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Analysis On Enhancement of The Performance of Food Supply Chain Using Blockchain

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Abstract

This research paper focuses on distributors' attitudes and involvement toward blockchain technology to resolve food safety, traceability, transparency, and efficiency issues. Traditional supply chain management systems often need help to address these challenges effectively. Blockchain technology has become a viable answer in recent years to enhance the FSC by providing secure, transparent, and decentralized data management. The initial step of the analysis involves reviewing relevant literature and collecting data to gain a comprehensive understanding of how blockchain technology can be effectively utilized in real-world scenarios within the FSC. It also looks at the consumer's overall perspective on the value of investing in safe food and how this demand affects the decision of distributors to use blockchain technology.

Keywords: Performance, Supply chain, Blockchain technology, Food, and challenges

Introduction:

The supply chain in food industry involves a series of interconnected processes that facilitate the movement of food from its source on the farm to the point of consumption at our tables. This encompasses various stages, including production, distribution, consumption, and disposal. Since every part of the FSC is intertwined with each other any minor effect in any part of the FSC will have a great effect on the prices. Blockchain technology is a highly secured system to record information which makes it difficult to hack or manipulate and hence can be used to provide transparency and traceability. By strengthening traceability and associated transactions, blockchain technology may be effectively employed in the FSC to ensure safety and improve the security of sensitive data. It is estimated to reach $886.18 million by 2025 with a CAGR of 47.1%. The primary factor driving the food industry's constant growth is the need for transparent food supply chains and easy-to-trace food provenance in order to ensure food's quality. The basis of the blockchain for the FSC is a distributed ledger that contains data on all events and transactions in the supply chain. The ledger is composed of time-stamped and encrypted data chunks that are synchronized chronologically. Each block is made up of multiple transactions that is verified by the preset consensus procedure.

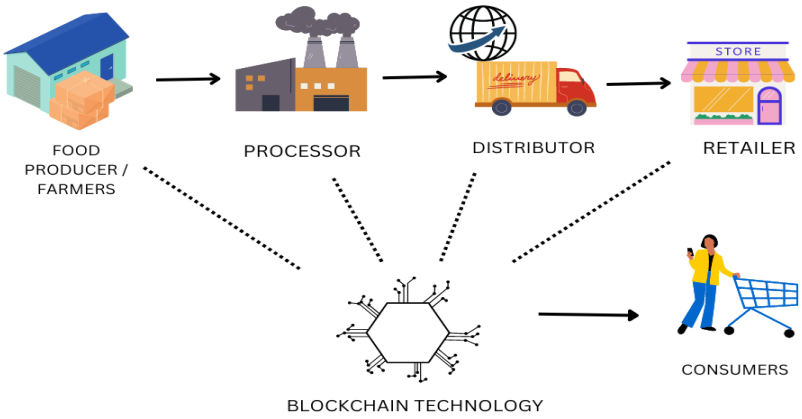
Role-specific mobile and internet applications are used by those involved in the FSC to communicate with the blockchain ledger.

Suppliers of raw foods exchange information about the product's place of origin and chain of distribution. Food makers provide information about ingredients and production methods. Documents pertaining to the product's origin and quality are verified by food inspectors and certification bodies. Transport companies post information about the whereabouts and storage circumstances of food items in transit. Distributors of food goods keep tabs on the food supply chain's actions to ensure moral

sourcing, high-quality food production, and consumer safety. End users can check the provenance of food goods to ensure their validity.

In simpler terms, a blockchain is a network of several computers that keeps a digital "record" for use in transactions. To improve food traceability, the Food and Drug Administration 2020 developed blueprint for Smarter Food Safety Era. This concept is being advanced and food traceability is being improved by a number of trading partners wanting to extend the usage of blockchain technology. A finished or marketable product can be tracked via blockchain technology, with greater security, from the farm to the fork. If Blockchain Technology and IoT are integrated, the entire FSC may be tracked very quickly. The IoT/QR code may be read and tracked in a matter of seconds for complete transparency. Blockchain technology can also be used to remove problematic foods and supplies at specific sources with precise accuracy. Blockchain technology enables systems to be instantly assessed for food product issues, tampering and waste that can be identified and categorized within supply chains, food contamination issues can be quickly identified, helping with in immediate product recalls. Additionally, it has been mentioned that the Indian food supply chain sector urgently need attention, and that blockchain technology has been widely implemented in the food and medical supply chains in countries like the United States, China, and Australia.

This paper mainly focuses on how the efficiency of the FSC can be elevated by understanding the consumer's attention towards food hygiene to influence the usage of blockchain technology with the distributors.



ARCHITECTURE OF BLOCKCHAIN TECHNOLOGY

Literature Review:

S.Balamurugan, et al. (2021), In their research paper on IoT-Blockchain driven traceability techniques for improved safety measures in FSC says how the fusion of Internet of Things and blockchain technology has led to advancements in methods for establishing and tracking the origin and path of a product or information for enhancing safety measures in the FSC. The study highlights how IoT devices can collect data at various supply chain stages, ensuring real-time tracking and monitoring. By integrating blockchain, the collected data becomes secure, immutable, and transparent, mitigating risks of contamination and fraud. The paper emphasizes the importance of this IoT-Blockchain integration in

ensuring the integrity and authenticity of information, thereby improving safety and efficiency in the FSC.

Angelo Marchese, et al. (2022), In their article "A Blockchain-Based System for Agri-Food Supply Chain Traceability Management", discuss a blockchain-based system designed for managing traceability in the agri-FSC. The system utilizes blockchain technology to ensure data immutability and ensuring openness and visibility at every stage of the supply chain. It enables collecting, verifying, and sharing information related to product origins, handling, and quality. Smart contracts are employed to automate and enforce compliance with traceability regulations and standards. The paper highlights the potential of blockchain in improving transparency, accountability, and food safety in the agricultural and food sector through efficient and secure traceability management.

Xiaohong Chen, et al. (2022), In their article "Internet of Things (IoT)—blockchain-enabled pharmaceutical supply chain resilience in the post-pandemic Era", focuses on the use of blockchain and IoT to strengthen the resiliency of the pharmaceutical supply chain during the post-global pandemic period. It discusses how Internet of Things devices can collect real-time data on pharmaceutical products, storage conditions, and transportation. By integrating blockchain, the collected data becomes secure, transparent, and tamper-proof, ensuring the integrity and authenticity of the supply chain information. The paper emphasizes the significance of leveraging IoT and blockchain to enhance supply chain visibility, reduce counterfeiting risks, improve logistics efficiency, and ensure the availability of essential medicines during and after a pandemic.

Amanptreet Kaur, et al. (2022), In their research paper on Adaptation of IoT with Blockchain in Food Supply Chain Management: An Analysis-Based Review in Development, Benefits and Potential Applications presents an analysis-based review on the adaptation of IoT and Blockchain in food supply chain management. It explores the development, benefits, and potential applications of integrating these technologies. The study emphasizes how IoT devices can collect real-time data throughout the supply chain, while blockchain ensures data integrity and transparency. The paper discusses the benefits of this integration, including improved traceability, enhanced food safety measures, reduced fraud, and increased operational efficiency. It concludes by highlighting the potential applications of IoT and blockchain in areas such as product authentication, cold chain management, and supply chain sustainability in the food industry.

Alia AI Sadawi , et al. (2021), In their paper on A Survey on the Integration of Blockchain With IoT to Enhance Performance and Eliminate Challenges, presents a survey on integrating blockchain with IoT to enhance performance and address challenges. It examines various research works and case studies in this domain. This study highlights the potential benefits of combining blockchain and IoT, such as increased data security, improved trust, and enhanced scalability. The paper also discusses the challenges faced in implementing this integration, including scalability issues, energy consumption, and interoperability. It concludes by providing insights into future research directions and potential blockchain and IoT integration applications.

Feng Tian, (2016), In their article "An agri-food supply chain traceability system for China based on RFID & blockchain technology" found that an agri-FSC traceability system for China using RFID and blockchain technology. The system focuses on enhancing transparency and traceability in the supply chain. It utilizes RFID tags to collect real-time data on product information, while blockchain ensures data integrity and transparency. The paper discusses the design and implementation of the system, highlighting its potential to improve food safety and quality control. It concludes by emphasizing the

importance of systems for tracking products in the agri-food sector and the potential benefits of integrating RFID and blockchain technologies.

Horst Treiblmaier, et al. (2023), In their article "Using Blockchain to signal quality in the food supply chain: The impact on consumer purchase intentions and the moderating effect of brand familiarity" says that the impact on purchase intentions of consumers and the influence of brand familiarity. This paper examines the usage impact blockchain to signal quality in the FSC on consumer purchase intentions. It explores how blockchain technology can enhance transparency and trust in the food industry. The study investigates the moderating effect of brand familiarity on consumers' responses to blockchain-based quality signals. The findings suggest that blockchain-based quality signals positively influence consumer purchase intentions, and this effect is stronger for consumers with higher brand familiarity. The paper highlights the potential of blockchain in improving consumer perceptions of food quality and provides insights for businesses and policymakers in leveraging blockchain technology in the FSC.

S. Thangamayan, et al. (2023), In their article "Blockchain-Based Secure Traceable Scheme for FSC found that a blockchain-based secure and traceable scheme for the FSC" says that The scheme utilizes blockchain technology to ensure the integrity and transparency of information throughout the supply chain. It focuses on addressing challenges such as food fraud, traceability gaps, and data privacy concerns. The proposed scheme incorporates cryptographic techniques and smart contracts to enhance security and traceability. The study highlights the potential of blockchain in improving food safety, reducing fraud, and enhancing consumer trust in the FSC.

Problem Statement:

The purpose of this study is to analyze distributors' decision to use blockchain to enhance the FSC. This study aims to understand the distributor's demand to use blockchain technology based on the consumer's attitude towards the safety of the FSC. This study also aims to determine the demographic variables and how they have an effect.

The findings will provide insights into the transparency and traceability of food, willingness to pay more for verified food, concern about food fraud and mislabeling, and efficiency and cost-effectiveness of the FSC have significant impacts on the willingness of distributors to use a blockchain-based FSC.

Objectives Of Research

The objective is to identify the elements that influence distributor's decisions to adopt blockchain to improve the FSC. Investigate the impact of the food's transparency and traceability on the decision of distributors to employ a blockchain-based FSC.

Hypothesis Formulation:

1) H0: The transparency and traceability of the food purchased has no significant impact on the willingness of distributors on using blockchain based FSC.

H1: The transparency and traceability of the food purchased has a significant impact on the willingness of distributors on using blockchain based food supply chain

2)H0: The quality and safety of the food purchased has no significant impact on the willingness of distributors on using blockchain based food supply chain

H1: The quality and safety of the food purchased has a significant impact on the willingness of distributors on using blockchain based food supply chain

3)H0: The customer's willingness to pay more for the food that has been verified to be of higher quality and safety has no significant impact on the willingness of distributors on using blockchain based food supply chain

H1: The customer's willingness to pay more for the food that has been verified to be of higher quality and safety has a significant impact on the willingness of distributors on using blockchain based food supply chains

4)H0: The concern on food fraud and mislabelling has no significant impact on the willingness of distributors on using blockchain based FSC.

H1: The concern on food fraud and mislabelling has a significant impact on the willingness of distributors on using blockchain based FSC.

5)H0: The rapid and ease of access to real-time information has no significant impact on the willingness of distributors on using blockchain based FSC.

H1: The rapid and ease of access to real-time information has a significant impact on the willingness of distributors on using blockchain based FSC.

6)H0: The reduction of food wastage in the supply chain has no significant impact on the willingness of distributors on using blockchain based FSC.

H1: The reduction of food wastage in the supply chain has a significant impact on the willingness of distributors on using blockchain based FSC.

7)H0: The improvement of efficiency and cost-effectiveness of the food supply chain has no significant impact on the willingness of distributors on using blockchain based FSC.

H1: The improvement of efficiency and cost-effectiveness of the food supply chain has a significant impact on the willingness of distributors on using blockchain based FSC.

Methodology:

Data Collection and Response:

To investigate the willingness of distributors on using blockchain-based food supply chain a structured questionnaire was employed to collect primary data. We received a total of 126 responses from shop keepers. The questionnaire comprised of 15 questions covering demographic variables, transparency and traceability factor of the food purchased, quality and safety factor of the food purchased, customer's willingness to pay more for the verified food, concern on food fraud and mislabelling, familiarity on blockchain technology, reduction of food wastage, improvement of efficiency and cost-effectiveness of the food supply chain. The survey was conducted using google forms and the perceived details of the respondents were collected.

VARIABLES	YES	MAYBE	NO
Experience faced with quality or safety	55.6%	31%	13.5%
Willingness to pay	52.4%	31.7%	15.9%

Improve transparency and traceability	53.2%	34.1%	12.7%
Improve the efficiency and cost-effectiveness	51.6%	34.9%	13.5%
Participation in blockchain-based food supply chain	50.8%	33.3%	15.9%

VARIABLES	VERY CONCERNED	SOMEWHAT CONCERNED	NOT CONCERNED
Concern about transparency and traceability	55.6%	26.2%	18.3%
Concern about food fraud and mislabelling	57.1%	30.2%	12.7%

VARIABLE	VERY IMPORTANT	SOMEWHAT IMPORTANT	NOT IMPORTANT
Knowledge of the origin of the food they purchase	27.8%	50%	22.2%
Fast and easy access to real-time information about the purchased food	29.4%	45.2%	25.4%

LOCALITY OF THE PEOPLE	PERCENTAGE
City	57.1%
Town	29.4%
Rural	13.5%

FAMILIARITY WITH BLOCKCHAIN TECHNOLOGY	PERCENTAGE
5	22.2%
4	22.2%
3	31%
2	10.3%
1	14.3%

FEATURES TO BE USED IN BLOCKCHAIN	PERCENTAGE
Food origin	15.9%
Production and processing of information	4%
Transportation and storage conditions	22.2%
Food safety information	37.3%
All of the above	20.6%

INTEREST IN USING BLOCKCHAIN TO TRACK FOOD	PERCENTAGE
Very interested	46.8%
Somewhat interested	34.1%
Not interested	19%

HELPFULNESS IN REDUCING FOOD WASTE USING BLOCKCHAIN TECHNOLOGY	PERCENTAGE
A lot	27.8%
A little	59.5%
Not at all	12.7%

Data Analysis and Interpretation:

- Respondents' location distribution: 57.1% from the city, 29.4% from town, 13.5% from rural areas.
- Concern about traceability and transparency: 55.6% very concerned, 26.2% somewhat concerned, 18.3% not concerned.
- Experience with food safety issues: 55.6% faced issues, 31% unsure, 13.5% had no issues.
- Willingness to pay more for verified food: 52.4% strongly agreed, 15.9% strongly disagreed, 31.7% unsure.
- Importance of knowing food origin: 27.8% very important, 50% slightly important, 22.2% unimportant.
- Concern about food fraud and mislabelling: 57.1% strongly concerned, 30.2% somewhat concerned, 12.7% unbothered.
- Importance of fast and easy access to food information: 45.2% slightly important, 29.4% highly important, 25.4% least important.
- Familiarity with blockchain technology: 31% neutral, 22.2% slightly familiar, 22.2% very familiar, 14.3% least familiar, 10.3% no familiarity.
- Belief in blockchain improving transparency and traceability: More than half strongly believed, 34.1% neutral, 12.7% did not believe.
- Interest in using blockchain-based platform for food supply chain tracking: 46.8% strongly interested, 34.1% slightly interested, 19% uninterested.
- Perception of blockchain's impact on reducing food waste: 59.5% little impact, 27.8% significant impact, 12.7% no significant impact.

- Belief in blockchain improving efficiency and cost-effectiveness: 51.6% strongly agreed, 34.9% unsure, 13.5% disagreed.
- Willingness to use blockchain-based food supply chain: Majority willing, significant number unsure, 15.9% unwilling.
- Most important features of a blockchain-based food supply chain: 37.3% food safety, 22.2% transportation/storage conditions, 15.9% food origin, 4% production/processing, 20.6% all of the above.

Multiple Regression:

SUMMARY OUTPUT								
REGRESSION STATISTICS								
Multiple R				0.97				
R Square				0.94				
Adjusted R Square				0.94				
Standard Error				0.19				
Observations				126				
ANOVA								
	Df	**SS**	**MS**		**F**		**Sig.F**	
Regression	7	64.45	9.21		259.29		0.00	
Residual	118	4.19	0.04					
Total	125	68.63						
	Coeffs	**Std Error**	**t Stat**	**P value**	**Lower 95%**	**Upper 95%**	**Lower 95.0%**	**Upper 95.0%**
Intercept	0.08	0.27	0.29	0.03	-0.45	0.61	-0.45	0.61
Transparency and Traceability	0.29	0.06	4.88	0.00	0.17	0.41	0.17	0.41
Quality and Safety	-0.06	0.10	-0.56	0.57	-0.25	0.14	-0.25	0.14
Pay more for verified food	0.18	0.07	2.55	0.01	0.04	0.32	0.04	0.32
Food fraud and Mislabelling	-0.19	0.08	-2.36	0.02	-0.35	-0.03	-0.35	-0.03
Rapid and Ease of access to real-time information	-0.06	0.04	-1.63	0.11	-0.13	0.01	-0.13	0.01
Reduction in wastage of Food	-0.01	0.04	-0.29	0.78	-0.10	0.08	-0.10	0.08
Efficiency and Cost-effectiveness	0.70	0.08	8.52	0.00	0.54	0.86	0.54	0.86

The following multiple regression table presents the coefficients and associated statistics for a model that predicts a specific outcome variable. Here are the interpretations based on the table:

Multiple R: The multiple correlation coefficient, 0.98 suggests a strong positive correlation between the independent variables included in the regression model and the dependent variable. This indicates that

there is a tendency for the dependent variable to increase as the values of the independent variables increase collectively.

The obtained coefficient of determination (R-squared) is 0.94, which signifies that approximately 94% of the fluctuations in the outcome variable can be elucidated by the independent variables included in the model. In other words, the predictors utilized in the model explain 94% of the observed variations in the decision-making process of distributors to adopt blockchain technology for their food supply chain. This discovery holds substantial importance within the specific research field under investigation.

Now let's discuss the interpretations of the coefficients:

- **Constant:** The constant coefficient is 0.08. It represents the estimated average value of the outcome variable when all other independent variables are held at zero. However, since the confidence interval for this coefficient (-0.45 to 0.61) includes zero and the p-value (0.03) is less than the typical significance level of 0.05, the constant term is statistically notable. Therefore, we can conclude that it has a meaningful impact on the decision of distributors to use blockchain based FSC.
- **Transparency and Traceability:** The coefficient for this variable is 0.29. It implies that, on average, a one-unit increase in transparency and traceability is associated with a 0.29 unit increase in the decision of distributors to use blockchain based food supply chain when all other variables are held constant. The p-value (0.00) is much lower than 0.05, indicating that this coefficient is statistically notable. The 95% confidence interval (0.17 to 0.41) provides a plausible range for the true population coefficient.
- **Quality and Safety:** The coefficient for this variable is -0.06. It indicates that, on average, a one-unit increase in quality and safety is linked with a decrease of 0.06 units in the decision of distributors to use a blockchain-based food supply chain when all other variables are held constant. The p-value (0.57) is higher than 0.05, indicating that this coefficient is not statistically notable. Therefore, we cannot conclude that this variable strongly influences the outcome variable.
- **Pay more for Verified Food:** The coefficient for this variable is 0.18. It depicts that, on average, a one-unit increase in willingness to pay more for verified food is linked with a 0.18-unit increase in the decision of distributors to use a blockchain-based food supply chain when all other variables are held constant. The p-value (0.01) is lower than 0.05, indicating that this coefficient is statistically notable. The 95% confidence interval (0.04 to 0.32) provides a plausible range for the true population coefficient.
- **Food Fraud and Mislabelling:** The coefficient for this variable is -0.19. It suggests that, on average, a one-unit increase in concern about food fraud and mislabelling is associated with a decrease of 0.19 units in the decision of distributors to use blockchain-based food supply chains when all other variables are held constant. The p-value (0.02) is lower than 0.05, implying that this coefficient is statistically notable. The 95% confidence interval (-0.35 to -0.03) provides a plausible range for the true population coefficient.
- **Rapid and Ease of access to real-time information:** The coefficient for this variable is -0.06. It shows that, on average, a one-unit increase in rapid and ease of access to real-time information is associated with a decrease of 0.06 units in the decision of distributors to use a blockchain-based food supply chain when all other variables are held constant. However, the p-value (0.11) is higher than 0.05, indicating that this coefficient is not statistically notable. Therefore, we cannot conclude that this variable strongly influences the outcome variable.

- **Reduction in wastage of Food:** The coefficient for this variable is -0.01. It suggests that, on average, a one-unit increase in the reduction of food wastage is associated with a decrease of 0.01 units in the decision of distributors to use blockchain-based food supply chains when all other variables are held constant. The p-value (0.78) is higher than 0.05, suggesting that this coefficient is not statistically notable. Hence, we cannot conclude that the reduction in food wastage has a significant impact on the outcome variable.
- **Efficiency and Cost-effectiveness:** The variable has a coefficient of 0.70. This suggests that, on average, a one-unit increase in the improvement of efficiency and cost-effectiveness is associated with a 0.70-unit increase in the outcome variable when all other variables are held constant. The p-value (0.00) is much lower than 0.05, indicating that this coefficient is statistically notable. The 95% confidence interval (0.54 to 0.86) provides a plausible range for the true population coefficient.

  To summarize, based on the regression analysis, variables such as Transparency and Traceability, Pay more for Verified Food, Food Fraud and Mislabelling, and Efficiency and Cost-effectiveness show statistically significant associations with the decision of distributors to use blockchain-based food supply chains. However, variables such as Quality and Safety, Rapid and Ease of access to real-time information, and Reduction in wastage of Food do not demonstrate statistically significant effects.

Findings of the Study:

Based on the regression coefficients, the standardized coefficient for transparency and traceability of food is 0.29, with a t-value of 4.88, a p-value of 0.00, which is below the predetermined level of significance is 0.05, we can disprove the null hypothesis (H0) and infer that there is a notable difference or positive relationship among the transparency and traceability of food and the willingness of distributors to use a blockchain-based FSC.

The standardized coefficient for quality and safety of food is -0.06, with a t-value of -0.56 and a p-value of 0.57. Given that higher the p-value is than the predetermined significance level of 0.05, we are unable to disprove the null hypothesis (H0) and can conclude that there is insufficient evidence to establish a significant association between the quality and safety of food and the willingness of distributors to use a blockchain-based FSC.

The standardized coefficient for willingness to pay more for verified food is 0.18, with a t-value of 2.55 and a p-value of 0.01. Since the p-value is less than the significance level of 0.05, we disprove the null hypothesis (H0) and conclude that there is an important positive relationship between the willingness to shell out money more for verified food and the willingness of distributors to use a blockchain-based FSC.

The standardized coefficient for concern about food fraud and mislabelling is -0.19, with a t-value of -2.36 and a p-value of 0.02. Since the p-value is less than the significance level of 0.05, we reject the null hypothesis (H0) and conclude that there is a significant negative relationship between the concern about food fraud and mislabelling and the willingness of distributors to use a blockchain-based FSC.

The standardized coefficient for rapid and ease of access to real-time information is -0.06, with a t-value of -1.63 and a p-value of 0.11. Since the p-value is greater than the significance level of 0.05, we fail to disprove the null hypothesis (H0) and conclude that there is insufficient evidence to support a significant

relationship between the rapid and ease of access to real-time information and the willingness of distributors to use a blockchain-based FSC.

The standardized coefficient for reduction in wastage of food is -0.01, with a t-value of -0.29 and a p-value of 0.78. Since greater the p-value is than the significance level of 0.05, we approve the null hypothesis (H0) and conclude that there is insufficient evidence to support the relationship between the reduction in wastage of food and the willingness of distributors to use a blockchain-based FSC is significant.

The standardized coefficient for efficiency and cost-effectiveness of the food supply chain is 0.70, with a t-value of 8.52 and a p-value less than 0.001. Since the p-value is lesser than the significance 0.05, we disprove the null hypothesis (H0) and conclude that there is a significant positive relationship among the efficiency and cost-effectiveness of the FSC and the willingness of distributors to use a blockchain-based FSC.

In summary, the findings indicate that the transparency and traceability of food, willingness to pay more for verified food, concern about food fraud and mislabelling, and efficiency and cost-effectiveness of the FSC have significant impacts on the willingness of distributors to use a blockchain-based FSC. However, there is insufficient evidence to support significant relationships between ensuring the excellence and safety of food, with a focus on speed and ease of access to real-time information, and reduction in wastage of food with the willingness of distributors to use a blockchain-based food supply chain.

Conclusion:

In conclusion, this research provides valuable insights on the usage of blockchain technology by the distributors. The findings indicate that blockchain technology holds great promise in enhancing the FSC by enabling improved traceability and transparency. Distributors recognize the significance of investing in food safety and comprehending its value meeting consumer demands for food safety. They also acknowledge that blockchain technology can help build trust among consumers by providing verifiable and tamper-proof information about the origin, quality, and handling of food products.

However, the adoption of blockchain technology among distributors is influenced by various factors. These include the perceived cost-effectiveness and efficiency of implementing blockchain solutions, the level of technical expertise required, the availability of supporting infrastructure, and the willingness of stakeholders to collaborate and share data. Distributors' attitudes towards blockchain technology are also shaped by their understanding of its potential benefits and the overall perceived value it adds to their operations.

The findings support the notion that blockchain technology can effectively address challenges related to food safety, traceability, and transparency in the supply chain. Distributors recognize the value of implementing blockchain solutions to enhance the trust and consumer trust and belief in the food products they distribute. The ability of blockchain to provide secure and decentralized data management aligns with the growing consumer demand for safe and trustworthy food.

Future research in this area can explore additional factors that may influence the willingness of distributors to adopt blockchain technology, delve deeper into the barriers and challenges faced during implementation, and examine the long-term effect of blockchain on the FSC. Such investigations would further advance our understanding of the potential of blockchain technology to revolutionize the food sector and create a safer and more transparent food system.

References:

[1] S.Balamurugan, A.Ayyasamy,& K. Suresh Joseph.(2021). IoT-Blockchain driven traceability techniques for improved safety measures in food supply chain.

Springer Link. International Journal of Information Technology 14. https://doi.org/10.1007/s41870-020-00581-y

[2] Angelo Marchese&Orazio Tomarchio.(2022). A Block chain-Based System for Agri-Food Supply Chain Traceability Management.

*Springer Link. SN Computer Science 3*https://doi.org/10.1007/s42979-022-011483

[3] Xiaohong Chen, Caicai He, Yan Chen & Zhiyuan Xie. (2022). Internet of Things (IoT)—blockchain-enabled pharmaceutical supply chain resilience in the post-pandemic era.

Springer Link. Frontiers of Engineering Management 10(1) https://doi.org/10.1007/s42524-022-0233-1

[4] Amanptreet Kaur, Gurpreet Singh, Vinay Kukreja& Sparsh Sharma.(2022). Adaptation of IoT with Blockchain in Food Supply Chain Management: An Analysis-Based Review in Development, Benefits and Potential Applications. *Sensors 22* https://doi.org/10.3390/s22218174

[5] Yan Xu, Xiangxin Li, Xiangquan Zeng& Jiankang Cao. (2020). Application of blockchain technology in food safety control : current trends and future prospects, *Taylor and Francis Online 62(10)* https://doi.org/10.1080/10408398.2020.1858752

[6] Alia AI Sadawi, Mohamed S. Hasan& Malick Ndiaye. (2021). A Survey on the Integration of Blockchain With IoT to Enhance Performance and Eliminate Challenges.

IEEE 9 https://doi.org/10.1109/ACCESS.2021.3070555

[7] Feng Tian. (2016). An agri-food supply chain traceability system for China based on RFID&blockchaintechnology.

IEEE http://dx.doi.org/10.1109/ICSSSM.2016.7538424

[8] Horst Treiblmaier& Marion Garaus. (2023). Using blockchain to signal quality in the food supply chain: The impact on consumer purchase intentions and the moderating effect of brand familiarity.

Science Direct 68 https://doi.org/10.1016/j.ijinfomgt.2022.102514

[9] S. Thangamayan, Kalyani Pradhan, Ganesh Babu Loganathan& S. Sitender, S.Sivamani. (2023). Blockchain-Based Secure Traceable Scheme for Food Supply Chain.

Hindawi, Journal of Food quality https://doi.org/10.1155/2023/4728840

[10] Jerome Verny & Wei Guan. (2022). Blockchain Adoption in Food Supply Chain.

Intech Open DOI: 10.5772/intechopen.106402

[11] Nam Vu, Abhijeet Ghadge & Michael Bourlakis. (2021). Blockchain adoption in food supply chain : a review and implementation framework,z.

[12] *Taylor and Francis Online* https://doi.org/10.1080/09537287.2021.1939902

[13] Mika Westerlund, Soham Nene, Seppo Leminen & Mervi Rajahonka. (2021).An Exploration of Blockchain –based Tracebility in Food supply chain: On the benefits of Distributed Digital Records from Farm to Fork.

https://timreview.ca/article/1446

[14] Kay Behnke & M.F.W.H.A. Janssen. (2020). Boundary conditions for traceability in food supply chains using blockchain technology.

Science Direct 52 https://doi.org/10.1016/j.ijinfomgt.2019.05.025

[15] Lu Yang, Jun Zhang & Xiutian Shi. (2021). Can blockchain help food supply chains with platform operations during the COVID-19 outbreak?,

Science Direct 49 https://doi.org/10.1016/j.elerap.2021.101093

[16] Fran Casino, Venetis Kanakaris, Thomas K. Dasaklis, Socrates Moschuris & Nikolaos P. Rachaniotis. (2019). Modeling food supply chain traceability based on blockchain technology.

Science Direct 52(13) https://doi.org/10.1016/j.ifacol.2019.11.620

[17] Anna Holmberg & Rebecca Aquist. (2018). Block chain technology in food supply chains.

Master Thesis 30 HP/ECTS http://www.divaportal.org/smash/get/diva2:1231110/FULLTEXT01.pdf

[18] Slawomir Jarka. (2019). Food Safety in the Supply Chain using Blockchain Technology.

Acta Sci. Pol. Oeconomia 18(4) http://dx.doi.org/10.22630/ASPE.2019.18.4.43

[19] Martina Thume, Julia LOange, Martin Unkel, Alexander Prange & Malik Schurmeyer. (2021). Blockchain-based traceability in the food industry: requirements analysis along the food supply chain.

OSF Preprints DOI: 10.31219/osf.io/uyb64

[20] Bowen Tan , Jiaqi Yan, Si Chen & Xingchen Liu. (2018), The Impact of Blockchain on Food Supply Chain: The Case of Walmart.

Springer Link 11373 https://link.springer.com/chapter/10.1007/978-3-030-05764-0_18

[21] Fran Casino, Venetis Kanakaris, Thomas k. Dasaklis, Socrates Moschuris, Spiros Stachtiaris & Maria Pagoni. (2021). Blockchain-based food supply chain traceability: a case study in the dairy sector.

Taylor and Francis 59(19) https://doi.org/10.108/00207543.2020.1789238