, 2021; Tagaris, A. C. et al, 2021). Cocco, L. et al (2021); Niknejad, N. et al (2021); Kamblea, S. S. et al (2020) and Kaijun, L. et al (2018) investigated a blockchain in Agri-food or Agri-culture. Manning, A. et al (2022) consider the ethical narrative used when adopting AI (Artificial Intelligence) in the supply chain. Saurabh, A. S and Kushankur (2020) and Fua, H. et al (2020); study on blockchain technology adoption and sustainable agri-food supply chain. Visconti, P. et al (2020) developed a software platform for smart farming through the implementation of IoT. While Rejab, A. et al (2022) discussed digitalization in food supply chains. Furthermore, Almadani, B. and Mostafa, M (2021); Yadav, S. et al (2020) and Luthra, S. et al (2018) introduced IOT and blockchain (Bhat, S. A. et al, 2022) on multimodel for Agro-Industres or Agri-Culture and supply chain. Moreover, Egwuonwu, A. et al (2022) examined the influence of blockchain and IoT on the global value chain. Finally, Barbosa, M. W. (2021) critically reviewed Agri-food supply chain management by bibliometric study. Detailed descriptions of this topic can be found in the next section.

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Table 1: Literature Summary (Final Access in September 2023)

No.	Key Words	Author/Year
1	IoT, Agro-Industries	Almadani B. & Mostafa S. M. (2021)
2	Agri-food Supply Chain	Barbosa M. W. (2021);
3	Block Chain, IoT	Bhat, S. A., Huang, Nen-Fu, Sofi, I. B.; Sultan, M. (2022)
4	Block Chain, Agri-food	Cocco, L., Mannaro, K., Tonelli, R., Mariani, L., Lodi, M. BB., Melis, A., Simone, M., Fanti, A. (2021)
5	Block Chains, IoT	Egwuonwu, A., Mordi, C., Egwuonwu, A., Uadiale, O. (2022)
6	Agri-food, Supply Chain	Dadi, V., Nkhil, S. R., Mor, R. S., Agarwal, T., Arora, S., (2021)
7	Block Chain, Agri-food	Fu, H.; Zhao, C., Cheng, C., Ma, H. (2020)
8	Block Chain, Agrifood	Jahanbin, P., Wingreen, S. C., Sharma, R., Ijadi, B., reis, M. M. (2023)
9	IoT and Block Chain	Hasan, I., Habib, M. M., Mohamed, Z., Tewari, V. (2023)
10	Smart Agriculture	Jararweh, Y., Fatima, S., Jarrah, M., AlZu'bi, S. (2023)
11	Agri-cultural Supply Chain	Kaijun, L., Ya, B., Linbo, J., Nieuwenhuyse, I. V. (2018)
12	Block Chain, Agri-culture	Kamble, S. S., Gunasekaran, A., Sharma, R. (2020)
13	Technologies, Agrifood	Konfo, T. R. C., Djouhou, F. M. C., Hounhouigan, M. H., Dahouennon-Ahoussi, E., Avlessi, F., Sohounhloue, C. K. D. (2023)
14	IoT, Supply Chain	Luthra, S., Mangla, S. K., Garg, D., Kumar, A. (2018)
15	Supply Chain	Manning, L., Brewer, S., Craigon, P. J., Frey, J., Gutierrez, Jacobs, A. Kanza, N., S., Munday, S., Sacks, J., Pearson, S. (2022)
16	Block Chain, Agriculture	Niknejad, N., Ismail, W., Bahari, M., Hendradi, R., Salleh, A. Z. (2021)
17	Smart Farming, IoT	Prakash, C., Singh, L. P., Gupta, A., Lohan, Sk. K., (2023)
18	Food Supply Chain	Rejab, A., Rejab, K., Abdollahi, A., Zailani, S., Iranmanesh, M. (2022)
19	Block Chain, Agri-food	Saurabh, S., & Dey, K. (2021)
20	IoT Based System	Tagaris, A. C., Benos, L., Kateris, D., Tsotsolas, N, Bochtis, D. (2021)
21	IoT Based System	Trenerry, B., Chng, S., Wang, Y., Suhaila, Z. S.,Lim, S. S.; Lu, H. Y.; Oh, P. H. (2021)
22	Agri-food	Visconti, P., Fazio, R. D., Velazquez, R., Del-ValleSoto, C. (2020)
23	IoT, Traceability	Xie, J., Wan, C., Becerra, A. T., Li, M. (2022); Guangjie, L. V., Caixia, S., Pengmin, X., Zhiguo, Q., Heyu, s., Yi., L. (2023)
24	IoT System	Wang, T., Wang, X., Jiang, Y., Sun, Z., Liang, Y., Hu, X., Li, H., Shi, Y., Xu, J., Ruan, J. (2023)
25	IoT, Agri-food	Yadav, S., Luthra, S., Garg, D. (2021)
26	IoT, Agri-food Supply Chain	Yadav, S., Luthra, S.; Garg, D. (2022)

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Each article includes a set of 4-6 keywords that are specific to the authors and help describe the content of the papers. When these keywords co-occur, it indicates the evolution and development of a particular field of study over time. The size of the nodes in the diagram represents the frequency of occurrence, with larger nodes indicating higher frequency. The lines connecting the nodes show co-occurrence. The most frequently used keywords in this analysis were "Agri-food supply chain, Supply chain, agri-food, blockchain, IoT based system, ethical language interaction, production system, digital transformation, smart farming, traceability, food industries, technologies, coordinating systems, smart agri-cultural, IoT, and agro-industries". These keywords had the highest occurrences, highlighting the emphasis on the issues related to IoT and agri-food supply chains. Colour coding was used to distinguish between different clusters represented on the map (see Figure 2).

Discussion

IoT and Agriculture Supply Chain

The main issue that has been studied by researchers in agri-food supply chain industries is the blockchain system. Nicknejad, N. et al (2021) highlighted three categories of research trends on blockchain technology in agri-food studies including traceability, transaction, IoT, safety, and food supply chain. Traceability seems as the most highlighted when Kamble, S. S. et al (2020) found that traceability was the main reason for blockchain implementation for managers and policymakers. The other reason was audibility, immutability, and provenance. Saurabh, S. and Dey, K. (2021) in their research approved that traceability, dis-intermediation, price, trust, compliance, coordination and control as blockchain ICT's integrated were important influences on supply chain application. To maximise transparency and audibility traceability, quality of the products, and hygienic conditions along the supply chain process, Cocco, L. et al (2021) in their research proposed the Near Field Communication (NFC) and RFID as a model implementation of an IOT blockchain-based system in Carasau Bakeries.

Blockchain System

The main issue that has been studied by researchers in agri-food supply chain industries were blockchain system. Nicknejad, N. et al (2021) highlighted three categories of research trends on blockchain technology in agri-food studies including traceability, transaction, IoT, safety, and food supply chain. Traceability seems as the most highlighted when Kamble, S. S. et al (2020) found that traceability was the main reason for blockchain implementation for managers and policymakers. The other reason was audibility, immutability, and provenance.

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The revolution in agri-food technological advances influenced by IoT leading benefits and optimization of productive processes led Visconti, P. et al (2020) to develop smart traceability for farm management system based on IoT, proposed suitable software to support the process of decision making, designed and testing solar-powered wireless sensor network (WSN), Bluetooth Low Energy (BLE) as low-cost sensor tag to monitor the parameter of failure processing products and mobile application for monitoring tracking information and sharing

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the data of the products. However, all the prototypes were tested for 5.6 months with certain particular devices, and only several tests were carried out to verify the function of certain applications.

On the other side, there is also emerging demand for clean, hygienic, and fresh fruits and vegetables in the current world market. These demands become one of the push factors towards agri-food industries. However, certain challenges are faced including increasing the cost related to transportation, processing, packaging, handling, and shipping. Thus, it is very important to develop a reliable agri-food supply chain to maximise food safety. There is a study that proposed a system that incorporated IoT and websites, as well as an android as a platform to monitor the quality of the fruits and vegetables throughout the agri-food supply chain processes. One of the systems named as AgroTRACE with user-friendly open access tracing system, and data sharing on operational processes, as proposed by Tagaris, A. C. et al (2021).

However, the prevention of food safety, security, and traceability in the agri-food supply chain need to be emphasized rather than only responding and reacting to peoples (Dadi, V. et al, 2021). Digitalization and advanced technological usage remain important solutions towards agri-food supply chain industries. In addition, there is a certain scope of the issues that need to be explored in future related to the implementation cost, cyber-security, blockchain technology (BCT) application, combination and integration of technologies, and stakeholders issues on implementation.

Despite all this research, most of the previous studies on traceability applications in agri-food products have not been accessed on how far the systems are effectively implemented. Xie, J. et al (2022) introduce an integrated system machine to machine-to-machine connections in Organic Apple production that automatically collects information in the operation field. The IoT base system is integrated with a hardware system, a platform of Smart Farm Cloud (SFC), and a mobile application including collecting, uploading, and storing information. Throughout the system, a QR code is generated to provide traceability information by consumers. Therefore, it is important to focus on the efficiency of the IoT systems and the trustworthy manner of practical application rather than the methodology issues. The implemented IoT system will increase the customer's confidence towards the products, as well as increase the product value.

However, optimization of the storage scale, the ability to inter-operations, encounter the security and privacy issues of personal data, as well as the storage concerns on agriculture supply chain systems also need to be focused. Bhat, S. A. et al (2022) present Agri-SCM-BIoT (Agriculture Supply Chain Management using Blockchain and the Internet of Things). There is also a discussion on security treating classification with an IoT infrastructure as a mechanism for blockchain-based defence. The study also emphasized the emerging need for trustworthy blockchain-based cross-chain in supply chain management systems to encounter issues related to confidentially, integrity, and availability.

In another study, Kaijun, L. et al (2018) found that certain chains from the agri-food sector applied adopted in the Chinese Public Service Sector. Thus, the study used double chain architecture for the security of information, seeking resources, and increasing the credibility and efficiency of the public service systems.

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On the other hand, it is important to focus on the reformation of agri-food supply chain management with blockchain technology from the institutional economics perspective, rather than only on the application of blockchain from a technological perspective. Fu, H. et al (2020) described the possible situation on how to utilise opportunities effectively based on the blockchain agri-food supply chain aspect (uncertainty, trading frequency, asset specificity). However, it is also important to look a from broad perspective, on how to ensure the business will able to remain sustainable in the industries. Egwuonwu, A. et al (2022) discussed the enhancement impact of a combination of blockchain technology and IoT ecosystem towards global value chain (GVC) and value creation. Their study approved that a combination of blockchain technology and IoT were able to improve GCV in terms of scalability, security, and traceability. It is also recognized that this combination creates significant value for value chain partners to increase competitive advantage.

Digital Transformation

Alongside issues on IoT, blockchain, and traceability system, digital transformation towards IoT implementation in the agri-food supply chain need to be emphasized. Trenerry, B. et al (2021) proposed the information on digital transformation across multi-disciplines and integrated the findings into the multi-level framework (individual, group, organization). At the individual level, the factors of employees' effective digital transformation were technological adoption; perceptions and attitudes on technological changes; skills and training; workplace adaptability; and work-related well-being. The factors of digital transformation at the group level were team communication and collaboration; workplace relationship and team identification; and team adaptability and resilience. Finally, there are three factors of digital transformation at the organization level leadership; human resources; and organizational culture/climate. However, other future research may provide an integrated rich body of literature on technology adoption with the process of digital transformation and the outcomes.

At the same time, the involvement of Information, Communication, and Technology (ICT) in digital transformation cannot be denied. Rejab, A. et al (2022) focus on ICT and implementation towards agriculture and food security, IoT and blockchain on the food supply chain (FSC). The study found that the FSCs papers have significantly grown from 1975 to June 2021. Thus, it is suggested to explore numerous research on the strategy to ensure the successful adoption of sustainability and circular economy into technology enable on agri-food supply chain, increasing research on transformation traditional supply chain and business modal to non-linear sustainable systems, emphasizes the needs of collaboration between industry and academia, country between another country for initiating solutions on food safety and security in future.

Coordinating System, Production System, and Ethical Language Interaction

The implementation of IoT in the agri-food supply chain also can be seen from another perspective which is likely not highlighted by researchers. There are coordinating systems, production systems, and ethical language interaction. Coordinating system in the agri-food supply chain is able to become a framework towards enabling' relationships and improving coordination with operational and strategic decisions. Yadav, S. et al (2022) developed the DEMATEL-ISM method to support coordinating systems with IoT influences. Throughout the process, seven enables have been identified. After adopting this method, it was found that Top Management Support (TMS) were the main driver value. Aside from that, there is also the involvement of stakeholder theory in developing IoT with coordination systems on AFSCM.

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These studies contributed as a guide for managers in developing strategies using strength-weaknesses-opportunities-threats (SWOT) analysis.

The production system in the agro-food supply chain is important to precise the operation in the production system, and reduce the unnecessary cost. Almadani, B. and Mostafa, S. M. (2021) reviewed the literature on the current industrial revolution on technology in the agriculture sector, with emphasis on the gap in supply chain management and identified specific issues in multi-vendor production systems in the industrial and agricultural sectors. The study also proposed a multi-model for communication model on systematic integration of multi-vendor agricultural production systems.

The growth of artificial intelligence (AI) in agri-food supply chain industries raises the studies on ethical language by stakeholders when there is an issue of failure to differentiate nuance meanings that become a barrier to technology adoption. Manning, L. et al (2022) published a review paper to consider the embedded ethical language perspective by stakeholders collaborating with AI adoption in the food supply chain. The study increased an understanding of the used language, exploring ethical interaction and increasing engagement between AI technology and management activities. Although there is a discussion on the benefits of seven aspects of AI technology and algorithm application to consider in the food supply chain (transparency, traceability, explainability, interpretability, accessibility, accountability, responsibility), it is also leading towards algorithmic bias only for one group in the food supply chain over another group of AI in decision making.

Conclusion

The agriculture industry has undergone a significant transformation in recent years, shifting from traditional practices to a more intelligent approach known as “Agri-Food 4.0”. This involves incorporating information and communication (ICT) technology into the cultivation process. By utilizing wireless sensor networks, IoT sensors, traceability systems, optimization techniques, and machine learning algorithms, smart farming can maximize agricultural productivity. These emerging technologies have the potential to improve crop productivity and quality, reduce costs, and decrease the environmental impact of traditional farming methods.

A key focus in smart farming is maximizing crop productivity with minimal human involvement. IoT-based systems offer numerous advantages in addressing this concern for both the global population and farmers. These systems incorporate wireless technologies, modules, sensors, and gateways to collect vast amounts of real-time data for optimization and analysis. This article provides an overview of the latest advancements in IoT-based farming methods and technologies, with the aim of assisting researchers in developing a global solution for smart farming.

As the global population grows and agricultural land diminishes, there is a pressing need for smarter, healthier, and more efficient agricultural practices. Advanced farming techniques have evolved over time, and ongoing research continues to yield impressive developments. Machine learning models and big data solutions play a crucial role in predictive analytics for smart farming. However, overcoming challenges related to inequity, implementation scope, infrastructure feasibility, and cost is necessary for the widespread adoption of machine learning models. Comprehensive approaches to adopting these models are required to effectively analyze systems, solutions, and the agricultural life cycle in smart farming conditions.

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Recent research has demonstrated significant progress in the field of agriculture, particularly regarding data mining through IoT in smart farming. This approach enables farmers to make informed decisions under challenging farming conditions by providing valuable insights such as yield prediction, optimal harvest timing, and suitable crop selection for specific seasons. In conclusion, data mining through IoT systems empowers farmers with actionable insights, enhances productivity, and promotes sustainable farming, thereby driving the transition toward modern agriculture.

Future research in IoT-based smart farming should focus on optimizing the integration of IoT technologies in various farming aspects, utilizing data analytics and AI for informed decision-making, enhancing security and privacy measures, ensuring scalability for small-scale farmers, and exploring IoT-based supply chain management to streamline agricultural processes and improve overall efficiency.

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References

Almadani, B., & Mostafa, S. M. (2021). IIoT based multimodal communication model for agriculture and agro-industries. *IEEE Access, 9*, 10070-10088.

Barbosa, M. W. (2021). Uncovering research streams on agri-food supply chain management: A bibliometric study. *Global Food Security, 28*, 100517.

Bhat, S. A., Huang, N.-F., Sofi, I. B., & Sultan, M. (2021). Agriculture-Food Supply Chain Management Based on Blockchain and IoT: A Narrative on Enterprise Blockchain Interoperability. *Agriculture, 12*(1), 40.

Cocco, L., Mannaro, K., Tonelli, R., Mariani, L., Lodi, M. B., Melis, A., Fanti, A. (2021). A blockchain-based traceability system in agri-food SME: Case study of a traditional bakery. *IEEE Access, 9*, 62899-62915.

Dadi, V., Nikhil, S. R., Mor, R. S., Agarwal, T., & Arora, S. (2021). Agri-food 4.0 and innovations: Revamping the supply chain operations. *Production Engineering_Archives, 27*(2), 75-89.

Egwuonwu, A., Mordi, C., Egwuonwu, A., & Uadiale, O. (2022). The influence of blockchains and internet of things on global value chain. *Strategic Change, 31*(1), 45-55.

Fu, H., Zhao, C., Cheng, C., & Ma, H. (2020). Blockchain-based agri-food supply chain management: case study in China. *International Food and Agribusiness Management Review, 23*(5), 667-679.

Hasan, I., Habib, M. M., Mohamed, Z., & Tewari, V. (2023). Integrated Agri-Food Supply Chain Model: An Application of IoT and Blockchain. American Journal of Industrial and Business Management, 13(2), 29-45.

Jahanbin, P., Wingreen, S. C., Sharma, R., Ijadi, B., & Reis, M. M. (2023). Enabling affordances of blockchain in agri-food supply chains: A value-driver framework using Q-methodology. International Journal of Innovation Studies, 7(4), 307-325.

Jararweh, Y., Fatima, S., Jarrah, M., & AlZu'bi, S. (2023). Smart and sustainable agriculture: Fundamentals, enabling technologies, and future directions. *Computers and Electrical Engineering*, 110, 108799.

Konfo, T. R. C., Djouhou, F. M. C., Hounhouigan, M. H., Dahouenon-Ahoussi, E., Avlessi, F., & Sohounhloue, C. K. D. (2023). Recent advances in the use of

International Journal of Entrepreneurship and Management Practices
IJEMP
EISSN : 2600-8750
Volume 6 Issue 23 (December 2023) PP. 35-44
DOI: 10.35631/IJEMP.623003

digital_technologies in agri-food processing: a short review. *Applied Food Research*, 100329.

Leng, K., Bi, Y., Jing, L., Fu, H.-C., & Van Nieuwenhuyse, I. (2018). Research on agricultural supply chain system with double chain architecture based on blockchain technology. *Future Generation Computer Systems, 86*, 641-649.

Lv, G., Song, C., Xu, P., Qi, Z., Song, H., & Liu, Y. (2023). Blockchain-Based Traceability for Agricultural Products: A Systematic Literature Review. *Agriculture*, 13(9), 1757.

Manning, L., Brewer, S., Craigon, P. J., Frey, J., Gutierrez, A., Jacobs, N., Pearson, S. (2022). Artificial intelligence and ethics within the food sector: Developing a common language for technology adoption across the supply chain. *Trends in Food Science & Technology*.

Prakash, C., Singh, L. P., Gupta, A., & Lohan, S. K. (2023). Advancements in Smart Farming: A Comprehensive Review of IoT, Wireless Communication, Sensors, and Hardware for Agricultural Automation. *Sensors and Actuators A: Physical*, 114605.

Rejeb, A., Rejeb, K., Abdollahi, A., Zailani, S., Iranmanesh, M., & Ghobakhloo, M. (2021). Digitalization in food supply chains: A bibliometric review and key-route main path analysis. *Sustainability, 14*(1), 83.

Saurabh, S., & Dey, K. (2021). Blockchain technology adoption, architecture, and sustainable agri-food supply chains. *Journal of Cleaner Production, 284*, 124731.

Tagarakis, A. C., Benos, L., Kateris, D., Tsotsolas, N., & Bochtis, D. (2021). Bridging the Gaps in Traceability Systems for Fresh Produce Supply Chains: Overview and Development of an Integrated IoT-Based System. *Applied Sciences, 11*(16), 7596.

Visconti, P., de Fazio, R., Velázquez, R., Del-Valle-Soto, C., & Giannoccaro, N. I. (2020). Development of sensors-based agri-food traceability system remotely managed by a software platform for optimized farm management. *Sensors, 20*(13), 3632.

Wang, T., Wang, X., Jiang, Y., Sun, Z., Liang, Y., Hu, X., & Ruan, J. (2022). Hybrid machine learning approach for evapotranspiration estimation of fruit tree in agricultural cyber-physical systems. *IEEE Transactions on Cybernetics*.

Xie, J., Wan, C., Tolón Becerra, A., & Li, M. (2022). Streamlining Traceability Data Generation in Apple Production Using Integral Management with Machine-to-Machine Connections. *Agronomy, 12*(4), 921.