Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 4 Issue 2 (2024)

"Block Chain for a Sustainable Future: Paving the Way towards Achieving Sustainable Goals"

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Abstract:

Objective-This study aims to explore the potential of blockchain technology to significantly contribute to the achievement of sustainable development goals (SDGs). By focusing on its capacity to enhance accountability, transparency, traceability, and cyber-resilience, the study examines how blockchain can improve operational efficiency in global partnerships and support monitoring progress towards the United Nations' SDGs.

Method-A systematic literature review (SLR) was conducted to review literature from 2015 to 2023. 28 studies were selected, employing PRISMA guidelines. Bibliometric analysis using VOS Viewer unveiled publication trends, citations, and thematic clusters, offering a comprehensive research landscape understanding.

Result-The findings indicate that blockchain technology holds substantial promise for promoting sustainability, particularly within supply chain management and the logistics sector. The technology's ability to transform the measurement and validation of carbon emission rights and carbon credits is crucial for addressing environmental pollution and advancing progress towards the SDGs. The literature review highlights the critical role of blockchain in facilitating sustainable practices and enhancing the efficiency and transparency of global operations.

Future Implications-The adoption of blockchain technology presents significant opportunities for fostering positive changes and driving advancements in achieving sustainable development goals. Future research and practical applications should focus on further integrating blockchain solutions within various industries to enhance sustainability efforts. By leveraging blockchain's capabilities, stakeholders can better address environmental challenges and promote global partnerships aimed at achieving the SDGs.

Keywords: Blockchain technology, sustainable development goals, accountability, transparency, traceability, cyber-resilience

Introduction:

Block chain technology plays a crucial role in promoting governance and sustainability. Operating on a decentralized platform, it facilitates information exchange with inherent transparency and accountability. Smart contracts and consensus mechanisms ensure proper execution of processes in a governed manner. Blockchain technology holds the promise of contributing to the attainment of sustainable development goals through its capacity to provide accountability, transparency, traceability, and cyber-resilience. Additionally, it enhances operational efficiency in global partnerships (Treiblmaier, H., 2019). By enabling shared data views throughout the supply chain, blockchain facilitates the integration of triple bottom line (TBL) goals into supply (Horner, J., & Ryan, P., 2019). The utilization of blockchain technology in sustainable development programs fosters transparency and trust by enabling tracking and auditing of data, exchanges, and transactions (P Fraga-Lamas & et al. 2020). Moreover, it finds application in various aspects of supply chain management, particularly logistics, to bolster sustainability efforts (Kozhanov, N., & Woebbeking, F., 2021). The technology's ability to validate sustainable development outcomes and identify quantifiable indicators of value and progress further supports its potential as a valuable tool in achieving sustainable development goals. The block chain technology can significantly

improve the design, structure, and management of supply chains, ultimately contributing to the realization of sustainable development objectives. Moreover, block chain has the capacity to revolutionize the measurement of carbon emission rights and verification of carbon credits, crucial for combatting environmental pollution and advancing the SDGs (Chamberlain, S. L., 2019). Nevertheless, it is important to acknowledge that the full impact of block chain on sustainable development outcomes is still under investigation, and conclusive evidence of measurable improvements has yet to be demonstrated (Kim & et al 2020). Despite this, block chain technology remains a promising tool for bringing about institutional change and increasing efficiency in collective efforts to address global challenges. The Sustainable Development Goals (SDGs) constitute a set of 17 global objectives aimed at creating a more promising and sustainable future for everyone. These goals tackle a wide range of challenges affecting both people and the planet, encompassing environmental, economic, social, and urban aspects. Accomplishing the SDGs necessitates managing negative impacts and capitalizing on the advantages through well-executed plans and programs. Notably, solid waste management (SWM) plans and programs have varying effects on different SDGs, with the most significant influence observed in goals related to sustainable cities and communities, as well as good health and well-being. However, implementing the SDGs encounters contradictions and challenges, making their success contingent on systems thinking, collaboration among multiple stakeholders, and meaningful engagement of businesses and other essential actors. (Domingo-Echaburu, S., Dávalos, L. M., Orive, G., & Lertxundi, U., 2021); (Elsheekh & et al. 2021); (Sonal, Chamargore, 2020); (Liam & et al 2021), (Amato, V., 2021).

Block chain for Sustainability - Paving the Way for Optimism and Accountability

In 2015, the United Nations brought together 193 countries to agree on an ambitious and all-encompassing development agenda aimed at benefiting people and the planet by 2030. This initiative gave birth to the Sustainable Development Goals (SDGs), consisting of 17 global objectives designed to revolutionize our world by the target year. These goals represent the most pressing needs of our time and present a formidable challenge to tackle. By addressing issues like hunger and poverty reduction, inequality, and responsible consumption and production, the SDGs aspire to create a better world and present a distinct opportunity for businesses to make a lasting impact on our planet through block chain sustainability. To attain these goals, a collaborative effort is essential, involving governments, societies, the private sector, individuals, and communities, all supported by the necessary resources, innovations, and partnerships. The private sector holds a pivotal role in contributing to this global development agenda, encompassing not only multinational corporations and industries but also small and medium enterprises (SMEs), social enterprises, and start-ups. Innovation is indispensable within this sector to successfully achieve the 169 ambitious targets comprising the 17 SDGs. The private sector's active involvement will be instrumental in realizing the SDGs, and it stands to gain from potential business opportunities worth approximately US$12 trillion, which, in turn, could generate nearly 380 million jobs by the year 2030. Distributed Ledger Technology (DLT) represents a step towards Web 3.0, the Internet of Value, with block chain being a specific type of DLT. It involves time stamped transaction blocks linked through cryptographic hashes. Its decentralized architecture provides numerous benefits, including security, privacy, integrity, transparency, accountability, authenticity, and robustness. By eliminating intermediaries, block chain enhances operational efficiency. Traditional systems face challenges like manual recording leading to a lack of trust and labour-intensive processes. Updating data by multiple stakeholders on a trustworthy basis and avoiding involvement of third parties are additional hurdles. Moreover, traditional databases are vulnerable to security breaches. Block chain addresses these challenges and contributes to Sustainable Development Goals (SDGs) in several ways. For sustainability, block chain fosters transparency by offering end-to-end visibility on a shared platform, promoting trust among stakeholders. It enables traceability, allowing the tracking of products from source to consumption, validating fair and sustainable practices. By providing a digital identity for products, block chain ensures authenticity and accountability across the entire value chain.

Security is strengthened by block chain's tamper-proof and encrypted data, safeguarding against manipulation. The technology also drives innovation through smart contracts, enabling accurate collaboration among stakeholders based on consensus. Intellectual property protection is enhanced through time stamped and open source licensing records, preventing tampering and infringements. Open data on a decentralized platform ensures data protection and privacy among stakeholders, while regulatory compliance is facilitated by time stamped transactions, enabling an auditable product trail. Blockchain technology can also offers potential solutions like providing secure, transparent, and efficient data management

and storage solutions to cater the the issues & challenges posed by digital hoarding (Ali, E. S., & Afzal, M. (2023). Therefore, block chain plays a vital role in promoting sustainable practices, transparency, and innovation.

Block chain and its Impact on the SDGs

The Sustainable Development Goals (SDGs) consist of 17 global objectives aimed at addressing various sustainable development issues such as poverty, equality, education, climate change, infrastructure, land and water, and production/consumption. The target date for achieving these goals is set for 2030. Increasingly, the United Nations' SDGs are becoming a significant framework for global asset owners, particularly those seeking thematic investment approaches. According to a survey by Morgan Stanley investment banking, 78% of institutions that integrate or consider sustainable investments are also exploring alignment with the SDGs as part of their investment strategies. The SDGs serve as a guiding framework for thematic investments and pursuing impact-driven initiatives. The UN identified these strategic objectives during its 2015 General Assembly due to their potential global impact and significance for humanity's future. They encompass critical goals such as eradicating poverty, ensuring food security and sustainable agriculture, and promoting inclusive and sustainable economic growth with decent work opportunities. The 2030 Agenda was created to work towards achieving these objectives before 2030. In line with this agenda, the UN's International Telecommunications Union (ITU) has been evaluating the role of Blockchain in advancing the SDGs.

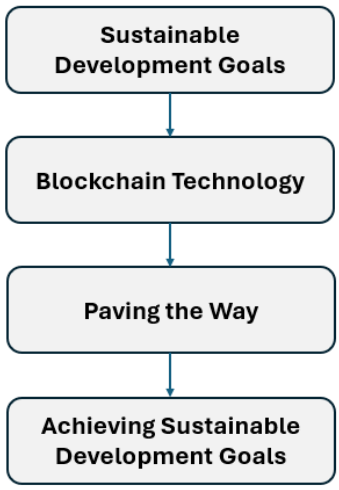

Figure 1.1- Pathway towards Achieving Sustainable Goals Via using Block chain technology.

The analysis has revealed that successful implementation of the SDGs requires efficient management of financing and monitoring actions. Blockchain technology, when used in parallel with existing systems, can help minimize blockages, bottlenecks, and accelerate financial liquidity by reducing frictions in value transfer. By utilizing Blockchain as a tool, it becomes possible to enhance the efficiency and transparency of financial operations, ultimately contributing to the achievement of the SDGs (Figure 1.1). Block chain technology offers valuable applications that contribute to several of the UN Sustainable Development Goals (SDGs). Block chain can enhance financial inclusion for smallholder farmers by increasing efficiency, traceability, and transparency in financial processes. Through authentication and registration of transactions without intermediaries, block chain-based solutions enable access to financial services through mobile and internet platforms. By facilitating traceability in the food supply chain, block chain helps build sustainable food production systems. End-to-end traceability reduces food wastage and optimizes supply chains. Sustainable agriculture practices lead to improved productivity and focus on proper sourcing to address hunger issues. Block chain’s traceability ensures transparency in the food supply chain, addressing issues related to food recalls and ensuring consumer safety. Adoption of sustainable practices guarantees safe and healthy food for consumers. Block chain traceability solutions improve efficiency in food supply chains, leading to enhanced productivity and reduced costs. This, in turn, promotes economic growth and sustains livelihoods for the producer community. Through traceability, block chain fosters resilience in the food supply chain by tracking sustainable crop agronomy and practices. This promotes sustained food production, resource efficiency,

and prevents environmental degradation. Block chain technologies play a critical role in decarbonisation efforts. Its decentralized, collaborative, and transparent platform aids in integrating climate changes into national policies and strategies. The food and agriculture sector faces various challenge, including demand, supply, regulations, and climate-related issues. Embracing block chain can significantly accelerate progress toward SDG targets. Trustworthy peer-to-peer data exchange platforms will be instrumental in fulfilling the UN's Sustainable Development Goals. Block chain provides a layer of traceability and global transparency, benefiting all participants involved in the SDGs. This transparency encourages responsible resource usage among actors and promotes ethical behaviour. Block chain offers robustness and security, preventing unilateral manipulations that could harm others. The decentralized nature of blockchain ensures a tamper-resistant system, promoting trust among stakeholders. Smart contracts within blockchain technology ensure precise surveillance and validation of actions. This automation streamlines processes and ensures that actions taken within the blockchain network adhere to the intended objectives. Considering these advantages, block chain emerges as a fast, cost-effective, resilient, and equitable technological alternative for all actors participating in the pursuit of each SDG.

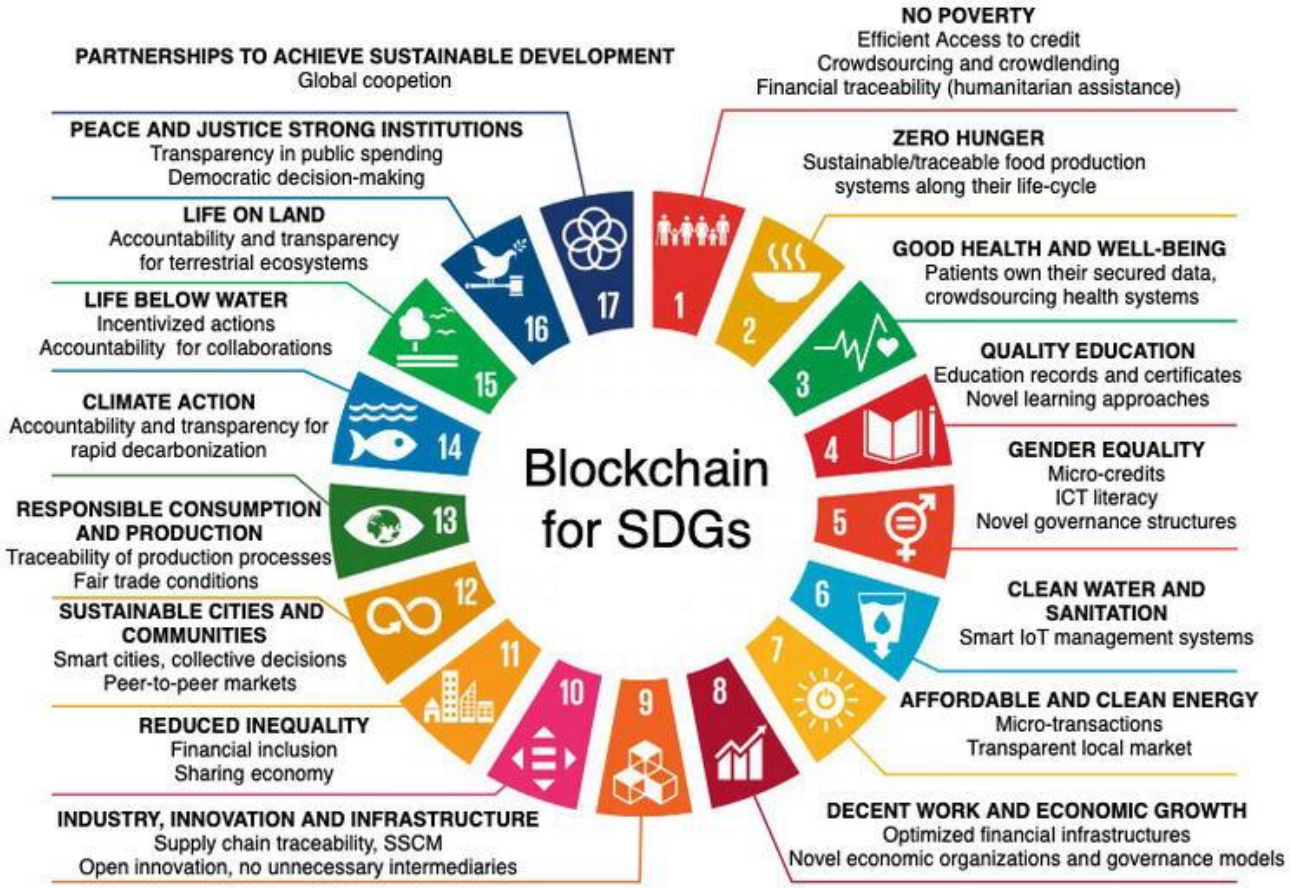

Figure 1.2-Blockchain for Sustainable Development Goals (SDGs)
Source: Fraga-Lamas, P., & Fernández-Caramés, T. M. (2020).

Initiatives based on Blockchain for Sustainable Development Goals (SDGs)

The focus of this program's Blockchain-based innovations is on addressing climate change (SDG 13: Climate Action). The United Nations recognizes that employing Blockchain technology in this context can yield various benefits. Blockchain enhances the monitoring and verification of the impacts of climate action initiatives, ensuring greater accuracy and accountability. By providing a transparent and secure traceability system, Blockchain enables cost-effective solutions while ensuring the authenticity of actions taken. The inherent transparency and immutability of Block chain foster trust among stakeholders involved in environmental efforts. Block chain offers mechanisms that encourage climate action, particularly

in ways accessible to disadvantaged communities. (Figure 1.2). Block chain can facilitate the mobilization of green finance by providing an immutable record of ethical practices in the entire production chain (SDG 8: Decent Work and Economic Growth & SDG 12: Responsible Production and Consumption). Several Latin American countries have also implemented Block chain-based initiatives to combat poverty (SDG 1: End of Poverty). By providing digital identities, Block chain facilitates access to basic services for the less privileged, reducing cost overruns. Block chain's transparency and traceability prove beneficial in ensuring ethical production practices, like fair trade, preventing human exploitation, and increasing financing for disadvantaged sectors (SDG 8 and SDG 12). The ability to tokenize assets using Block chain allows for the traceable allocation and usage of funds, as seen in Sweden's program to promote healthy eating habits for children (SDG 2: Zero Hunger). Transparency and trust offered by Block chain play a pivotal role in monitoring public budgets in real-time, detecting deviations and combating corruption (SDG 16: Peace, Justice, and Strong Institutions). Block chain technology can be employed to maintain a citizen's unique medical history securely (SDG 3: Health and Well-being). In terms of energy saving and pollution reduction, Blockchain-based applications provide traceability for energy origin and CO2 footprint management, enabling the implementation of bonus programs using tokens (SDG 7: Affordable and Clean Energy).

Objectives:

- To identify patterns and connections that provide insights into the role of blockchain in achieving sustainable development goals.
- To explore the role of blockchain in promoting sustainability and contribution to the achievement of the Sustainable Development Goals (SDGs).

Methodology:

The research employed a systematic literature review (SLR) methodology to investigate Impact of Blockchain on Sustainable Development Goals (SDGs) and Blockchain Prospects for Positive Transformations. To better understand the transformative potential of blockchain in achieving sustainability goals, an extensive selection process was meticulously carried out. Carefully crafted criteria and specific keywords were used to sift through multiple databases from 2015 to 2023, resulting in a robust pool of relevant academic articles. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) technique was also utilized to complete the search process. The Keywords used in the study were "Blockchain Technology," "Sustainable Development Goals (SDGs)," "Blockchain and Sustainability," "Blockchain in Supply Chain Management," "Blockchain Transparency," "Blockchain for Positive Transformations," and "Blockchain for Sustainable Practices." Extracting data, organizing it into categories, and synthesizing the findings allowed for a thorough analysis of the impact of blockchain on sustainability. The advanced VOS Viewer tool was also utilized to map out relationships among identified publications, revealing insightful patterns and connections that illuminated major themes and trends in the literature. This methodology ensured a comprehensive investigation of the topic, offering valuable insights into the potential of blockchain to drive sustainable development.

PRISMA: (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)

Systematic literature reviews shed light on the research terrain, allowing us to traverse the extensive realm of pre-existing knowledge and acquire a thorough comprehension of a particular subject. To ensure their credibility and trustworthiness, SLRs require a guiding framework – and this is where PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) has emerged (Moher et al., 2009). Most of the studies were discovered post-2018.The review considered publications since 2015, and it includes 28 papers published in mostly in 2019, and the early part of 2020, 2021, 2022 and 2023. Since, no significant publications were identified during the year 2015 or 2016 on this subject.

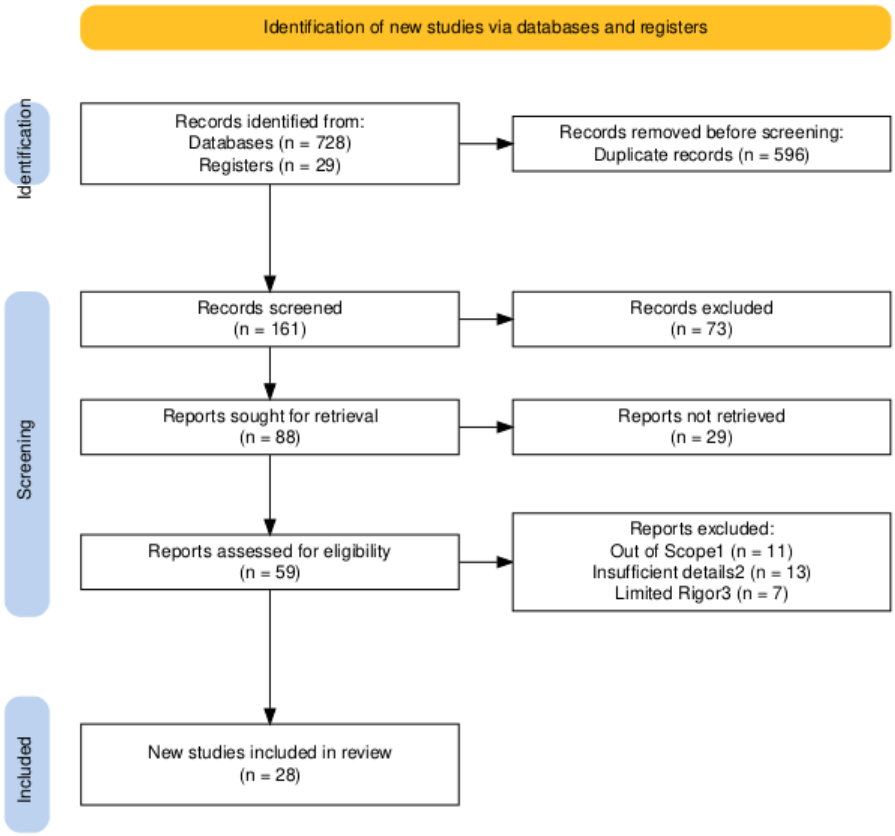

Figure 1.3-PRISMA flow diagram demonstrating method of systematic Literature review

The PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flow diagram (Figure 1.3) represents the Complete process of systematic literature review (SLR). It provides an outline of the step-by-step procedures involved in the identification, screening, and inclusion of studies within the review. Initially, a total of 757 records were obtained from databases (728 records) and registers (29 records), which were subsequently reduced to 161 unique records after eliminating 596 duplicates. 73 records out of these records, were excluded due to failure to meet the specified inclusion criteria. The remaining 88 reports were targeted for retrieval, although 29 were not successfully obtained. Consequently, 59 reports underwent evaluation for eligibility, resulting in the exclusion of 31 reports for various reasons: 11 were deemed irrelevant, 13 lacked sufficient details, and 7 displayed inadequate methodological rigor. Ultimately, 28 new studies were incorporated into the review. This systematic and transparent methodology ensures a review of the literature, Highlighting the potential of blockchain technology in achieving sustainability and contributing to the realization of the United Nations' Sustainable Development Goals (SDGs) through improved accountability, transparency, and operational efficiency everywhere.

Result & Discussion:

Block chain technology has shown significant promise in promoting governance and sustainability through its decentralized platform, which facilitates information exchange with transparency and accountability. The use of smart contracts and consensus mechanisms ensures proper execution of processes in a governed manner. By enabling shared data views throughout the supply chain, block chain integrates triple bottom line (TBL) goals into supply chains, enhancing operational efficiency in global partnerships (Treiblmaier, H., 2019).

Table 1.1-Summary of Included Literatures review.

SN	Year	Author	Title	Focus and Findings
1	2019	Coteur & et al.	"Structuring the myriads of sustainability assessments in agri-food systems: A case in Flanders"	Analyzed sustainability assessments in agri-food systems in Flanders.
2	2019	Treiblmaier, H.	"Combining Blockchain Technology and the Physical Internet to Achieve Triple Bottom Line Sustainability: A Comprehensive Research Agenda for Modern Logistics and Supply Chain Management"	Proposed a research agenda for using blockchain and the Physical Internet in logistics and supply chain management for sustainability.
3	2019	Horner, J., & Ryan, P.	"Blockchain Standards for Sustainable Development"	Discussed the role of blockchain standards in achieving sustainable development.
4	2019	Chamberlain, S. L.	"Assessing the Merits of Blockchain Technology for Global Sustainable Development Initiatives"	Evaluated the potential of blockchain technology for global sustainable development initiatives.
5	2020	Mehrabadi & et al.	"Regulatory-intervened sustainable generation expansion planning in multi-electricity markets"	Analyzed sustainable generation expansion in multi-electricity markets.
6	2020	Orjuela, Alvaro; Clark, James.	"Green chemicals from used cooking oils: Trends, challenges, and opportunities"	Discussed the production of green chemicals from used cooking oils.
7	2020	Fraga-Lamas, P., & et al.	"Leveraging Blockchain for Sustainability and Open Innovation: A Cyber-Resilient Approach toward EU Green Deal and UN Sustainable Development Goals"	Examined blockchain's role in sustainability and open innovation for the EU Green Deal and UN SDGs.
8	2020	Kim & et al.	"Blockchain of Carbon Trading for UN Sustainable Development Goals"	Discussed the application of blockchain in carbon trading for SDGs.
9	2020	Sonal, Chamargore.	"Sustainable development goals"	Provided an overview of the Sustainable Development Goals.
10	2020	Tham, Aaron; Sigala, Marianna.	"Roadblock(chain): bit(coin)s for tourism sustainable development goals?"	Investigated the potential of blockchain and Bitcoin in achieving tourism SDGs.
11	2021	De Villiers & et al.	"A (new) role for business – Promoting the United Nations' Sustainable Development Goals through the internet-of-things and blockchain technology"	Examined how businesses could promote SDGs using IoT and blockchain.
12	2021	Et. al., Mehtab Alam.	"Blockchain For Indian Agriculture: A Revolution"	Explored the potential of blockchain technology in Indian agriculture.
13	2021	Elsheekh & et al.	"Achieving sustainable development goals from the perspective of solid waste management plans"	Discussed SDGs from the perspective of solid waste management.

14	2021	Liam & et al.	"Sustainable Development Goals (SDGs)"	Provided an overview of the Sustainable Development Goals.
15	2021	Kozhanov & et al.	"Some aspects of using blockchain in supply chain management in the framework of achieving sustainable development goals"	Examined the use of blockchain in supply chain management for SDGs.
16	2021	Domingo & et al.	"Drug pollution & Sustainable Development Goals"	Investigated the impact of drug pollution on SDGs.
17	2021	Amato, V.	"The Sustainable Development Goals: A Framework for Business"	Examined how businesses could use the SDGs as a framework.
18	2022	Alam, A.	"Platform utilizing blockchain technology for eLearning and online education for open sharing of academic proficiency and progress records"	Explored blockchain technology for eLearning and its impact on sharing academic records.
19	2022	Benítez & et al.	"Neural blockchain technology for a new anticorruption token: towards a novel governance model"	Introduced a neural blockchain-based anticorruption token to improve governance.
20	2022	Rawal & et al.	"Implementing and Leveraging Blockchain Programming"	Discussed various aspects of blockchain programming implementation.
21	2023	Aziz, F.	"Beyond the Ledger: Enhancing Global Sustainability through Data-Driven Accounting Frameworks"	Discussed how data-driven accounting could enhance global sustainability.
22	2023	Chubarkina, Irina.	"Managing the sustainable development of new types of complex urban development in the format of urban blocks using a value approach"	Discussed sustainable urban development using a value approach.
23	2023	K. M., Mahesh; Aithal, P. S.; K. R. S., Sharma.	"Impact of Aatmanirbharta (Self-reliance) Agriculture and Sustainable Farming for the 21st Century to Achieve Sustainable Growth"	Examined self-reliant agriculture and sustainable farming in India.
24	2023	Kadaba & et al.	"Impact of Digital Financial Inclusion (DFI) Initiatives on the Self-Help Group: For Sustainable Development"	Investigated the impact of DFI initiatives on self-help groups for sustainable development.
25	2023	Kurita & et al.	"Drivers for circular economy development: making businesses more environmentally friendly"	Explored drivers for circular economy development in businesses.
26	2023	Mhlanga, David.	"Block chain technology for digital financial inclusion in the industry 4.0, towards sustainable development"	Discussed blockchain technology for digital financial inclusion in Industry 4.0.
27	2023	Sharma & et al.	"Biometric analysis, biosynthetic pathway and multipurpose uses of buckwheat local varieties in Namsai district of eastern Himalayas in India"	Examined the biometric analysis and uses of buckwheat varieties in the eastern Himalayas.

28	2023	Tyagi, Kalpana.	"A global blockchain-based Agro-food value chain to facilitate trade and sustainable blocks of healthy lives and food for all"	Discussed a blockchain-based Agro-food value chain for sustainable trade and healthy living.

The utilization of block chain technology in sustainable development programs fosters transparency and trust by enabling tracking and auditing of data, exchanges, and transactions (Fraga-Lamas, P., & et al., 2020). It finds application in various aspects of supply chain management, particularly logistics, to bolster sustainability efforts (Kozhanov, N., & Woebbeking, F., 2021). Moreover, the technology validates sustainable development outcomes and identifies quantifiable indicators of value and progress, further supporting its potential as a valuable tool in achieving sustainable development goals. Block chain has the potential to significantly improve the design, structure, and management of supply chains, ultimately contributing to the realization of sustainable development objectives. It can revolutionize the measurement of carbon emission rights and verification of carbon credits, crucial for combating environmental pollution and advancing the SDGs (Chamberlain, S. L., 2019). However, it is important to acknowledge that the full impact of block chain on sustainable development outcomes is still under investigation, and conclusive evidence of measurable improvements has yet to be demonstrated (Kim et al., 2020). Despite the ongoing research and uncertainty, block chain technology remains a promising tool for bringing about institutional change and increasing efficiency in collective efforts to address global challenges. By fostering transparency, accountability, and innovation, block chain can play a vital role in promoting sustainable practices and supporting the achievement of sustainable development goals. The Sustainable Development Goals (SDGs) encompass a set of 17 global objectives aimed at creating a more promising and sustainable future for everyone. These goals address a wide range of challenges affecting both people and the planet, including environmental, economic, social, and urban aspects. Solid waste management (SWM) plans and programs have varying effects on different SDGs, with the most significant influence observed in goals related to sustainable cities and communities, as well as good health and well-being (Domingo-Echaburu, S., Dávalos, L. M., Orive, G., & Lertxundi, U., 2021).The private sector, including multinational corporations, small and medium enterprises (SMEs), social enterprises, and start-ups, holds a pivotal role in contributing to the achievement of the SDGs. Innovation is indispensable within this sector to successfully achieve the ambitious targets comprising the 17 SDGs. The active involvement of the private sector is essential in realizing the SDGs and presents significant business opportunities and job creation potential. Distributed Ledger Technology (DLT), with block chain as a specific type, represents a step towards Web 3.0, the Internet of Value. Its decentralized architecture offers numerous benefits, including security, privacy, transparency, authenticity, and robustness. By eliminating intermediaries, block chain enhances operational efficiency, overcoming challenges faced by traditional systems like lack of trust, labour-intensive processes, and vulnerability to security breaches.

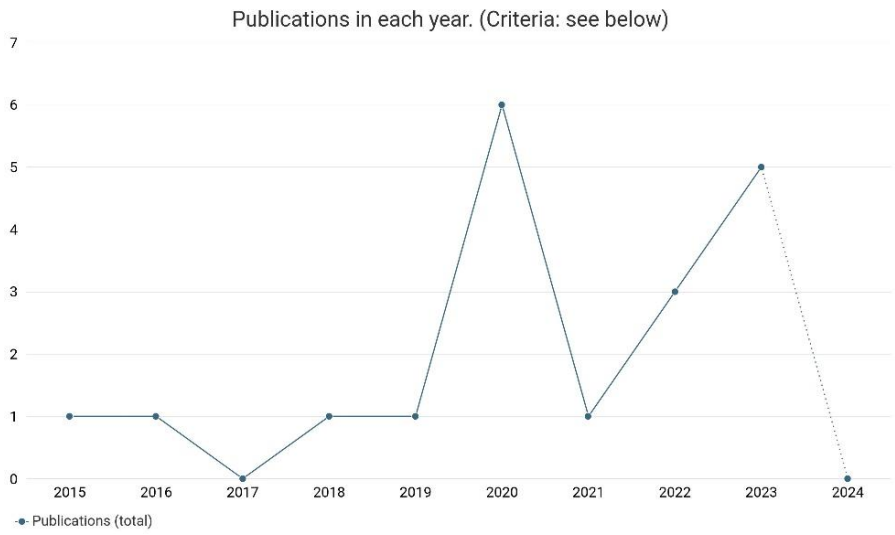

Figure 1.4- Showing Publication based on Blockchain Technology

Although blockchain technology is still in its nascent stages, its potential impact on sustainability remains uncertain. Nonetheless, a wealth of research and development is currently dedicated to exploring this potential, making it a technology worthy of our close attention. (Figure 1.4)

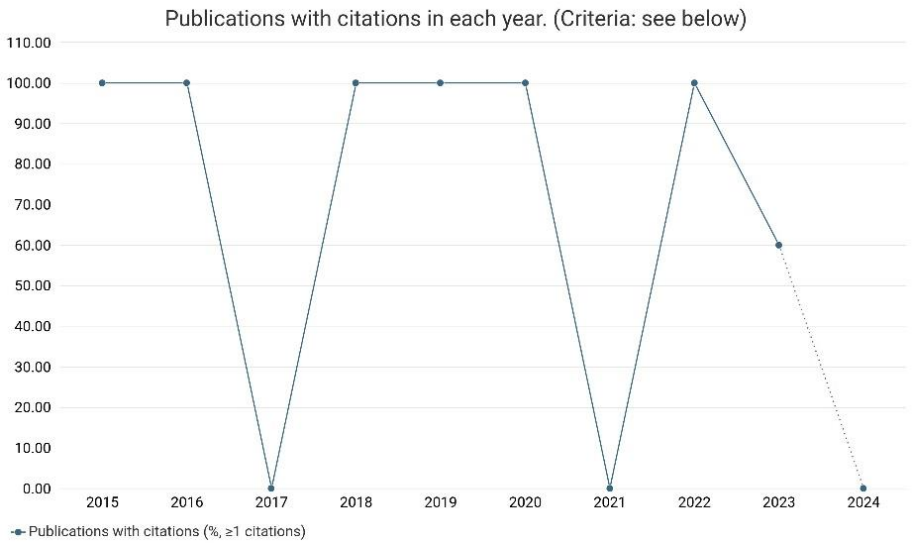

Figure 1.5-Publication with Citation based on Blockchain Technology

The continuously expanding research on blockchain technology, reflected in the rise of cited publications (Figure- 1.5), highlights its ability to play a significant role in attaining sustainable objectives. As the quest for innovative solutions for a greener tomorrow gains momentum, it is imperative to recognize the limitations of this data, such as its reliance on a specific database and its focus on citing publications.

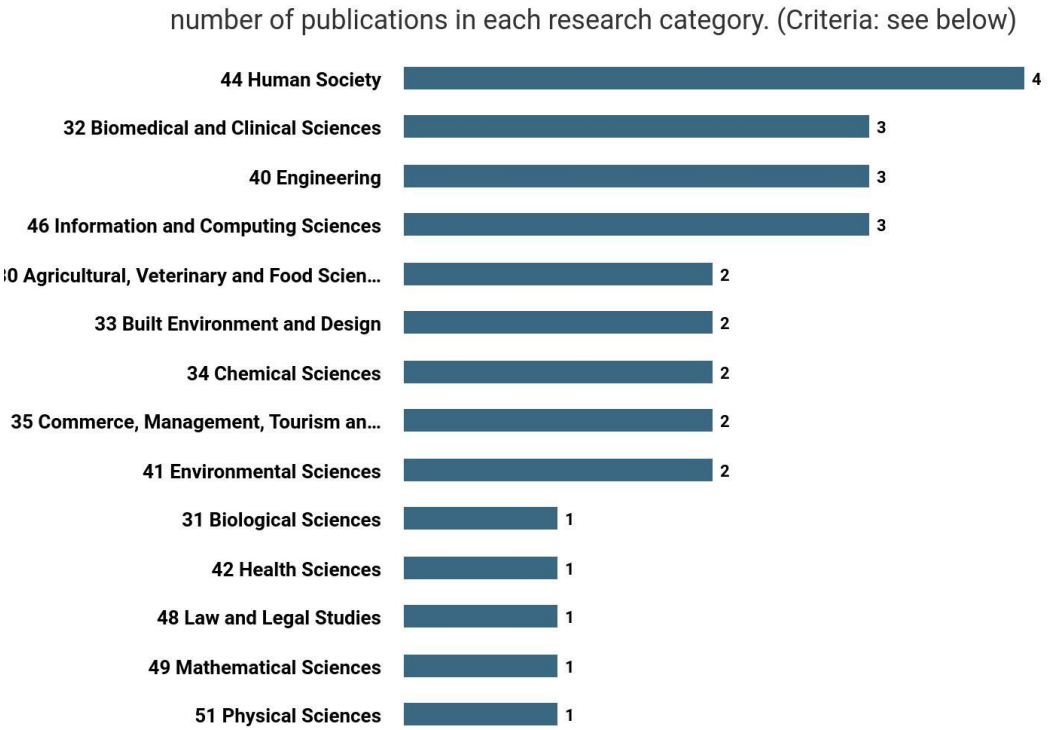

Figure 1.6- Number of Publication of Blockchain Technology in different research category

As diverse fields experience an overall increase in publications, there appears to be a parallel rise in interest and advancements in emerging technologies such as blockchain (Figure 1.6). Numerous studies highlight the potential of blockchain in effectively tackling sustainability challenges in various domains, from supply chain transparency to renewable energy management and sustainable finance. Interestingly, the distribution of publications captured in the image mirrors the call for interdisciplinary approaches that are often stressed in tackling sustainability issues.

VOS viewer map of co-authorship- Bibliometric Analysis

VOS viewer is a dynamic software tool that empowers users to generate and explore intricate bibliometric maps. By mapping connections between citation, co-occurrence, and authorship, the program illuminates the underlying intellectual framework of a body of literature. The interconnected nodes signify authors, while the varying sizes depict their publication output. (Figure 1.7). Additionally, the color-coding of the nodes denotes their belonging to distinct clusters. With VOS viewer, diving into the depth of scholarly networks has never been easier.

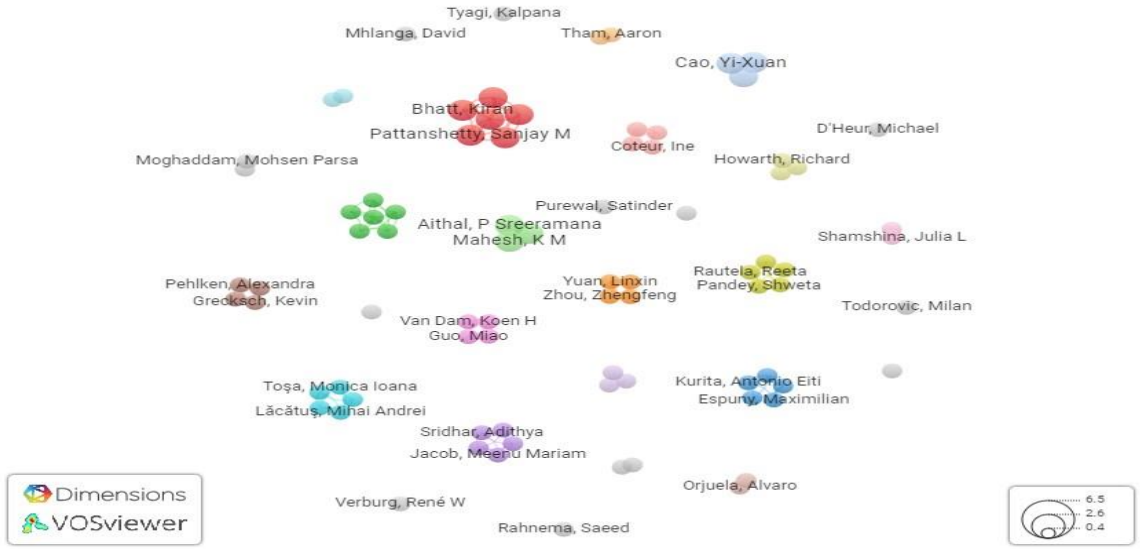

Figure 1.7- VOS viewer map of Co-authorship- Bibliometric Analysis

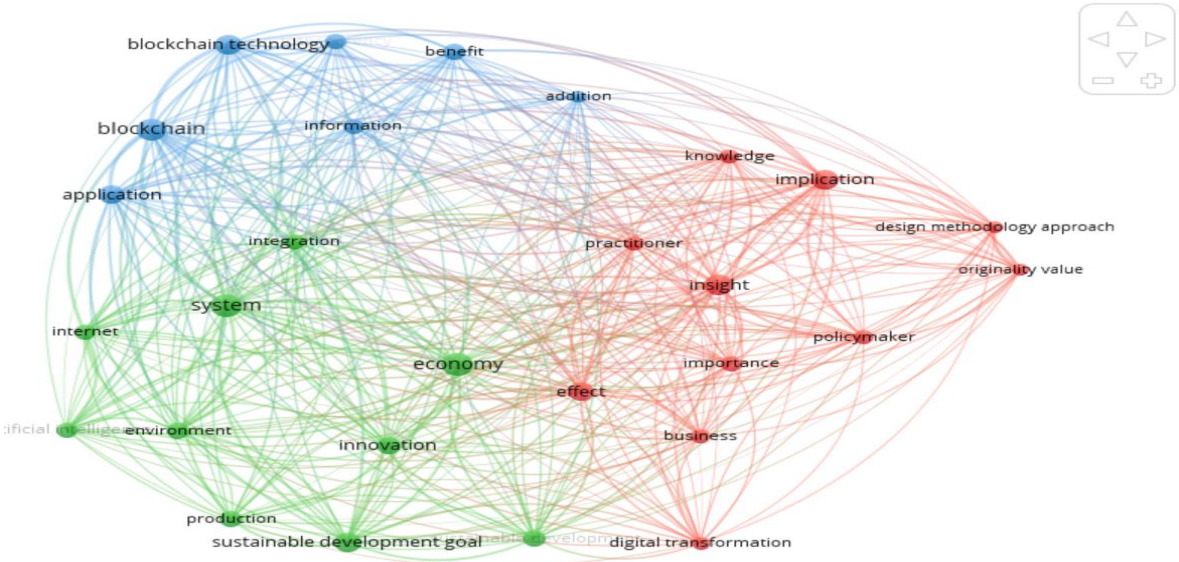

Figure 1.8- VOS viewer map of Network Visualization of Item

The VOS viewer map (Figure 1.8) would likely be a network of interconnected terms, with "Blockchain" at the centre and connections to other terms based on their co-occurrence in the reviewed studies. The thickness of the lines connecting terms might suggest the strength of the relationship between them in the analysed research.

In terms of the impact of block chain on the SDGs, it contributes to various objectives. For instance, in SDG1 (No Poverty), block chain enhances financial inclusion for smallholder farmers by providing efficient and transparent financial processes. In SDG2 (Zero Hunger), it facilitates traceability in the food supply chain, reducing food wastage and promoting sustainable agriculture. In SDG3 (Good Health and Well-being), block chain ensures transparency and safety in the food supply chain, preventing food recalls and ensuring consumer safety. In SDG8 (Decent Work and Economic Growth), it improves efficiency in food supply chains, leading to economic growth and sustaining livelihoods for producers. In SDG12 (Responsible Production and Consumption), block chain fosters resilience in the food supply chain, tracking sustainable practices and preventing environmental degradation. In SDG13 (Climate Action), block chain technologies play a critical role in integrating climate changes into policies and strategies. However, despite the potential benefits, the full impact of block chain on achieving the SDGs is still under investigation. Its implementation requires efficient management of financing and monitoring actions, and it can help minimize blockages and accelerate financial liquidity. By enhancing efficiency and transparency in financial operations, block chain can contribute to the achievement of the SDGs. Initiatives based on block chain for the SDGs have been implemented in various countries, addressing issues related to climate change, poverty, ethical production, corruption, and health. Block chain's transparency, traceability, and security have proven beneficial in various areas, including finance, agriculture, food supply chains, and public budgets. Block chain technology holds great promise in promoting governance and sustainability by providing transparency, accountability, and efficiency in various aspects of supply chains and development efforts. While it has shown potential in contributing to the SDGs, further research and evidence are needed to fully understand its impact. Nonetheless, block chain remains a valuable tool for fostering transparency, accountability, and innovation in achieving sustainable development objectives.

Conclusion:

Block chain technology has emerged as a powerful tool with significant potential in promoting governance and sustainability, particularly in the context of achieving the United Nations' Sustainable Development Goals (SDGs). Its decentralized platform facilitates information exchange with inherent transparency and accountability, ensuring proper execution of processes through smart contracts and consensus mechanisms. Through its applications in supply chain management, block chain enhances operational efficiency and integrates triple bottom line (TBL) goals into global partnerships, contributing to the realization of sustainable development objectives. The technology's capacity to provide accountability, transparency, traceability, and cyber-resilience has made it an asset in various sectors, including finance, agriculture, and public budgets. Furthermore, block chain technology has the capability to revolutionize the measurement of carbon emission rights and verification of carbon credits, playing a crucial role in combatting environmental pollution and advancing the SDGs. Its potential to foster transparency, trust, and innovation makes it a promising tool for promoting sustainable practices and supporting institutional change to address global challenges. Considering the UN's 2030 Agenda and the urgency of achieving the SDGs, it is essential for governments, businesses, communities, and individuals to embrace block chain technology's potential. Collaboration among multiple stakeholders and meaningful engagement of businesses will be crucial in harnessing the benefits of block chain to create a more promising and sustainable future for all. As block chain technology continues to evolve and demonstrate its effectiveness in advancing sustainable development goals, it is imperative to keep researching and exploring its applications. By leveraging the inherent strengths of block chain, such as transparency, traceability, and security, we can pave the way for a more equitable, resilient, and accountable global society. The future success of the SDGs depends on adopting innovative solutions like block chain to address complex challenges and promote sustainable development worldwide.

Practical Implications:

- The study can be a Visualization Tools for Research and Strategy for blockchain implementation in sustainable development initiatives.
- By leveraging blockchain's robust security measures, organizations can effectively enhance their cybersecurity and protect their resources.

- This Study provides invaluable insights for companies seeking to capitalize on blockchain's potential for sustainable development.

References:

1. Alam, A. (2022). Platform utilising blockchain technology for eLearning and online education for open sharing of academic proficiency and progress records. In Smart Data Intelligence: Proceedings of ICSMDI 2022 (pp. 307-320). Singapore: Springer Nature Singapore.
2. Aziz, F. (2023). Beyond the Ledger: Enhancing Global Sustainability through Data-Driven Accounting Frameworks. Farooq Aziz.
3. Benítez & et al. (2022). Neural blockchain technology for a new anticorruption token: towards a novel governance model. *Journal of Information Technology & Politics, 20(1), 18-Jan.*
4. De Villiers, C., Kuruppu, S., & Dissanayake, D. (2021). A (new) role for business–Promoting the United Nations' Sustainable Development Goals through the internet-of-things and blockchain technology. *Journal of business research*, *131*, 598-609.
5. Chubarkina, Irina. (2023). Managing the sustainable development of new types of complex urban development in the format of urban blocks using a value approach. *AIP Conference Proceedings, 2560(1), 50006.*
6. Coteur & et al. (2019). Structuring the myriads of sustainability assessments in agri-food systems: A case in Flanders. *Journal of Cleaner Production, 209, 472-480.*
7. Et. al., Mehtab Alam. (2021). BLOCKCHAIN FOR INDIAN AGRICULTURE: A REVOLUTION. *INFORMATION TECHNOLOGY IN INDUSTRY, 9(2), 513-518.*
8. Fraga-Lamas, P., & Fernández-Caramés, T. M. (2020). Leveraging blockchain for sustainability and open innovation: A cyber-resilient approach toward EU Green Deal and UN Sustainable Development Goals. In *Computer Security Threats*. IntechOpen.
9. Treiblmaier, H. (2019). Combining blockchain technology and the physical internet to achieve triple bottom line sustainability: a comprehensive research agenda for modern logistics and supply chain management. *Logistics*, *3*(1), 10.
10. Horner, J., & Ryan, P. (2019). Blockchain standards for sustainable development. *Journal of ICT Standardization*, *7*(3), 225-248.
11. K. M., Mahesh; Aithal, P. S.; K. R. S., Sharma. (2023). Impact of Aatmanirbharta (Self-reliance) Agriculture and Sustainable Farming for the 21st Century to Achieve Sustainable Growth. *International Journal of Applied Engineering and Management Letters, 175-190.*
12. Elsheekh, K. M., Kamel, R. R., Elsherif, D. M., & Shalaby, A. M. (2021). Achieving sustainable development goals from the perspective of solid waste management plans. *Journal of Engineering and Applied Science*, *68*, 1-15.
13. Kadaba, D. M. K., Aithal, P. S., & KRS, S. (2023). Impact of Digital Financial Inclusion (DFI) Initiatives on the Self-Help Group: For Sustainable Development. *International Journal of Management, Technology, and Social Sciences (IJMTS)*, *8*(4), 20-39.
14. Kurita & et al. (2023). Drivers for circular economy development: making businesses more environmentally friendly. *Environmental Science and Pollution Research, 30(33), 79553-79570.*
15. Liam, McCarton., Sean, O'Hogain., Anna, Reid. (2021). Sustainable Development Goals (SDGs). doi: 10.1007/978-3-030-50605-6_9.
16. Mehrabadi & et al. (2020). Regulatory-intervened sustainable generation expansion planning in multi-electricity markets. *Sustainable Cities and Society, 52, 101794.*
17. Mhlanga, David. (2023). Block chain technology for digital financial inclusion in the industry 4.0, towards sustainable development. *Frontiers in Blockchain, 6, 1035405.*
18. Moher, D., Liberati, A., Tetzlaff, J., Altman, D. G., & PRISMA Group*. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *Annals of Internal Medicine, 151*(4), 264-269.
19. Kozhanov, N., & Woebbeking, F. (2021). Some aspects of using blockchain in supply chain management in the framework of achieving sustainable development goals. In *E3S Web of Conferences* (Vol. 296, p. 06012). EDP Sciences.

20. Orjuela, Alvaro; Clark, James. (2020). Green chemicals from used cooking oils: Trends, challenges, and opportunities. *Current Opinion in Green and Sustainable Chemistry, 26, 100369.*
21. Fraga-Lamas, P., & Fernández-Caramés, T. M. (2020). Leveraging blockchain for sustainability and open innovation: A cyber-resilient approach toward EU Green Deal and UN Sustainable Development Goals. In *Computer Security Threats*. IntechOpen.
22. Rawal, B. S., Manogaran, G., & Poongodi, M. (Eds.). (2022). Implementing and Leveraging Blockchain Programming. Kent, OH: Springer.
23. Domingo-Echaburu, S., Dávalos, L. M., Orive, G., & Lertxundi, U. (2021). Drug pollution & sustainable development goals. *Science of The Total Environment*, *800*, 149412.
24. Kim, S. K., & Huh, J. H. (2020). Blockchain of carbon trading for UN sustainable development goals. *Sustainability*, *12*(10), 4021.
25. Sharma & et al. (2023). Biometric analysis, biosynthetic pathway and multipurpose uses of buckwheat local varieties in Namsai district of eastern Himalayas in India. *Trends in Food Science & Technology, 136, 251-267.*
26. Sonal, Chamargore. (2020). Sustainable development goals. Materials Today: Proceedings, doi: 10.1016/J.MATPR.2020.10.578.
27. Chamberlain, S. L. (2019). *Assessing the merits of blockchain technology for global sustainable development initiatives* (Doctoral dissertation).
28. Tham, Aaron; Sigala, Marianna. (2020). Roadblock(chain): bit(coin)s for tourism sustainable development goals? *Journal of Hospitality and Tourism Technology, 11(2), 203-222.*
29. Tyagi, Kalpana. (2023). A global blockchain-based agro-food value chain to facilitate trade and sustainable blocks of healthy lives and food for all. *Humanities and Social Sciences Communications, 10(1), 196.*
30. Amato, V. (2021). The Sustainable development goals: A framework for business. *Corporate Sustainability in Practice: A Guide for Strategy Development and Implementation*, 21-40.
31. Ali, E. S., & Sarkar, A. K. (2024). Academic Resonance: Women's Work-Life Harmony. *African Journal of Biological Sciences*, 6(5), 3123-3137.
32. Tiwari, Y., Patnaik, S. K., Ali, M. S. E., Akram, P. S., Gautam, R., & Paul, S. (2024). Data Privacy Challenges and Regulatory Responses in Cross-Border Cryptocurrency Transactions: A Comparative Analysis. *Educational Administration: Theory and Practice*, *30*(1), 822-832.
33. Ali, M. S. E., & Sarkar, A. K. (2024). Workplace politics in educational institutions: An interpretive structural modelling (ISM) analysis. *Educational Administration: Theory and Practice*, *30*(5), 7355-7365.
34. Ali, E. S., & Afzal, M. (2023). The dark side of digital possession: Understanding the causes and consequences of digital hoarding. *The Indian Journal of Technical Education*, *46*(4).
35. Ali, E. S. (2022). Unleashing financial fortitude: Exploring the saving and investment habits of rural women in Bareilly, India. *NeuroQuantology*, *20*(22), 4055–4070.