A Systematic Review and Bibliometric Analysis on BlockChain Technology in Sustainable Food Agro-Processing and Dairy Sector

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Abstract
The unprecedented situation of COVID-19 disrupts significant sectors of the supply chain, like the Milk Supply Chain (MSC). Eradication of hunger and providing nutrition to all sections of the demographic population is a global agenda of the G-20 summit. Sustainable Development Goals (SDG) 12 is adopting a green economy and technological practices in production and consumption patterns in agricultural and dairy farming to save the planet, people and their overall health. This article critically reviews the systematic literature on the emergence of technological adoption and digitalization in the Indian Agro-Processing and Dairy sector through statistical models and mathematical tools. This paper is based on data extraction from Web of Science, SCIVAL and Scopus sources of information. Quantitative methods represent a diverse range of epistemological, theoretical and disciplinary perspectives. About 325 articles from blockchain and 250 articles from dairy supply chain (DSC) retrieved from peer-reviewed journals were accessed from the database. This data was analyzed from a review of literature and bibliometric analysis. Sustainability is a core sub-theme of reviewed literature in Blockchain technology in the Indian milk and dairy supply chain (DSC). Beneficiation of research are researchers and academicians tend to explore extensive and systematic literature in a related field of study by using statistical tools and methods to develop substantive research. It provides a better lens to identify present, past and future trends in literature to research and publish. Vosviewer software was used to develop analytical models from the data retrieved from the present published literature during 2022-23. This research is based on adopting blockchain technology in sustainable agriculture and dairy farming. Research is limited to the theoretical aspect of the study. Citation analysis may be both positive and negative.

*Keywords***:** *Milk Supply Chain, Blockchain Technology, bibliometric analysis, DSC, SDG -12.*

1. Introduction

The agriculture sector contributes seventeen percent to the Gross Domestic Product (GDP) of the Indian economy. The Indian dairy sector, in terms of milk production and consumption, is the largest. The dairy sector is an integral part of attaining sustainable development goals to eradicate poverty, unemployment and health issues globally. The Indigenous market of the Indian dairy sector has the largest market share in rural areas, which is potential growth at the production level (Kasten

,2019). Nowadays due to urbanization and industrialization, consumers are mainly focused on quality of food due to changing lifestyle patterns and high disposable income. They mainly emphasise on pure, adulteration free and uncontaminated milk at their doorsteps (Choudahry and Genovese, 2022).Dairy supply chains achieve SDG's 12 for production and consumption patterns, enables them to create value addition, go green concepts, enhance the efficiency and effectiveness of activities involved in supply chain and logistics (Kasten,2019).

Developing countries like India, which has the highest milk production, face several environmental challenges in the food and dairy supply chain. There is a need for the incorporation of sustainable agro-processing techniques in a supply chain which contributes to alleviating poverty and increasing competitiveness and business development (Beber and Langer, 2021).

The food supply chain is an integrated approach and complex framework involving food wastage, safety, and minimization of losses. The food chain involves different channels of information network in the agriculture sector preceded by its stakeholders (producers/farmers, food processors, distributors, retailers, and the consumer) and cooperative societies (Kunpeng li et al., 2023). Blockchain is an emerging and revolutionary decentralized technology which minimizes losses in the food supply chain and provides efficiency in operational activities.

In conventional dairy farming processing and supply chain, it is difficult to manage the safety and quality of animal products, which poses new challenges for the food supply chain due to food contamination. Globally, food chains incur losses due to mislabelled and unbranded sales of milk and dairy products (Patel and Singh, 2023).

The main components of the food supply chain for improving its efficiency are trust, sustainability, transparency and digitalization. In the case of the dairy supply chain (DSC), trust is built among the stakeholders by mutually achieving the goals and benefits. Delivery of products, exchange of information in a comprehensive manner through technology

without delay and timely payment are the prerequisites of developing loyalty in behavior. Sustainability, in the case of DSC, means the optimum utilization of available resources without compromising future generations' needs to protect the planet from adverse environmental effects. Actors are involved in transparency in supply chain activities and create a value chain. Technological advancement in the dairy supply chain helps improve mechanized systems, production and logistics activities to produce final products and value-chain (Niya et al., 2021).

Based on physical and geographical location, production and consumption for DSC are classified into indigenous and global dairy supply chains. It is comprised of multiple channels of large retailers, dairy cooperatives and dairy companies, which include farmers, food processors (including all types of B2B food processors), food traders (consisting of distribution and retail) and end users (Djekic and et., 2021).

Based on the literature available, systematic research questions are formulated. The most crucial and difficult task in research design is devising the research questions (Cousell,1997).

RQ1: How does blockchain technology play an essential role in traceability and safety in the milk and dairy supply chain?

RQ2: What is the role of sustainable development goals SDG -12 in the production and consumption of dairy and milk supply chain?

Aim of the study is underline as follows:

1. To examine the role of blockchain technology in traceability and safety in the milk and dairy supply chain.

2. To analyze the role of sustainable development goals SDG -12 in the production and consumption of dairy and milk supply chain.

2. Literature Review:

This literature review focuses on the critical aspects of sustainability in the dairy and food supply chain. It emphasizes the role of blockchain technology in the dairy and food sectors. The bibliometric technique is adopted to review the literature in this domain.

2.1 *Sustainability in dairy and food supply chain (FSC)*: The dairy and FSC is a complex and integrated network for which minimizing losses and errors is challenging. A supply chain comprises a thread of three pillars of sustainability with its economic, social and environmental dimensions. Sustainable supply chain network practices (SSCNP)means to ensure better and ethical business practices as processors, manufacturers, and suppliers, protecting the environment economically in supply and logistics without compromising the social and welfare needs of the future generation (Chamcho, etal, 2021).

Indian dairy research institutes like NDRI, Department of Agricultural, Animal Husbandry, Dairying and Fisheries (DAHD) under the Ministry of Agriculture, GOI, FSSAI, and AMUL as market leaders, researchers and scientists are the stakeholders striving to achieve sustainable dairy policies in India (Djekic, etal., 2021)..

The purpose of all the activities perform in the supply chain and logistics to create value-addition in products and services in a sustainable manner. Strong intervention require by all actors (processors, manufacturers, and suppliers, retailers and statutory dairy and milk organizations) of supply chain and logistics to delivered low price high quality milk production of dairy and milk products (Sidwai and Ploeger, 2020).

Traceability in milk and dairy products is to locate and trace the activities performed from dairy farms to end users by monitoring and evaluating the performance successfully at multiple ends(singh,etal,2020). It establish a fine linkage between dairy farmers, processors/ manufacturers, distributors, retailers and consumers without disruptions in dairy supply chain. Coordination and communication among all the supply chain agents are carried out sustainably (Charlebois and Haratifar, 2015).

The dairy supply chain comprises many levels of distribution and production; dairy farmers initiate it from a farmhouse to milk shipping companies via distributors, suppliers, retailers and ultimate customer. The main phases are harvesting crops to feed cattle to extract the milk they produce. Cultivate crops for green fooder and manure as part of agriculture on land farmers have. Collection of milk from the dairy farm and distribution through transportation to different areas to milk providers. After packaging and labeling, they distribute to retailers and end users (Caro, Ali, et al. 2018).

2.2 *Bibliometric Analysis in Systematic Literature Review:* Bibliometric analyses provide quantitative analysis of academic literature. Bibliometrics" has comprises of two words: "Biblio" and "metrics". The word "Biblio" is derived from the combination of the Latin and Greek words "biblion," meaning book. The term "metrics", which indicates the science of meter (i.e. measurement), is derived either from the Latin or Greek word "metrics" or "metrikos", respectively, each meaning measurement (Sengupta,1992:76). Bibliometrics, " is the application of mathematics and statistical methods for books and other media of documents, Journal of Documentation (1969). The bibliometric process includes statistical analysis of published articles and citations to measure their impact.

2.3 *Blockchain chain technology in dairy and food supply chain:*
Blockchain is an integrated technology with a signing transaction account on an internet platform with a trustworthy, transparent, audibility and traceable system that helps minimize faults, errors and disruptions during operational activities (Hastig & Sodhi, 2019; Choi, 2020). Parties involved in transactional networks share all kinds of values and data with confidentiality and security to attain efficiency in performance and managing the set of activities in the value chain (Choi & Luo, 2019; Dutta et al., 2020; Orji et al., 2020; Li et al., 2020a, 2020b).

It is the fastest-growing technology, introduced by the pseudonym Satoshi Nakamoto, initially applicable to financial transactions through cryptocurrencies. It is the most extensive intervention in human life in this digital era, where applications of web technologies and icloud computing provide a network for performing operational and supply chain activities without disruptions. Information is dispersed through unique code, which creates a block-of-chain network quickly, error-free and efficiently (Mangla, etal., 2021).

Blockchain is a party to party network. In the case of the DSC quality of assurance, expert knowledge, traceability and checks and balances are crucial aspects. Incorporating blockchain technology in the DSC network helps optimize logistic operations and increase profit margin. Blockchain technology is embedded in a DSC to protect from adverse environmental impacts like emission of CO_2 gases by reducing proximity to the market for supplies products through local transportation. It also protects animals in the dairy farming business from fraud because of their sensor verification and veteran benefits (Koval,2022).

Blockchain applications initiate digitalization in the food and agro-processing industry as an integrated approach, and it is estimated that blockchain in supply chain management SCM is expected to expand at a pace of almost eighty percent in developed countries with an annual growth rate of 3,314.6 US $ in 2023(Chang et al., 2019). Indian dairy sector is expected to grow with a trajectory of INR 30,840 billion by the year 2027, which generates rural employment of approximately a significant statistic of 31 lakhs per year, with a potential scope of adoption of blockchain technology (Khanna, etal., 2022).

2.4 *Sustainable Development Goals (SDG) -12:* The dairy supply chain is highly perishable and has the shortest life span. Maintaining the quality and quantity is the biggest threat to the wastage of products. SDG 12 agenda is to reduce wastage and increase production and consumption in the supply chain (Marchi and zanoni, 2022).

Blockchain is a license-based network set up by a group of firms or organizations to form a network. The firms set up a network through the Hyperledger Fabric network called members. Each member is responsible for actively participating with other members by identifying themselves using cryptographic material such as Certificate Authority and related information. The main components for setting up a network are as follows:
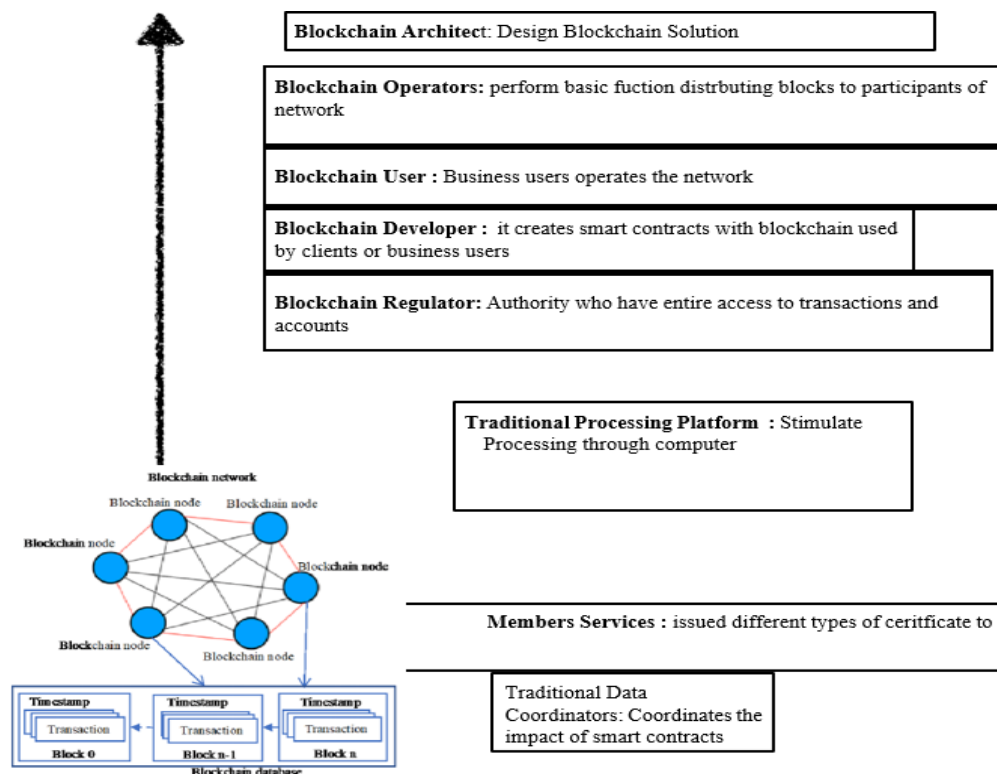

Fig 1: Blockchain Technology Components and its Architect

3. Research Gaps:

The Indian dairy industry comprises the formal and informal sectors, where the informal sector largely contributes to milk production and processing. Most dairy farmers/processors still need to procure milk from conventional methods, wasting resources and losses. Traditional food supply chains encouraged numerous challenges like production irregularities, unfair trade practices, contamination, impurity, perishability issues and adulteration in milk and dairy products. In unorganised sector traceability of food safety and quality is a major concern. Blockchain was introduced as effective tool to countering the traceability and food safety issues.

4. Conceptual Framework:

To ensure minimizing the losses, irregularities, unfair practices in the Indian dairy sector this paper aims to statistically measure through in depth literature review on blockchain technology. It examines the health issues mainly the non-epidemic diseases are major concern rises unprecedented in numbers in last two decades. Blockchain technology emerges as a new concept in formal dairy supply chain which improves efficiency at production level. India is the second largest Internet users in world. In dairy supply chain blockchain enables milk traceability framework that integrated with application of blockchain technology. From processing to deliver milk as the product of choice and necessity all the information supplies through internet all from the farm to the processing plant undergoes are recorded and uploaded onto the blockchain in an automated manner by the use of sensors. The use of QR codes can be widely seen in the work as it acts as a gateway to all information concerning a particular product.
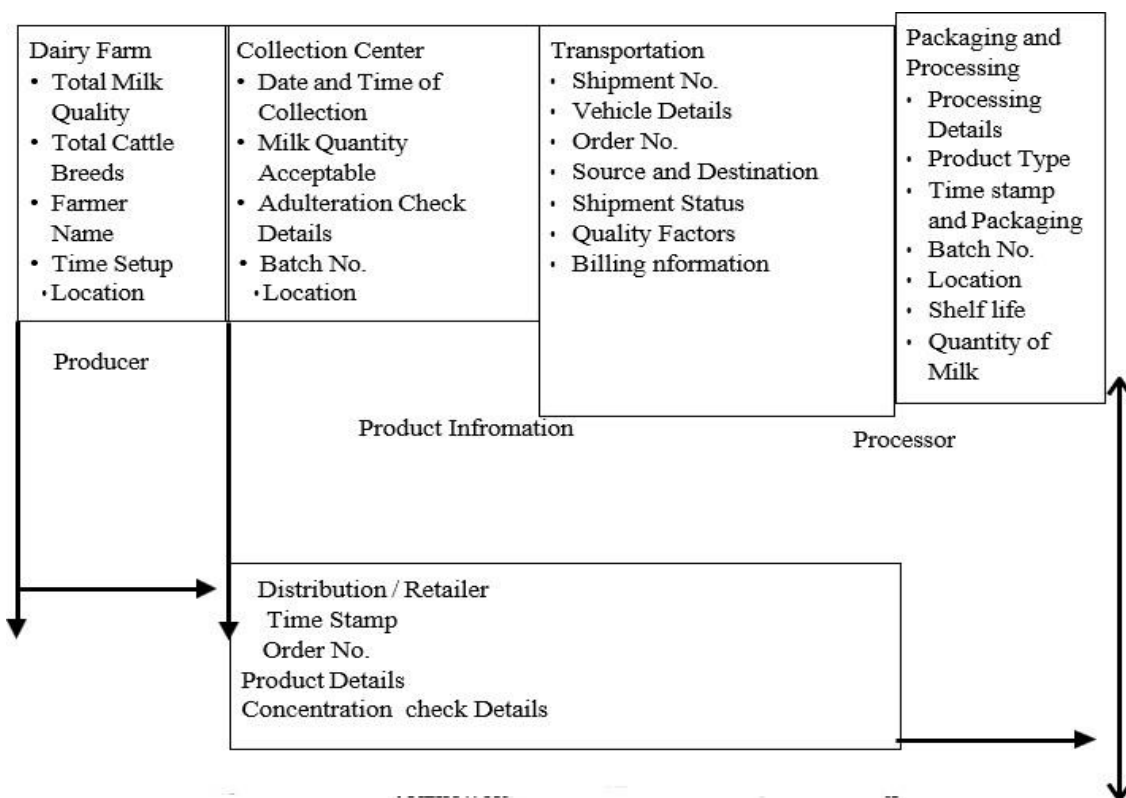
Fig. 2 Conceptual Framework of Modernised Dairy Supply Chain

4. Methodology:

This study is based on an in-depth literature review of the dairy supply chain and the adoption of blockchain technology. The data is retrieved from secondary sources through peer- reviewed journals, articles and other textual materials on Google Scholar. SLR have a different dimension to review the articles based on a theoretical framework and parameters or keywords (Rosado-Serrano et al., 2018; Canabal & White, 2008; Paul & Singh, 2017; Kahiya, 2018; Hao et al., 2019); Framework based (Paul & Benito, 2018), Searching articles through keywords is another from exploring and review the literature. The systematic way of performing literature is depicted in the diagram as follows:
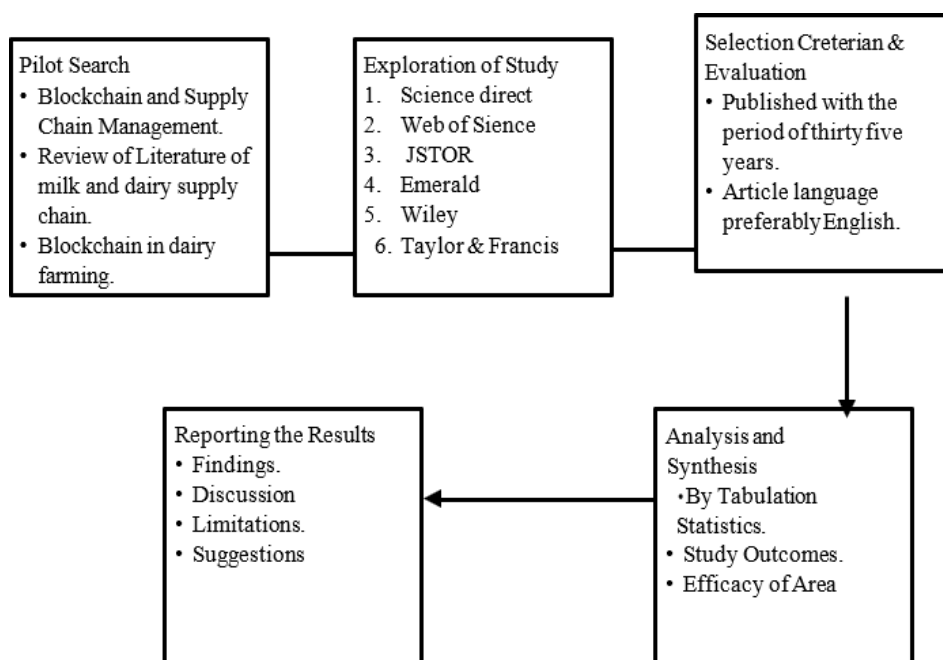
Fig. 3 Systematic Framework for Review of Literature

The Systematic framework for ROL provides a well-structured, clear picture of the review and selection process, which is transparent and clearly defined (Tranfield et al., 2003). based on a review of high-impact factor journals, the following tables show the literature review process. A systematic review of a pilot search is the initial step to start the process, using keywords to access the literature electronically. The articles are explored from various databases using SCOPUS, Google Scholar, Web of Science and JSTOR. We applied the five-step process to understand better the research area reviewed (Kitchenham et al., 2009) shown in Fig. 3.

5. Analysis and Synthesis

After gathering the appropriate collection of relevant papers, the data analysis and synthesis begin. Whereas the aim of the analysis is to breakdown each study into its constituent parts and describe the overall relationships and connections, the aim of synthesis is identify the asso- ciations between parts of different studies (Tranfield et al., 2003). Analysis and synthesis of this study are represented through the following subsections.

5.1. Searches by Keywords: In a systematic literature review, the initial step for pilot search for database is a keyword search. In searches the articles and documents logical operator like 'AND' ,'OR' are used. Searches can be conducted on the basis of research questions.

Table 1 Searches Database by Keywords

Data base	No. Of Article Reviewed	Type of Article	Search Keywords
JSTOR	10	Research Paper	Bibliometric Analysis
Scopus	50	Review Paper	Milk and Dairy supply chain
Scopus	40	Review Paper	Blockchain Technology
Emerald	40	Research Paper	Sustainability
Web of Science	45	Research Paper	Agro and Food Processing Industry

5.2. About Database

Bibliometric Analysis was widely used in Information and Library Science, but now it has gained importance in social sciences, too. The conceptual framework developed on the database retrieved from repositories for publication employs bibliometric analysis (Zupic and Čater 2015). By reviewing through bibliometric analysis, explore several related research fields via author, document and year as a source type. It shows the hi-index and impact factor with the reviewed articles in a scientific manner ((Ramos Rodríguez and Ruíz- Navarro 2004).

Table 2: Searches Database by Impact Factor

Title of the Paper	Journal Name	Area of Research	Impact Factor
Transforming Supply Chain Network and Logistics using Blockchain – A Survey	International Journal of Business Information System	Supply chain and Logistics	0.381
Forecasting the Next Revolution: Food Technology's Impact on Consumers' Acceptance and Satisfaction	Bristish Food Journal	Food Processing and Technology	3.224
Performance Analysis of Hyperledger Fabric based Blockchain for Traceability in Food Supply Chain	2021 IEEE 2nd International Conference on Technology, Engineering, Management for Societal Impact using Marketing, Entrepreneurship and Talent, TEMSMET 2021	Blockchain Technology	174 citation
Blockchain Applications in Management: A Bibliometric Analysis and Literature Review	Journal of Business Logistics	Bibliometric Analysis	10.3

Table 3: Publications by Blockchain Technology in DSC.

Source Name	Title of paper	Author Name	Year of Publication
ScienceDirect	Supply chain re-engineering using blockchain technology: A case of smart contract based tracking process	Chang, S.E., Chen, Y.-C., Lu, M.-F.	2019
Taylor & Francis	Food supply chain in the era of Industry 4.0: blockchain technology implementation opportunities and impediments from the perspective of people, process, performance, and technology	Kayikci, Y., Subramanian, N., Dora, M., Bhatia, M.S.	2022
Semnatic Scholar	The Role of Blockchain to Fight against COVID-19	Kalla, A., Hewa, T., Mishra, R.A., Ylianttila, M., Liyanage, M.	2020
ScienceDirect	Green marketing innovation and sustainable consumption: A bibliometric analysis	Kumar Kar, S., Harichandan, S.	2022

5.3. Trends in Publications: The articles reviewed during 2019-2022 are scanty; blockchain is an emerging technology that has gained attention in supply chain and logistics after COVID-19. Only some articles on blockchain technology were published during this period. Technological forecasting and social change have the highest cite score of seventy-four. The Journal of Cleaner Production has had many publications in 2020. Slope depicted that the number of published articles declined after COVID-19. The relevance of blockchain technology was prominent in COVID-19.
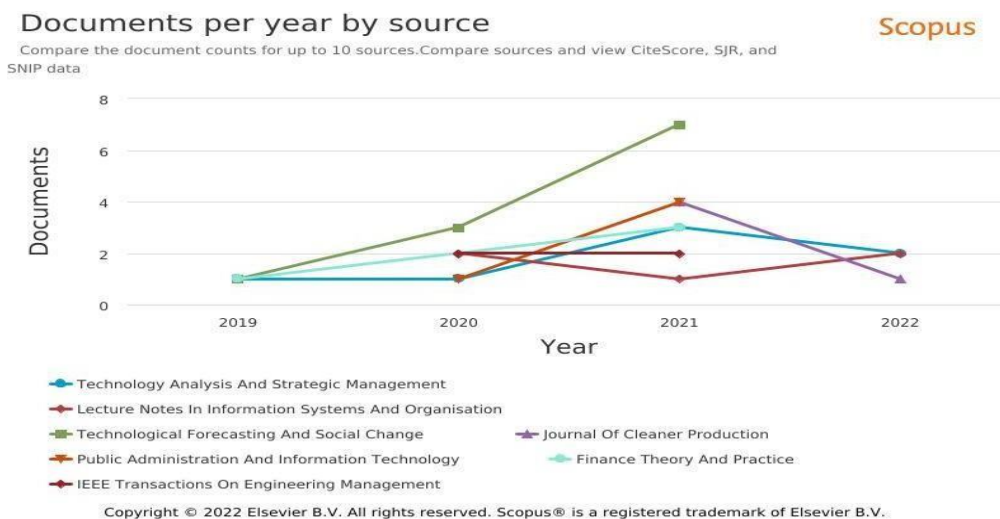**5.4.**

Fig. 4: Trends in Publication by database accessed.

In the past few years, trends have shown that the number of publications is at hilke between 2019 and 2021. Despite gaining interest in this research field, there needs to be more published work, and the researcher search in the area of blockchain in the dairy supply chain is stagnant. Source evaluated on the basis of cite score, SJR and SNP data. In bibliometric analysis, Scopus can use to measure reputed journals within database and use the metrics to analyze and visualise data of reviewed literature. Scopus is an Elsevier citation and abstract-based peer-reviewed database comprising scholarly scientific journals, books and conference proceedings. Bibliometrics, a key feature and tool for reviewing the literature, was used to track citations of past and previous years' published work related to a set of authors or documents. It enables assessing trends in search results, analyzing an author's publishing output, and gaining insight into journal performance. Popular topics are evaluated and measured by h-index along with the author profile. Cite score metrics help to assess journals, book series, and conference proceedings for several citations received by a journal in one year compared to documents published in the three previous years, divided by the number of documents indexed in Scopus published in those same three years.
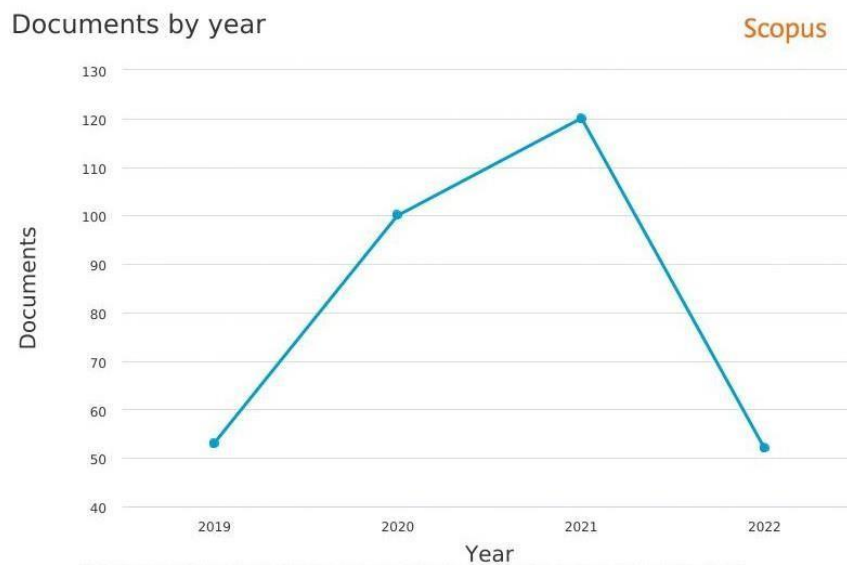
Fig. 5: Trends in publication by year .
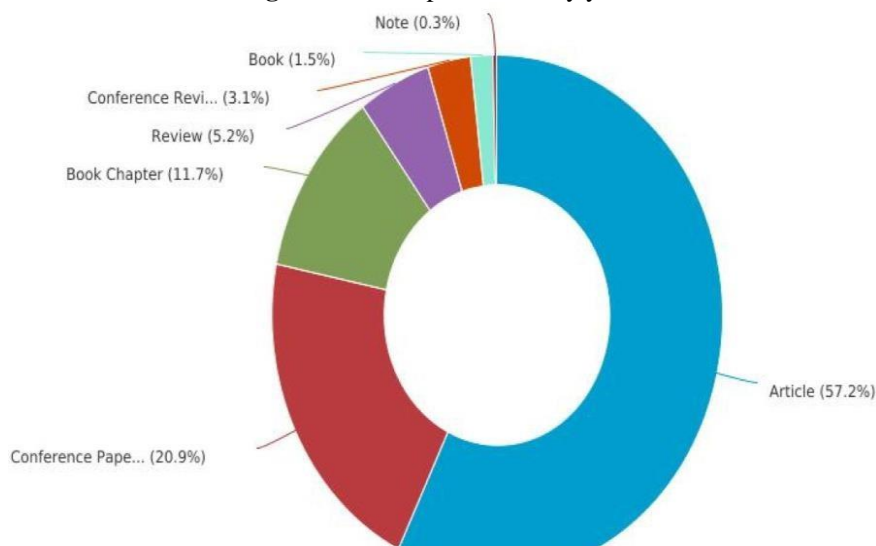
Fig. 6 : Publications in related source type.

5.5. Documentation of Related Domain:

In the past few years, half of the work was published in articles, nearly 57.2 %. Reviews of papers, notes, and books are less in number in the case of blockchain technology Papers published in conferences by almost twenty percent. Book chapters are significantly published in this domain.
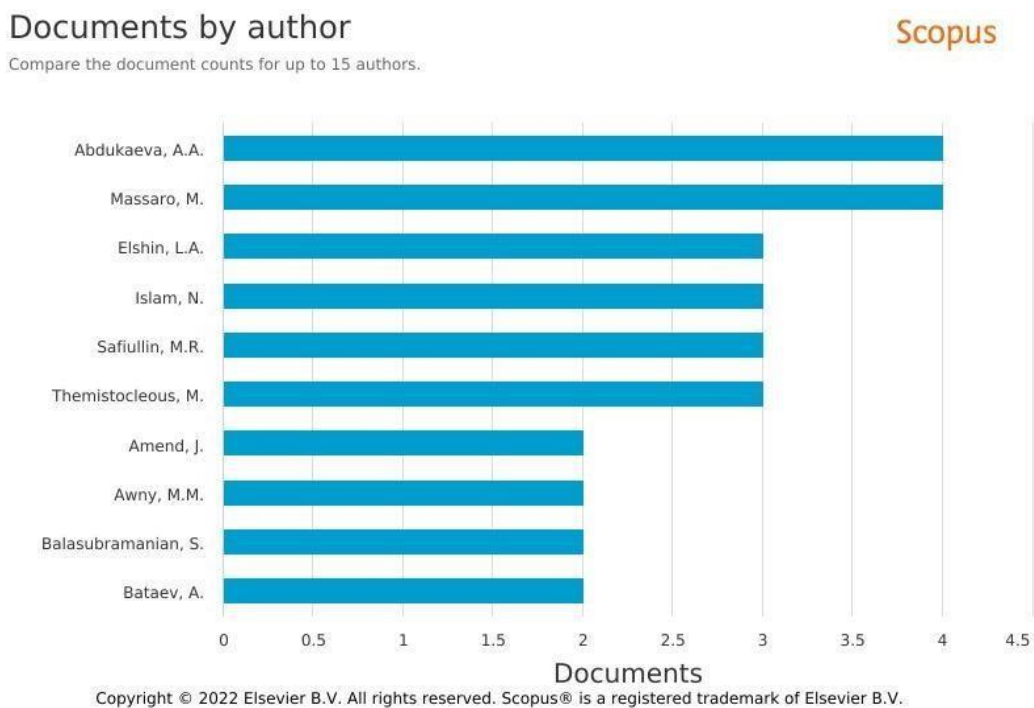
Fig. 7 : Document by author

This analysis suggested that most of the papers published by author A. A Abdukaeva and M Massaro in blockchain technology, even some authors have published an equal number of documents, followed by S. Balasubramanian and A. Bataev.
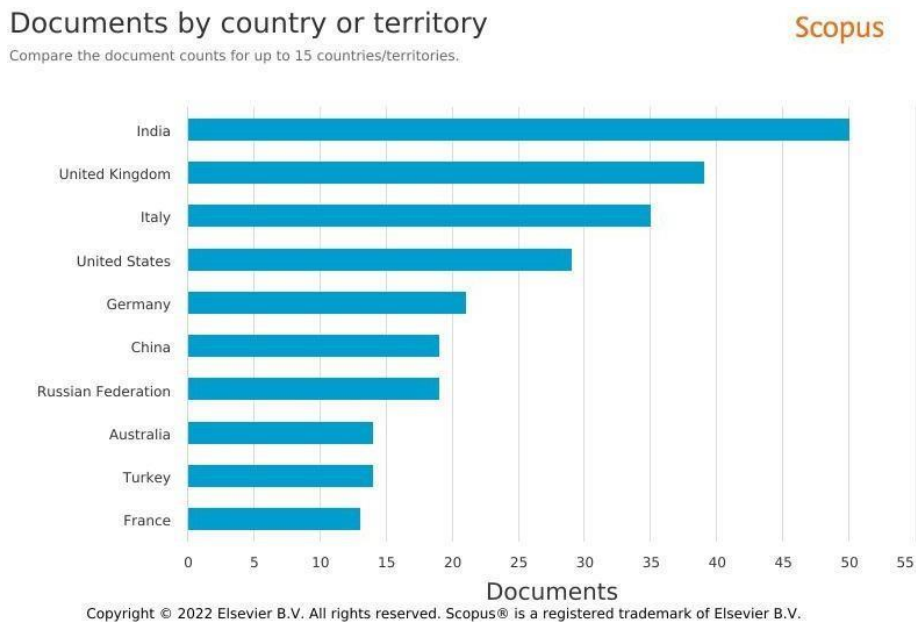
Fig. 8: Documentation by author or territory

In terms of publication by country, the intensity of a published total number of papers is in the following sequence (see Table 7 for details): in the Agro-processing and dairy supply chain sector, India holds the top position, followed by the United Kingdom, Italy, the United States, Germany and China. These countries are major contributors and sources of funding in this area for publishing more articles and related research.

5.6. Citation Analysis
The term citation is also known as bibliographic reference, and citation analysis means the study of abstracting and indexing services appearing in bibliographies, lists or catalogues referred from the range outside the context. Citation

analysis is a commonly used bibliometric method, which is based on constructing citation graphs and networks. It facilitates the exploration of the impact of their field of academics. Citation is a primary link between the two documents, one cited and the other cited. Citation represents a unique relationship between cited and citing papers. Citation establishes a connection between authors whose work has intensity to measure through literature. In citation analysis, the commonalities among associations are based on their subject area, the methodology adopted and the area of research. The reasons for citing the documents are, first and foremost, acknowledgment and criticism of previous work.

The degree of relationship is measured by number of times work is cited. Cite Score is a modest technique for calculating sources' citation influence, such as journals. Scopus counted the worldwide citation of articles on the 'total times cited count' based on "Cite Score Tracker 2020".

Table 4 : Contribution of Author and their cited score

id	label	x	y	clust er	weight< Links>	weight< Docume nts>	weight< Citation s>	weight< Norm. citation s>	score<A vg. pub. year>	score<A vg. citations >
16	borchard t, m.	0.4736	0.6162	1	8	1	14	3.2941	2021	14
29	chiappett a jabbour, c.j.	0.2539	-0.0002	1	8	1	14	3.2941	2021	14
36	de souza, m.	-0.7227	0.3891	1	8	1	14	3.2941	2021	14
50	gustavo, j.u.	-0.7295	-0.3789	1	8	1	14	3.2941	2021	14
76	lopes de sousa jabbour, a.b.	0.8352	-0.0065	1	8	1	14	3.2941	2021	14
86	ndubisi, n.o.	-0.2689	0.0006	1	8	1	14	3.2941	2021	14
103	pereira, g.m.	0.464	-0.6216	1	8	1	14	3.2941	2021	14
130	trento, l.r.	-0.1578	-0.7206	1	8	1	14	3.2941	2021	14

5.7. Analysis of Author contribution: In this section, Borchart (2021) has the highest contribution in the field of blockchain technology as all the authors have similar weighted links and average citations. The average citation score is 14 for all the contributor authors; on the other hand, similarly weighted sources are seen in (Table 4).

5.8. Word Views: In this analysis, keywords are searched based on the latest literature contributed by different authors with the help of VOS Viewer software. Research work in blockchain technology has become popular over the past four to five years. Hence, One cluster has been found due to the scarcity of literature in this field, as seen in (Fig.9). These segments propose critical and significant information for future researchers.
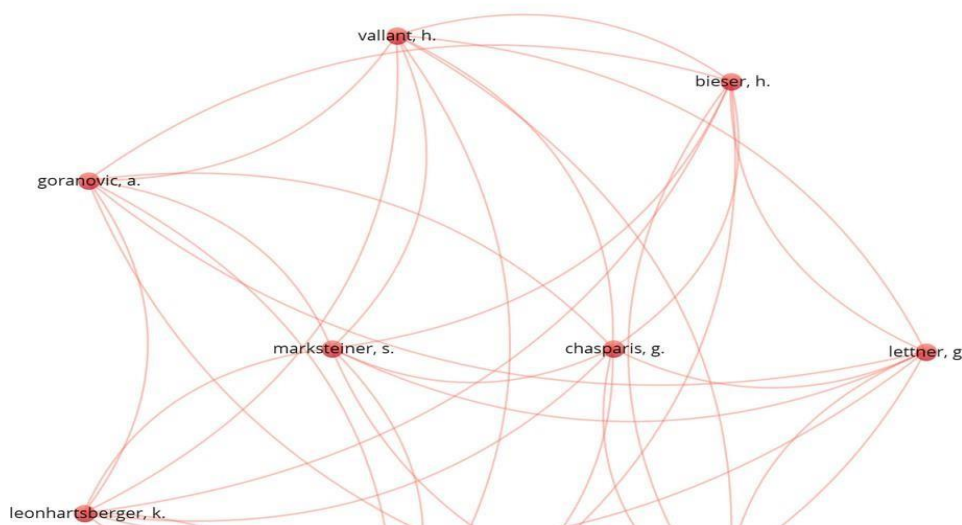

Fig. 9: Visual Display of Author Keyword

5.9. Author Keyword Network
The keywords related to blockchain technology, and its documents were used to identify past literature while searching a

database. Sometimes, the related themes need to be addressed in the trending keywords. This information also facilitates future researchers to understand the topic and identify the work that is over-researched and under-researched. This study employs the author's keywords for the analysis.
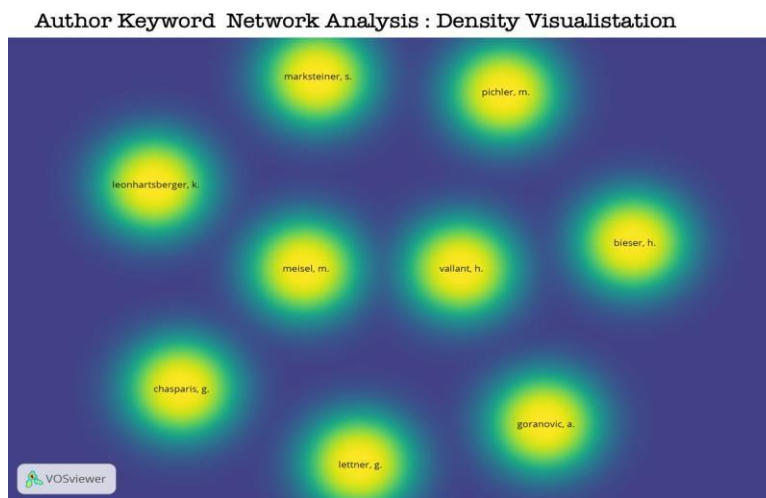
Figure 10. Author Network Keywords Analysis

6. Discussion, Conclusion and Future Implications

This article explains the process and architecture of blockchain. It ensures the flow of information in milk and DSC remains uninterrupted and free. This article helps to understand the mechanism of blockchain technology and its application in Dairy Supply Chain (DSC). Blockchain is an effective tool for testing adulteration in laboratory samples and maintaining quality standards. It enables stakeholders, regulators and dairy organizations to provide an efficient supply chain without disruptions within limited resources. This article also explains the benefits of traceability and safety of milk and dairy products from contamination and adulteration, an essential component of daily diet. Indian dairy market has a diverse composition of dairy and milk products. The adoption of blockchain technology ensures the extensiveness of consumption and production patterns. Blockchain is an emerging technology, an application-based platform that provides free information flow without disruptions in the food supply chain (Menon and Jain, 2021). The food and dairy supply chain is an integrated framework with multiple actors involved in the processing and procuring activities. Blockchain is not implemented fully due to a lack of awareness among dairy farmers and processors in the informal and formal Indian dairy sector (Vu and Bourlakis,2023). Blockchain technology in the food and dairy supply chain facilitates transparent and safe mechanisms for production and distribution, enhancing efficiency and sustainability in this sector (Gehlot et al., 2022). This emerging technology minimizes losses and wastage in the supply chain to deliver qualitative products to the final consumer (Marchi and Zanoni, 2022).

This study investigates blockchain technology's role in the dairy supply chain {DSC}, its application and implementation. This concept of bibliometric analysis in the DSC through blockchain provides new dimensions. This study comprises two sections. The first section reports results from a review of literature, dairy supply chain, and blockchain technology. The second section explains bibliometric analysis; the author's contribution integrates into homogenous clusters.

This article only reviews blockchain technology in the dairy sector to explore more cluster reviews from the agro-processing industry. In this paper, a review of literature on blockchain and dairy supply chain explored specific keywords with all-inclusive search terms on the themes and attained a figure of 325 articles after the refinement process from both the databases of dairy supply chain over the past 17 years (2005–2022) and for blockchain technology for five years. If the subject is further explored, the researcher has used other keywords, which would have resulted in different outcomes. Retrieving data from related data for SLR is a critical part of the review.

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