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Blockchain for Social Good: A Case Study on the Use of Distributed Ledger Technology for Transparent Supply Chains in Fair Trade Coffee

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ABSTRACT

Background. The increasing demand for transparency in global supply chains has prompted the exploration of emerging technologies such as blockchain. In particular, the application of distributed ledger technology (DLT) in fair trade industries has the potential to enhance accountability, traceability, and ethical sourcing practices. This study examines the use of blockchain in the fair trade coffee sector, where transparency is crucial to ensure that producers receive fair compensation and consumers can trust the authenticity of ethical claims.

Purpose. The primary aim of this research is to investigate how blockchain technology can improve transparency and efficiency in the coffee supply chain, from farm to consumer.

Method. The study employs a case study methodology, focusing on a fair trade coffee cooperative that implemented blockchain to track the journey of coffee beans. Qualitative interviews with stakeholders, including farmers, distributors, and consumers, were conducted to gather insights into the practical applications and challenges of blockchain in this context.

Results. The findings indicate that blockchain enhances transparency by providing immutable records of transactions, but challenges related to technology adoption, cost, and scalability remain.

Conclusion. The study concludes that while blockchain shows promise for social good in fair trade coffee, further research and development are needed to address the limitations and expand its implementation across the industry.

KEYWORDS

Blockchain, Distributed Ledger Technology, Ethical Sourcing, Fair Trade, Supply Chain Transparency

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INTRODUCTION

In recent years, blockchain technology has garnered significant attention for its potential to disrupt traditional industries and improve transparency, particularly in supply chains (Firouzian-Haji dkk., 2025). Distributed ledger technology (DLT), the backbone of blockchain, offers the ability to provide secure, immutable records of transactions that are accessible to all stakeholders in real-time (Kukjans dkk., 2025). The concept of blockchain for social good has gained traction, especially in sectors like fair trade, where transparency, accountability, and ethical sourcing are

critical. In the fair trade coffee industry, for instance, ensuring that coffee farmers receive fair compensation and that consumers can trust the ethical claims of the products they purchase remains a persistent challenge (Zhang dkk., 2025). Blockchain presents an innovative solution to these challenges by enabling the traceability of coffee from farm to consumer, providing a transparent view of the entire supply chain (Franz, 2025). This background sets the stage for understanding how blockchain technology can be leveraged for social good in fair trade systems, ensuring that both producers and consumers benefit from the increased visibility and trust that blockchain can provide.

The problem addressed by this research is the persistent lack of transparency and trust within the supply chains of fair trade coffee (Barati, 2025). Despite the noble intentions behind fair trade certifications, there is still skepticism about whether farmers receive a fair price for their products and whether ethical sourcing claims are valid (Chen, 2025). Many fair trade coffee cooperatives still rely on traditional systems of certification that involve intermediaries, which can be costly, inefficient, and prone to fraud or misrepresentation (Saha dkk., 2025). Blockchain, with its ability to provide a transparent, immutable, and decentralized record of transactions, promises to address these issues by creating a system where every step of the coffee's journey can be verified. However, the application of blockchain in this context is still relatively new, and there is limited empirical research on how effectively it can improve transparency, increase trust, and ensure that fair trade principles are upheld throughout the supply chain (Damaševičius & Maskeliūnas, 2025a). This research seeks to fill that gap by examining a case study of a fair trade coffee cooperative that has implemented blockchain technology to track and verify the journey of coffee beans, offering a practical exploration of the potential benefits and challenges associated with this technological intervention.

The primary aim of this research is to explore how blockchain technology can enhance transparency and efficiency in the fair trade coffee supply chain (Toufighi dkk., 2025). By focusing on a real-world case study, the study aims to assess whether blockchain can effectively address the key challenges of transparency, traceability, and ethical sourcing in fair trade coffee (Damaševičius & Maskeliūnas, 2025b). Additionally, the research seeks to identify the practical barriers and challenges associated with implementing blockchain in this context, including issues related to technology adoption, scalability, and the cost of implementation (Han dkk., 2025). The study also aims to provide insights into how blockchain can be integrated into existing fair trade systems to support social good, particularly in developing countries where farmers often face economic vulnerability and limited access to technological infrastructure (Jiang dkk., 2025). By evaluating the experiences of stakeholders such as farmers, distributors, and consumers within the blockchain-enabled fair trade coffee supply chain, the research will offer valuable lessons on the potential of blockchain for promoting transparency, trust, and ethical practices in global supply chains.

A significant gap in the existing literature is the lack of empirical studies that explore the application of blockchain technology specifically within the fair trade coffee industry (Aslam dkk., 2025). While there is a growing body of literature on blockchain's role in enhancing supply chain transparency and ethical sourcing in various industries, there remains limited research focused on its impact in the fair trade sector (Shen dkk., 2025). Most existing studies on blockchain for social good have primarily examined industries like food, agriculture, and retail, where the use of blockchain is still in its nascent stages (Mawrides dkk., 2025). Additionally, much of the research to date has focused on the technical aspects of blockchain, such as its security features and scalability, rather than its practical application in real-world settings or its impact on social and economic outcomes (Qiao dkk., 2025). This study addresses this gap by providing an in-depth, qualitative analysis of a case study in the fair trade coffee sector, offering insights into the real-world

implications of using blockchain to enhance transparency and trust (N. Kumar dkk., 2025). By focusing on a specific industry and examining the experiences of real stakeholders, this research contributes to a more nuanced understanding of how blockchain can be applied for social good, moving beyond theoretical discussions to practical applications.

The novelty of this research lies in its focus on blockchain's application within the specific context of fair trade coffee supply chains, a relatively underexplored area in the academic literature (Rajput dkk., 2025). While blockchain has been widely studied in other industries, its potential to transform the coffee trade, particularly in developing countries, remains largely unexplored. This study makes a unique contribution to the field by providing empirical evidence of how blockchain can support the values of fair trade namely, transparency, traceability, and ethical sourcing in a practical, scalable manner (Gómez & Garbinato, 2025). Additionally, this research contributes to the emerging field of blockchain for social good, expanding our understanding of how technology can be used not just for profit maximization, but also to promote ethical business practices and social justice. The research's findings are significant for both scholars and practitioners in the field of blockchain, fair trade, and supply chain management (Zayed & Yaseen, 2025). By highlighting the challenges and opportunities of blockchain adoption in fair trade coffee, the study provides valuable insights that could guide the implementation of similar technologies in other sectors and contribute to the broader discourse on how blockchain can be harnessed for sustainable development and social impact.

RESEARCH METHODOLOGY

This study employs a case study research design to explore the use of blockchain technology in enhancing transparency and accountability in the supply chains of fair trade coffee (Soori dkk., 2024). A case study approach allows for an in-depth investigation of how distributed ledger technology (DLT) can be applied in a real-world setting, focusing on a fair trade coffee cooperative that has integrated blockchain into its supply chain. The study examines the effectiveness of blockchain in improving traceability, ensuring ethical sourcing, and fostering trust among stakeholders within the coffee supply chain. The research design also allows for the identification of challenges and barriers faced during the implementation of blockchain technology in a sector traditionally governed by intermediaries and certification systems.

The population for this study consists of stakeholders within the fair trade coffee supply chain, including coffee farmers, cooperative managers, distributors, and consumers. A purposive sampling method was employed to select participants who are directly involved with or affected by the use of blockchain in the coffee supply chain. The sample includes 15 farmers from a fair trade coffee cooperative, 5 cooperative managers, 3 distributors, and 10 consumers who have engaged with blockchain-based coffee products. The sample size is considered sufficient to provide a broad perspective of the various stakeholders involved in the supply chain while maintaining a focus on those directly interacting with the blockchain technology. This approach ensures that the study captures diverse viewpoints on the implementation and impact of blockchain technology in fair trade coffee.

The primary instruments used for data collection in this study are semi-structured interviews, surveys, and documentary analysis. Semi-structured interviews were conducted with farmers, cooperative managers, distributors, and consumers to gather qualitative insights into their experiences with blockchain and its impact on transparency, traceability, and trust. A survey was also distributed to participants to collect quantitative data on their perceptions of blockchain technology and its effectiveness in improving supply chain transparency. Documentary analysis was

employed to review blockchain transaction records and supply chain documentation to verify the claims made by participants during interviews (Ahmadi Kaliji dkk., 2025). The combination of these instruments provides a comprehensive understanding of both the subjective experiences and the objective data related to the implementation of blockchain in the supply chain.

Data collection procedures involved conducting interviews both in person and remotely, depending on the participants' location and availability (Kshetri, 2025). Each interview was recorded with the participant's consent and transcribed for analysis. The survey was distributed electronically to participants with access to digital devices, while paper surveys were provided to those without such access. Documentary analysis was carried out by reviewing blockchain transaction logs provided by the cooperative and the relevant fair trade certification documents. The data were then analyzed using thematic analysis for the qualitative data and descriptive statistics for the survey responses. The entire process adhered to ethical standards, ensuring the confidentiality of participants, obtaining informed consent, and providing participants the option to withdraw at any point during the study (Pourrahmani dkk., 2025). The findings were triangulated across the different data sources to ensure validity and reliability.

RESULT AND DISCUSSION

The data collected for this study includes both quantitative and qualitative measures. The quantitative data were gathered through surveys distributed to 33 participants, including 15 coffee farmers, 5 cooperative managers, 3 distributors, and 10 consumers who engaged with blockchain-based coffee products. Table 1 below summarizes the demographic information and key survey responses related to participants' experience with blockchain technology. Among the participants, 40% were coffee farmers, 15% were cooperative managers, 9% were distributors, and 30% were consumers. The majority (70%) of participants had heard of blockchain before, while only 25% had directly interacted with blockchain applications in the coffee supply chain. Approximately 60% of participants reported a positive view of blockchain’s ability to improve transparency and traceability in the supply chain.

Table 1: Participant Demographics and Survey Responses

Characteristic	Frequency (%)
Participant Role	
Coffee Farmers	15 (45%)
Cooperative Managers	5 (15%)
Distributors	3 (9%)
Consumers	10 (30%)
Awareness of Blockchain	
Aware of Blockchain	23 (70%)
Unaware of Blockchain	10 (30%)
Positive Perception of Blockchain	20 (60%)
Negative Perception of Blockchain	7 (21%)

No Opinion	6 (19%)

The data suggests that there is a high level of awareness regarding blockchain among participants, particularly among those directly involved in the coffee supply chain. The majority of participants who were aware of blockchain expressed positive perceptions about its potential to improve supply chain transparency. Farmers, in particular, viewed blockchain as a way to gain better access to the market and ensure that their coffee was ethically sourced and traced accurately. However, a minority of participants, especially consumers, were either unaware of or skeptical about blockchain's role in the supply chain. This reflects the gap in understanding the technology's potential impact, particularly among stakeholders who are more distanced from the actual implementation of blockchain systems.

The qualitative interviews further illuminated the findings from the survey. Many participants expressed that blockchain could improve trust between coffee farmers and consumers by providing verifiable, transparent records of the coffee's journey. Coffee farmers, for example, mentioned that the ability to track their coffee from farm to market would increase their credibility and ensure they were paid fairly for their products. Cooperative managers highlighted that blockchain allowed them to maintain transparent records of coffee sourcing, which aligned with fair trade principles. However, challenges related to blockchain implementation were also evident in the qualitative responses. For instance, farmers and distributors cited the costs of technology adoption, the need for digital literacy training, and the lack of infrastructure in rural areas as significant barriers. These challenges suggest that while blockchain has the potential to drive transparency, its implementation in rural, low-tech environments may require significant support and investment to be successful.

A case study of one specific cooperative, the "Green Beans Cooperative," further illustrates the impact of blockchain on the fair trade coffee supply chain. This cooperative began using blockchain technology to track its coffee beans from the farm to the consumer (Chu & Pham, 2024). By recording every transaction on the blockchain, the cooperative was able to offer complete transparency on the origins of its coffee. Consumers could scan a QR code on the coffee packaging to access the blockchain ledger and verify the journey of the beans, from the farmer to the roaster. The cooperative's use of blockchain resulted in positive feedback from consumers, who appreciated the transparency. However, the cooperative also faced challenges related to the cost and complexity of integrating blockchain with their existing systems, as well as resistance from some farmers who lacked digital literacy (A. Kumar dkk., 2025). Despite these challenges, the cooperative's blockchain adoption is seen as a step forward in improving the ethical standards of fair trade coffee and increasing consumer trust.

Statistical analysis of survey data revealed a significant relationship between participants' awareness of blockchain and their perceptions of its impact on supply chain transparency. Using a Chi-square test, the data showed a strong association between awareness of blockchain and a positive perception of its role in fair trade coffee (p-value = 0.01). Participants who had direct experience with blockchain systems in the coffee supply chain were significantly more likely to view the technology as an effective tool for ensuring transparency and traceability. Conversely, those without direct experience tended to be less confident in its effectiveness, suggesting that familiarity with the technology plays a crucial role in shaping attitudes towards its use (Rashid dkk., 2024). This highlights the need for increased education and engagement among stakeholders, particularly consumers and farmers, to fully realize the potential benefits of blockchain in the fair trade sector.

The relationship between digital literacy and blockchain adoption emerged as a key theme in both the quantitative and qualitative data (Mazrae dkk., 2025). The data indicates that farmers who had higher levels of digital literacy were more likely to embrace blockchain technology, while those with limited digital skills were more hesitant to adopt it. This relationship was further supported by interviews with cooperative managers, who noted that farmers' ability to use smartphones and digital platforms significantly influenced the successful implementation of blockchain. In addition, the data revealed that distributors and cooperative managers who were more technologically savvy were able to integrate blockchain into their systems more efficiently (Böhmecke-Schwafert, 2024). This suggests that digital literacy is a critical factor in determining the success of blockchain adoption in fair trade coffee supply chains, and addressing this gap will be crucial for future efforts to scale blockchain use in the industry.

The case study of the "Green Beans Cooperative" provides a detailed example of the practical application of blockchain in the fair trade coffee supply chain. The cooperative implemented blockchain to create a transparent record of each coffee transaction, from harvest to sale. This allowed consumers to verify that the coffee was ethically sourced and that farmers were paid fairly for their products. While the cooperative faced challenges in educating farmers about the technology, the implementation was successful in increasing consumer trust and boosting sales. However, the case study also highlighted the challenges of integrating blockchain with existing supply chain management systems, as well as the initial resistance from farmers who were unfamiliar with the technology (Saha dkk., 2024). Despite these obstacles, the case study illustrates the potential of blockchain to improve transparency and foster trust in the fair trade coffee industry.

The case study of "Green Beans Cooperative" exemplifies how blockchain can facilitate transparency in supply chains and help fair trade principles come to life. However, it also underscores the importance of addressing the technological and educational gaps that hinder the widespread adoption of blockchain in low-tech environments (Zhan dkk., 2025). The success of this initiative is largely attributed to the cooperative's commitment to educating farmers and stakeholders about the benefits of blockchain, despite the challenges posed by limited infrastructure. The case study highlights the potential of blockchain to increase consumer confidence in fair trade coffee, but it also demonstrates that its full benefits can only be realized through comprehensive training and investment in digital literacy. The cooperative's experience provides valuable lessons for other fair trade organizations looking to implement blockchain technology as part of their supply chain operations.

The results from this study suggest that blockchain technology holds great promise for enhancing transparency and trust in fair trade coffee supply chains (Henrichs dkk., 2025). However, the findings also highlight significant barriers to widespread adoption, particularly related to digital literacy, infrastructure, and the costs associated with integrating new technologies. Despite these challenges, the case study of the "Green Beans Cooperative" demonstrates that blockchain can be effectively used to promote fair trade values and improve supply chain accountability. As the fair trade coffee sector moves toward greater technological integration, future research should focus on strategies to overcome these barriers, particularly in rural and low-tech environments, to ensure that blockchain can truly serve as a tool for social good.

The findings of this study indicate that blockchain technology, when applied to the fair trade coffee supply chain, significantly enhances transparency and accountability. The research revealed that blockchain successfully provides immutable records of every transaction, enabling consumers to trace the origin of coffee beans from farm to market (Stopfer dkk., 2024). The case study of the "Green Beans Cooperative" demonstrated that blockchain increased consumer trust by verifying

ethical sourcing practices. However, the study also uncovered barriers to blockchain adoption, particularly in terms of digital literacy, infrastructure limitations, and the costs associated with technology implementation. Despite these challenges, the adoption of blockchain in this cooperative proved beneficial in fostering transparency and improving consumer confidence in fair trade coffee.

This study's findings align with the broader literature on the potential of blockchain to enhance supply chain transparency, as seen in other sectors like food and agriculture. However, this research offers a unique contribution by focusing on the fair trade coffee industry, which has specific ethical and transparency requirements. Previous studies have highlighted blockchain's role in improving traceability and reducing fraud in supply chains (e.g., Tapscott & Tapscott, 2016), but few have explored its application within the fair trade context. While blockchain has been successfully implemented in other industries, this study fills a gap by examining how it can be tailored to meet the ethical and social goals of fair trade, offering valuable insights for the future of blockchain in social enterprises.

The results of this study signal a growing recognition of blockchain's potential to promote social good, particularly in ethical sourcing and transparent supply chains. The positive outcomes observed in the "Green Beans Cooperative" case suggest that blockchain can bridge the trust gap between producers and consumers, ensuring fairer compensation for farmers and better-informed purchasing decisions for consumers (Abdennadher dkk., 2024). However, the barriers related to digital literacy and infrastructure limitations also highlight the need for broader systemic changes to support blockchain adoption in low-tech environments. This study, therefore, serves as a clear indicator that while blockchain offers promising solutions, its effective implementation requires addressing the technological gaps that prevent marginalized communities from benefiting from such innovations.

The implications of these findings are far-reaching for both the fair trade coffee sector and the broader field of blockchain for social good. For fair trade organizations, the study suggests that blockchain can play a pivotal role in enhancing supply chain transparency, ensuring ethical sourcing, and improving the financial stability of small-scale farmers. For blockchain developers and practitioners, the results highlight the importance of creating solutions that are not only technologically sound but also accessible to users with varying levels of digital literacy. Policymakers should consider the potential of blockchain in promoting social good by investing in digital infrastructure and literacy programs to ensure that the benefits of blockchain are widely distributed and accessible to all stakeholders within the supply chain.

The results of this study are shaped by several factors, including the increasing interest in blockchain as a tool for transparency and the challenges faced by rural communities in accessing new technologies. As the research demonstrates, the success of blockchain in enhancing transparency is contingent upon addressing the barriers to its adoption, such as limited digital literacy and infrastructure. These barriers explain why blockchain has not yet been universally adopted in the fair trade coffee sector, despite its potential. The need for digital literacy and support in rural and low-tech environments is a critical factor in determining the success of such technologies. The findings suggest that blockchain's effectiveness in achieving its social good potential depends on the extent to which these challenges are overcome, making future research and development efforts in digital education and infrastructure crucial to the broader adoption of blockchain in fair trade systems.

Moving forward, it is essential to continue exploring the practical implications of blockchain in the fair trade sector. Future research should focus on expanding the scope of case studies to include more cooperatives and regions, particularly in countries where access to digital technology

is limited. Additionally, future studies could assess the long-term impact of blockchain adoption on the livelihoods of coffee farmers, tracking how increased transparency translates into better financial outcomes for producers. Furthermore, research into the scalability of blockchain solutions for fair trade and the integration of blockchain with existing systems will be crucial for ensuring that the benefits of the technology are realized across the industry. As blockchain technology evolves, it is important to address the digital divide, ensure regulatory frameworks that support its use, and explore how blockchain can be further optimized for social good across a wider range of industries.

CONCLUSION

The key finding of this research is that blockchain technology significantly enhances transparency and trust in the fair trade coffee supply chain, particularly by providing an immutable record of transactions from farm to consumer. The case study of the "Green Beans Cooperative" demonstrated that blockchain successfully allowed consumers to trace the origins of their coffee, thus increasing confidence in the ethical sourcing claims made by the cooperative. However, the study also revealed that the technology's adoption was hindered by barriers such as limited digital literacy, high implementation costs, and inadequate infrastructure in rural areas. Despite these challenges, the implementation of blockchain technology has proven beneficial in enhancing the traceability of fair trade coffee, fostering transparency, and improving consumer trust.

This research contributes to the existing literature by focusing on the application of blockchain technology in the fair trade coffee sector, a relatively underexplored area. While blockchain has been widely studied in other industries for its potential to improve supply chain transparency, this study provides new insights into its role within social enterprises, particularly those aiming for ethical practices and sustainability. The study's methodological contribution lies in its mixed-methods approach, combining quantitative surveys with qualitative case study analysis to assess the practical impact of blockchain adoption. This approach offers a holistic view of both the technical benefits and the real-world challenges faced by stakeholders, making it an important contribution to the growing field of blockchain for social good.

The limitations of this research stem from the relatively small sample size and the focus on a single cooperative in one geographical location. The case study approach, while providing in-depth insights into the practical application of blockchain, limits the generalizability of the findings. Future research could expand the scope by examining the experiences of multiple fair trade cooperatives in different regions, particularly those in countries with less technological infrastructure. Additionally, this study focused primarily on the perspective of stakeholders who were directly involved in blockchain implementation. Further research should explore the broader impact of blockchain on other actors in the supply chain, such as consumers, wholesalers, and third-party certification bodies, to understand the full extent of blockchain's influence on fair trade practices.

AUTHORS' CONTRIBUTION

Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

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