Applying Block Chain Processes In Food Industry

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Abstract - Blockchain technology has shown promise in improving traceability, transparency, and trust across a range of businesses, including the food industry. Stakeholders in the food business can create decentralized, unchangeable records of transactions by utilizing blockchain technology, protecting the supply chain's integrity from farm to fork. This abstract examines how blockchain technology can be used in the food business, emphasizing how it can solve important problems including food theft, contamination, and inefficiencies in conventional supply chain management. Distributed ledger technology enables all parties involved in the food supply chain to safely document and monitor each stage of the manufacturing, processing, and delivery of food, giving customers never-before-seen insight into the source and path of the goods they purchase. Moreover, smart contracts powered by blockchain technology have the ability to automatically adhere to rules and specifications, promoting smooth collaboration between manufacturers, suppliers, regulators, and retailers. Food production, distribution, and consumption could undergo a radical change as a result of blockchain procedures, which promise to provide safer, more sustainable, and ethically produced food items through increased accountability and transparency.

I. INTRODUCTION

Blockchain technology offers a transformative solution to the complexities of the food industry's supply chains, addressing issues of safety, transparency, and sustainability. Blockchain improves traceability, ensures food safety, and increases consumer confidence by creating a secure and transparent ledger to follow the journey of food products from manufacturing to consumption. Its ability to improve supply chain management through automation and efficiency highlights its significance in creating a safer, more transparent, and sustainable food ecosystem. However, the existing research environment reveals a need for a more in-depth examination of blockchain's implications for food traceability, including infrastructure, interoperability, and policy issues, identifying opportunities for further investigation and development.

Blockchain technology emerges as a game changer for the food industry's complex supply networks, providing a solution to long-standing issues with safety, transparency, and sustainability. Blockchain allows for thorough tracking of food goods from their origins to their consumption by generating a secure and decentralized ledger. Increased traceability not only improves food safety, but also boosts consumer confidence. Furthermore, blockchain improves supply chain operations by automating processes and lowering administrative hassles. Despite its potential, there is a lack of comprehensive study on blockchain's usefulness in enhancing food traceability, highlighting the need for greater exploration and understanding in this rapidly growing subject.

- Concept (Applying block chain process in food industry.

The concept of applying blockchain technology in the food business is based on utilizing its inherent qualities to improve the transparency, traceability, and efficiency of food supply chains. Blockchain is a decentralized, unchangeable database that stores and validates transactions in a safe and transparent way. When applied to the food business, blockchain allows stakeholders to trace food goods throughout their lifecycle, from manufacture and processing to distribution and consumption. Each stage in the supply chain is recorded as a block, which includes information such as ingredient origin, manufacturing procedures, shipping details, and quality assurance measures. By establishing a tamper-proof record of these transactions, blockchain improves traceability, helps the early discovery of concerns such as contamination or fraud, and increases consumer

confidence in the safety and the validity of food items. Moreover, blockchain improves supply chain procedures by automating documentation, decreasing paperwork, and enhancing overall efficiency. This concept of blockchain in the food business represents a paradigm change towards a more transparent, secure, and sustainable food ecology.

II. LITERATURE REVIEW

Food production is divided into four phases. The first stage is locating (local or international) raw materials and verifying their quality and safety standards. Next, after the food is processed, it is sent to the handling and storage stage, where it is cleaned and processed into various end products. The subsequent phase comprises handling and storage, where they are packed according to their specifications before being moved on to distribution and transportation. There are different supply-chain models, such as continuous (cash crops), fast chain (perishable items), efficient (unique products), agile (retail products), flexible (agricultural and meat products) and custom figured (hybrid food items).

Moreover, the global food supply chain is complex and struggles to meet the sustainability and safety benchmark. Therefore, a more robust supply chain structure and market governance are needed to maintain an innovative, sustainable food system. Furthermore, sustainability, availability, financial capital, food safety and security, and traceability are crucial to building a smooth FSC.

Effect of Pandemic Disruptions on Food Supply Chain
The food systems are meeting enormous stress and challenges due to the pandemic disruptions. The world food manufacturers and supply chain providers are now trying to meet that demand by using effective international and domestic trading protocols to stop supply chain resources and bottlenecks.

The COVID-19 epidemic has ushered in a new era in the world, with FSC bearing the full brunt. Considering the food supply chain, commercial activities and the supply of various food products have been halted due to a reduction in demand, the closure of food manufacturing facilities, and financial constraints. Farm labour, processing, transportation, and logistics obstacles, as well as significant shifts in demand. The majority of these disruptions are the result of policies implemented to slow the spread of the virus. In the face of these pressures, food supply chains need resilience. Grocery shop shelves are being emptied at a quick pace as stockpiling activity shifts in conjunction with panic buying behaviour among customers. Moreover, the greatest threat to food security is not a lack of food, but a lack of consumer access to food.

Food policymakers are working hard to maintain costs and flows at as minimal a level as possible. The worst-affected section is labour scarcity in foodprocessing and packaging companies, as the industries have been asked to reduce their workforce to stop transmissions. As a result there are more significant bottlenecks in the FSC.

- Conventional Food Supply Chain and Issues

As the world's population grows, so does the need for more food, demanding a more excellent supply of high-quality commodities. On the supply side, however, there is still concern about the industry's ability to fulfill higher product yields and quality improvements as a result of issues such as climate change, droughts, and agricultural productivity. The global agricultural linkages are intricate because they involve numerous actors at various levels, from those who generate and add value to processed goods to those who sell. When there are several distinct food items, each with its own unique and widely fragmented supply chain, the complexity rises. Consumers are increasingly concerned about responsible food sources and food production. FSC management is more difficult in developing countries because they typically involve small-scale farmers with hardly any market governance and outreach. Adverse effects on food availability are generated because of the hurdles faced by FSC, such as substantial intermediation, diminished profitability, decreased quality, food waste, and loss of revenue.

Therefore, major players are now motivated to adopt sustainable methods in their supply chains since they can guarantee a consistent food supply and profitability. However, sustainability has a price and workflow to follow. It is one of the major trump cards that can fetch an organization's competitive advantage

as per the natural resource-based view. The parameters of successful sustainability directly reduce wastes and improve environmentally green practices (waste reduction), social responsibility (social wellbeing), and economic viability (improved livelihood). It would be interesting to see how technological tools assist in addressing these challenges in FSC.

- Application of Internet of Things (IoT), Big Data & Blockchain in FSC

In underdeveloped countries, only a tiny part of the food supply chain will usually be considered for food ecosystem security audits. The accessibility of the ecosystem, access to the supply chain, and utilization of the food chain are three measurement scales generally used to inspect food and ecosystem security. Food supply networks are complex and interconnected, and IoT-based systems can monitor them to capture details on food materials and protect the ecosystem. The Internet of things (IoT) platform can provide product traceability information in the food supply chain, assisting customers, especially during this pandemic disruption where the information available is so vague. By combining IoT and blockchain technologies, FSC can become more transparent and productive by delivering robust and stable information to clients and related stakeholders.
At present, pathogenic and parasitic contaminations can move with frozen food packages, according to scientific evidence, especially in the context of the current COVID-19 situation, where traceability is critical in maintaining food quality and safety. To create a tamperproof audit trail to verify parasites and viruses in packed foods in the FSC, IoT-based, tamperproof data sharing with a centralized architecture and blockchain smart contracts can be used. IoTs can efficiently handle seedling procurement and temperature management in the agriculture industry . Ortañez et al. (2020) built an effective and flexible IoT-based coordinating system for boosting the coordinating mechanism in the agriculture food supply chain during natural outbreaks, to stop the issues caused by fake food. Balamurugan et al. (2021) presented a supplier-based, blockchain hyperledger technology to ensure that FSC data is available and traceable, with an unimpaired substantial computational capacity when implemented within the realms of the IoT.

Mondal et al. (2019) presented a distributed ledger technology assisted by IoT architecture, and created a transparent food supply chain using a proof-of-object-based authentication system, similar to cryptocurrency's proof-of-work protocol, coupled with an RFID-connected sensor for real-time data acquisition. As a result, establishing a food traceability supply chain is an effective strategy to address the food safety issue. However, the running costs of a standard food traceability supply chain system are substantial. In an environment where economies are growing more competitive, diversified, and complex, customers have now started to expect high quality and traceability. Blockchain-based software platforms have been advocated to improve traceability by increasing transparency within the FSC .

Because of rapid technological advancements, key competitive techniques are rapidly changing. The amount of data globally is continuously increasing; every 12 months, the amount of data in the world doubles. Customers now put too much emphasis on food ingredients and nutritional composition. Even while organic foods are nutritious, they need stringent certification procedures. Big data and blockchain can suffice this issue by providing the necessary certification platform.

Li et al. (2017), created a prototype tracking tool that allows the use of sensor data and the creation of data-driven pricing decisions in a variety of operational scenarios and product features. Furthermore, in the same context, Ji et al. (2017), [30] previously introduced a Bayesian network approach for predicting market demand that combines sample data and establishes a cause-and-effect relationship between data, as well as a crisp schematic on how large data can be integrated into Bayesian mathematical network optimization to anticipate demand. Moreover, a service-oriented traceability platform (SOTP) used in the packaged foods supply chain allows real-time dynamic data acquisition and processing of packaged foods information, creating a ubiquitous environment in the packaged foods supply chain. This ensures packaged food's life-cycle visibility and traceability from their production, circulation, and consumption. Additionally, the objective of algorithms for tracing contamination

sources and locating potentially contaminated food in markets can be achieved.

2.5. Blockchain in FSC

Blockchain is a secure digital ledger that records and validates user transactions that cannot be altered or deleted. These actions are known as blocks, each having its own digital signature and a connection to the previous one. This approach creates a growing list of chronologically arranged encrypted records. Digital currencies or cryptocurrencies are utilized across the supply chain to pay for the quality of assets. Agriculture farmers, distributors, and consumers can pay for selective access, sharing, and authentication of products. The transactions are followed by advanced encryption systems. A QR code is placed on food packaging that contains all of the evidence gathered along the supply chain. Consumers may scan the QR code to obtain comprehensive stock traceability, including origin information. Moreover, in global logistics, the distributed ledger technology-based smart contracts (which use the blockchain to execute agreements), and the smart web (cloud) have all been used to preserve container information so that its partners may receive data on container conditions, such as humidity and temperature .

Furthermore, this allows banks to also benefit from the FSC's visibility and lend money to farmers without risk. Buyers will have an easier time verifying whether the seller's statements regarding the food quality are accurate through blockchain smart contracts. This technology makes it easier to decentralize, enhance security, sustain and manipulate supply chains during disruptions. Furthermore, a better cost-control mechanism of the food traceability supply chain-based system is also possible to practice .

III. RESEARCH METHODOLOGY

Objectives of the Study:

- How much people aware about block chain processes in food industry.
- To know the current challenges in food safety, traceability, and transparency within the food industry supply chain.

Research Design:

The descriptive research design is a method of describing every characteristics of the population which is considered in studied. This research design is focuses on the 'WHAT' of the research subject rather than 'why' of the research subject.

Source of Data:

1) Primary data: Such data collected first hand, either by the researcher or by someone else, especially for the study is known as primary data. The primary data to be collected for study are questionnaire. Questionnaire: A questionnaire is a list of question or items used to gather data from respondents about their attitudes, experience, or opinions. It can be used to collect quantitative or qualitative information.

2) Secondary data: Secondary data means data that are already available. i.e., they refer the data, which have been collected and analyzed by someone else. When the researcher utilizes secondary data, then he has to look into various sources from where he can obtain them. Secondary data may either published data or unpublished data. Usually published data are available in Books, magazines and newspapers or Data provided by the company or Internet.

Data collection method:

For data collection method we use Questionnaire .because questionnaire is a research instrument that consists of a set of questions for the purpose of gathering information from respondents through survey or statistical study. A research questionnaire is typically a mix of close-ended questions and open-ended questions. *Questionnaire* is mailed to respondents who are expected to read and understand the questions and write down the reply in the space meant for the purpose. Analysis of *questionnaire* responses is concerned with what people think and do as revealed by what they put on paper.

Population:

A population is the entire group that you want to draw conclusions about. in research, a population doesn't always refer to people. It can mean a group containing elements of anything you want to study, such as objects, events, organizations, countries, species, organisms, etc. here also for research we will take sampling from such industry experts, organizations for study.

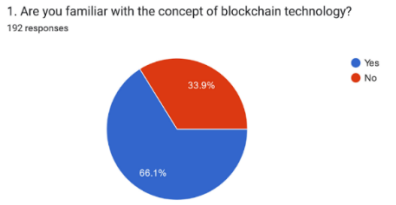
Sampling Method:

For this project convenience sampling is used. Convenience sampling is a non-probability sampling method. Convenience focuses on gaining information from participants who are convenient for the researcher to access. Convenience sampling is also known as opportunity or availability sampling. Convenience sampling include online and social media surveys, asking acquaintances, and surveying in a mall, on the street, and in other crowded areas.

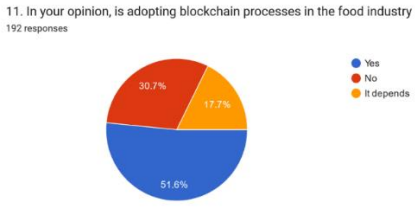
Data Collection Instrument:

Questionnaire method is used for this study, the questions are framed to capture quantitative data efficiently, making the analysis precise and comprehensive. These instruments facilitate structured data collection, allowing for systematic analysis and comparison.

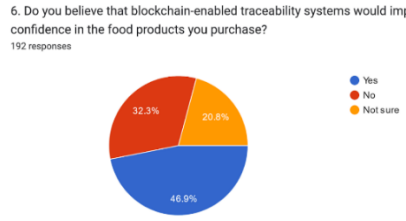
IV. DATA ANALYSIS



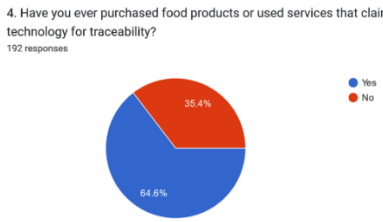
Interpretation:- There are 68.3% of respondents are Male and 31.7% respondents are Female.



Interpretation:- There are 51.6% respondents are agree, 30.7% respondents are not agree and 17.7% respondents are says that 'it depend' on situation.



Interpretation:- There are 46.9% respondents are agree with that blockchain-enabled traceability systems would improve your trust and confidence in the food products you purchase , 32.3% respondents are not agree and 20.8% respondents are not sure about that.



Interpretation:- There are 64.6% respondents are purchased food products or used services that claim to utilize blockchain technology for traceability and 35.4% are not.

HYPOTHESIS:

Objective:1 How much people aware about block chain processes in food industry.

Here for hypothesis testing there is used chi-square test. For descriptive data. Here the questionaries' contain categorical question that's why this research paper use chi-square test for hypothesis testing.

H0: there is no relationship between block chain and food industry.

H1: there is relationship between block chain and food industry.

Are you familiar with blockchain? * applying blockchain system in food industry is reliable? Crosstabulation

Count

		applying blockchain system in food industry is reliable?		
		Yes	no	it depands	Total
are you familiar with blockchain?	yes	74	30	23	127
	no	27	29	11	67
Total		101	59	34	194

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	8.367[a]	2	.015
Likelihood Ratio	8.219	2	.016

Linear-by-Linear Association	2.005	1	.157
N of Valid Cases	194		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 11.74.

Here defines hypothesis of one objective. That contains knowledge of blockchain system in food industry. Here shows chi-square test.157 that is shows there is no significant relationship between blockchain system and food industry.

H0: there is no significant relationship between challenges of employer and food industry.

H1: there is significant relationship between challenges and food industry.

Do people think blockchain system improve tryst for the product which purchase. * have you ever purchase a product which utilize blockchain in that. Crosstabulation

Count

		have you ever purchase a product which utilize blockchain in that.	
		yes	no	Total
do people think blockchain system improve tryst for the product which purchase.	yes	63	27	90
	no	39	23	62
	not sure	22	20	42
Total		124	70	194

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.895[a]	2	.143
Likelihood Ratio	3.851	2	.146
Linear-by-Linear Association	3.824	1	.051
N of Valid Cases	194		

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 15.15.

Here shows second objective proven hypothesis that include challanges faced in blockchain system and blockchain process in food industry.

V. FINDINGS

- It is found that major 68.3% of respondents are Male and 31.7% respondents are Female.
- It is found that major 51.6% respondents are agree, 30.7% respondents are not agree and 17.7% respondents are says that 'it depend' on situation.
- 46.9% respondents are agree with that blockchain-enabled traceability systems would improve your trust and confidence in the food products you purchase , 32.3% respondents are not agree and 20.8% respondents are not sure about that.
- There are 64.6% respondents are purchased food products or used services that claim to utilize blockchain technology for traceability and 35.4% are.

CONCLUSION

The pressing issues faced by the food industry, including challenges related to food safety, traceability, and transparency. These challenges, such as foodborne infections, supply chain inefficiencies, and consumer demands for transparency, have necessitated the exploration of innovative solutions. Blockchain technology emerges as a promising solution to address these challenges, offering a decentralized and tamper-proof ledger system that can track food products throughout the supply chain, ensuring transparency and accountability. By leveraging blockchain processes, stakeholders in the food industry can enhance traceability, improve food safety, and meet the evolving demands of consumers.

ACKNOWLEDGEMENTS

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