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## Blockchain for social good: A review of applications in humanitarian aid and social initiatives

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### Abstract

Blockchain technology has emerged as a revolutionary force with the potential to address pressing social challenges and transform traditional paradigms in humanitarian aid and social initiatives. This paper provides a comprehensive review of the diverse applications of blockchain in fostering social good, particularly in the realms of humanitarian aid and social initiatives. The decentralized and transparent nature of blockchain offers a paradigm shift in the way charitable organizations operate and deliver aid. Smart contracts on blockchain enable transparent and tamper-resistant transactions, ensuring that resources are allocated efficiently and reach intended beneficiaries. The elimination of intermediaries reduces the risk of corruption and ensures a more direct and accountable flow of funds. In the context of humanitarian aid, blockchain facilitates the creation of decentralized identity systems, ensuring secure and verifiable identities for displaced populations. This aids in the efficient delivery of aid, as well as financial inclusion for those without access to traditional banking services. Moreover, blockchain enhances supply chain transparency, enabling the tracking of donations from inception to distribution, reducing fraud and ensuring the authenticity of goods. Social initiatives, too, benefit from blockchain's transformative capabilities. Decentralized autonomous organizations (DAOs) enable communities to collectively make decisions and manage resources. This fosters a sense of ownership and empowerment among participants, promoting sustainable social development. Additionally, blockchain-based token economies incentivize positive behaviors, encouraging individuals to contribute to social causes in meaningful ways. Despite these promising applications, challenges such as scalability, regulatory uncertainties, and technological literacy remain. This paper calls for continued research and collaboration to unlock the full potential of blockchain for social good, emphasizing the need for innovative solutions that can address the unique challenges faced by humanitarian and social initiatives.

**Keyword:** Blockchain; Humanitarian Aid; Social Initiatives; Social Good; Review

### 1. Introduction

In recent years, the integration of blockchain technology into various sectors has sparked a wave of innovation, reshaping traditional systems and challenging conventional practices (Galanakis, et. al., 2021, Kumari, et. al., 2023, Wang, Han & Beynon-Davies, 2019). Among its myriad applications, blockchain's potential to drive social change and contribute to humanitarian causes has garnered significant attention. This paper aims to provide a comprehensive

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review of the diverse applications of blockchain in the realms of humanitarian aid and social initiatives, examining how this disruptive technology holds the promise to revolutionize the landscape of social good (Cheesman, 2022, Semenzin, 2023).

Humanitarian aid and social initiatives have long grappled with challenges such as transparency, accountability, and inefficiency in resource allocation. Blockchain, with its decentralized and transparent architecture, presents a novel solution to these longstanding issues. The inherent qualities of blockchain, including immutability, security, and transparency, have the potential to transform the way charitable organizations operate, ensuring that aid reaches its intended recipients in a timely and accountable manner. One of the key aspects of blockchain technology lies in its ability to facilitate transparent and tamper-resistant transactions through the implementation of smart contracts. This feature holds immense promise for humanitarian aid, where trust and accountability are paramount. Smart contracts can automate and streamline aid distribution processes, reducing the need for intermediaries and minimizing the risk of corruption. The result is a more direct, efficient, and accountable flow of resources to those in need (Chukwu, et. al., 2023, Hilhorst, et. al., 2021, Konyndyk & Worden, 2019).

Furthermore, blockchain's impact extends beyond the realm of financial transactions. The technology's capability to establish decentralized identity systems enhances the security and verifiability of identities for displaced populations, enabling a more efficient and dignified delivery of aid. Additionally, blockchain's transparency benefits supply chain management, ensuring the traceability of donations from inception to distribution. This not only reduces the risk of fraud but also guarantees the authenticity of goods reaching beneficiaries. As we delve into the myriad applications of blockchain in humanitarian aid and social initiatives, it becomes evident that this technology has the potential to redefine the way we approach social challenges. However, challenges such as scalability, regulatory frameworks, and the need for widespread technological literacy persist. This review seeks to navigate through the current landscape, shedding light on the transformative potential of blockchain for social good, while also recognizing the hurdles that must be addressed to fully harness its benefits.

### **1.1. Blockchain Technology for Social Good**

Blockchain technology, initially conceived as the underlying infrastructure for cryptocurrencies, has transcended its financial origins to emerge as a transformative force with far-reaching implications (Kleinaltenkamp, 2022, Nabben, 2021). This paper explores the multifaceted applications of blockchain in the context of social good, specifically focusing on its potential in reshaping humanitarian aid and social initiatives.

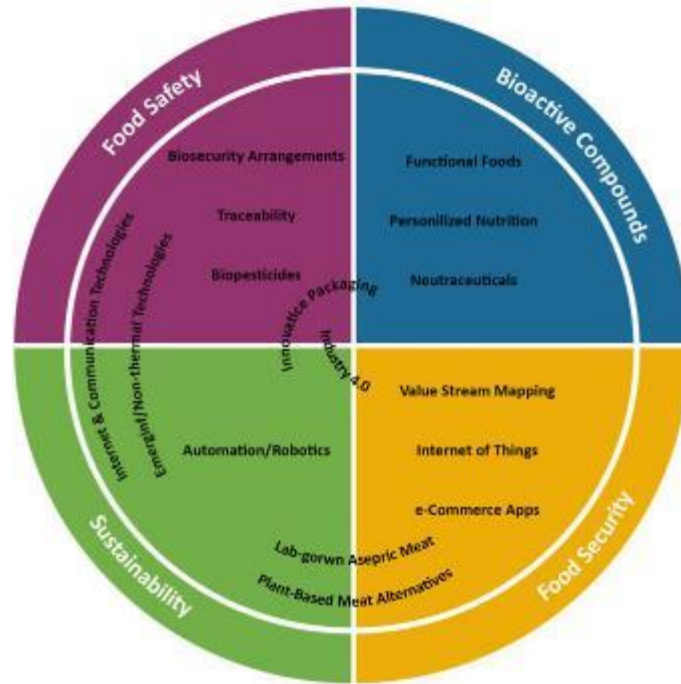
At its core, blockchain is a decentralized and distributed ledger technology that records transactions across a network of computers. Each transaction, or block, is linked to the preceding one through cryptographic hashes, forming an immutable chain. The decentralization ensures that no single entity has control, and the transparency of the ledger provides a shared and verifiable history of transactions. Smart contracts, self-executing contracts with the terms directly written into code, further enhance blockchain functionality by automating processes and facilitating trustless interactions.

The key foreseen innovations and disruptive technologies to tackle challenges of the four directions affected by the COVID-19 pandemic viz food safety, bioactive compounds, food security, and sustainability are shown in figure 1.

The examination of blockchain in the context of social good is driven by a confluence of factors rooted in the technology's inherent features and the persistent challenges faced by humanitarian aid and social initiatives. Blockchain's immutable and transparent nature addresses longstanding issues of trust and accountability. In humanitarian aid, where efficient resource allocation is paramount, blockchain's ability to create tamper-resistant transaction histories through smart contracts ensures that aid reaches its intended recipients without the risk of corruption or mismanagement. This increased transparency instills confidence among donors and beneficiaries alike.

For many marginalized populations, access to traditional banking services remains elusive. Blockchain's capacity to create decentralized identity systems offers a solution by providing secure and verifiable identities. This is particularly critical in humanitarian scenarios, enabling the efficient delivery of aid to individuals who lack formal documentation due to displacement or crisis (Dive, 2023, Manski, 2020, Mazile, 2021). The traditional aid model often involves multiple intermediaries, leading to delays, inefficiencies, and increased costs. Blockchain streamlines this process by removing intermediaries, automating tasks through smart contracts, and ensuring that resources are directed where they are needed most. This disintermediation not only reduces costs but also accelerates response times during crises.

Blockchain's impact on humanitarian aid is exemplified by transparent and tamper-resistant transactions. Through smart contracts, the allocation, distribution, and tracking of aid can be automated, reducing the need for intermediaries and minimizing corruption risks. This streamlined process ensures that resources are efficiently deployed and accurately accounted for. In crisis situations, individuals often lose access to essential identification documents. Blockchain facilitates the creation of decentralized identity systems, ensuring that affected populations can establish secure and verifiable identities. This, in turn, expedites aid distribution and supports financial inclusion by providing a basis for accessing banking and financial services.



**Figure 1** The key foreseen innovations and disruptive technologies of COVID-19 pandemic (Galanakis et. al., 2021)

While the potential benefits of blockchain for social good are significant, challenges and considerations must be addressed. Scalability issues, regulatory uncertainties, and the need for widespread technological literacy pose barriers to the widespread adoption of blockchain in social initiatives. Collaborative efforts among researchers, policymakers, and industry stakeholders are crucial to overcoming these challenges and unlocking the full potential of blockchain for social good (Bandara, et. al., 2021, Wang & De Filippi, 2020).

In conclusion, blockchain technology holds immense promise in revolutionizing humanitarian aid and social initiatives. By addressing issues of trust, transparency, and efficiency, blockchain has the potential to create a more equitable and accountable global ecosystem for social good. Continued research, collaboration, and innovative applications are essential to fully harness the transformative power of blockchain in the service of humanity.

## 1.2. Fundamentals of Blockchain Technology

In the rapidly evolving landscape of technology, blockchain has emerged as a groundbreaking innovation with profound implications for various industries. At its core, blockchain is a decentralized ledger technology that has revolutionized the way information is stored, shared, and secured. This paper delves into the fundamentals of blockchain, exploring the intricacies of decentralized ledger technology, key features such as transparency, security, and immutability, and the pivotal role played by smart contracts in blockchain applications (Palmié, et. al., 2020, Toufaily, Zalan & Dhaou, 2021, Wang, Han & Beynon-Davies, 2019).

At its essence, a blockchain is a distributed database that operates on a decentralized network of computers, often referred to as nodes. Unlike traditional centralized databases where a single authority has control, a decentralized ledger distributes control among multiple participants in the network. Each participant, or node, maintains an identical copy of the ledger, ensuring consensus and transparency. When a transaction occurs, it is broadcast to the network and grouped with other transactions into a block. Before being added to the existing chain, each block must undergo a validation process, commonly known as consensus. The consensus mechanism ensures that all nodes agree on the

validity of the transaction, eliminating the need for a central authority to validate and authenticate transactions. This decentralized consensus model is fundamental to the trust and security underpinning blockchain technology.

Transparency is a hallmark feature of blockchain technology. The ledger is visible to all participants in the network, creating a transparent and accessible record of transactions. Each participant can view the entire transaction history, fostering trust and accountability. In financial transactions, this transparency mitigates fraud and ensures an accurate audit trail (Bailur, Rao & Iyengar, 2020, Jimoh, Abdullahi & Ibrahim, 2019, Rijal & Saranani, 2023).

Blockchain achieves security through the use of cryptographic techniques. Each block contains a unique identifier called a hash, generated based on the information within the block and the hash of the previous block. This creates an unbroken chain of blocks, with altering any block requiring the alteration of all subsequent blocks—a practically impossible feat. The decentralized nature of blockchain further enhances security by removing the vulnerability associated with a single point of failure. Immutability is a fundamental property of blockchain, ensuring that once a block is added to the chain, its content cannot be altered or tampered with. The cryptographic hash function plays a pivotal role in guaranteeing immutability, as any change in the block content would result in a completely different hash. Immutability is particularly valuable in maintaining the integrity of historical records, making blockchain a reliable source of truth.

Smart contracts are self-executing contracts with the terms directly written into code. They operate on the if-then principle; if a certain condition is met, then a specified action is automatically executed. Deployed on the blockchain, smart contracts facilitate trustless and automated transactions, eliminating the need for intermediaries. The automation enabled by smart contracts brings unparalleled efficiency to various processes. In financial transactions, for example, smart contracts can automate payment processes, reducing the time and cost associated with manual processing. In supply chain management, they can automatically trigger actions based on predefined conditions, such as validating the authenticity of goods or triggering payments upon delivery.

Smart contracts foster trustless interactions by executing actions automatically when conditions are met, without the need for intermediaries or third parties. This not only reduces the risk of fraud but also streamlines processes by eliminating the delays and complexities associated with traditional contractual agreements. While the fundamentals of blockchain technology present a promising landscape, challenges such as scalability, regulatory uncertainties, and the need for widespread adoption remain. Scalability issues, in particular, must be addressed to ensure that blockchain can handle the increasing volume of transactions without compromising efficiency.

In conclusion, understanding the fundamentals of blockchain technology is essential to grasp the transformative potential it holds. Decentralized ledger technology, coupled with key features like transparency, security, and immutability, lays the foundation for a new era of secure and transparent transactions. Smart contracts further enhance the utility of blockchain, providing a mechanism for trustless and automated interactions. As we navigate through the complexities of blockchain, it becomes evident that this technology is not merely a buzzword but a fundamental shift in the way we conceptualize and implement secure and transparent digital transactions. The ongoing evolution of blockchain technology promises to reshape industries, foster innovation, and redefine the way we engage with information and value.

### **1.3. Blockchain in Humanitarian Aid**

Humanitarian aid, often marked by urgency and a need for transparency, faces numerous challenges in ensuring efficient, secure, and accountable resource distribution. Blockchain technology has emerged as a powerful tool in transforming the landscape of humanitarian aid, offering solutions to persistent issues (Khan, et. al., 2019, Pizzi, Romanoff & Engelhardt, 2020, Van den Homberg, Gevaert & Georgiadou, 2020). This paper explores the application of blockchain in humanitarian aid, focusing on transparent and tamper-resistant transactions and the implementation of decentralized identity systems.

Blockchain's integration of smart contracts revolutionizes the distribution of aid by automating and securing the entire process. Smart contracts are self-executing contracts with predefined rules and conditions written into code. In the context of humanitarian aid, these contracts automate the release of funds and resources based on predetermined criteria, eliminating the need for manual intervention.

Smart contracts facilitate immediate and automatic responses to predefined triggers. For instance, when a certain condition is met, such as reaching a specific number of beneficiaries or achieving a particular project milestone, funds are automatically disbursed. This automation reduces delays, ensuring that aid reaches those in need promptly.

Traditional aid distribution involves multiple intermediaries, leading to increased costs and higher corruption risks. By leveraging blockchain's smart contracts, direct peer-to-peer transactions are enabled. This reduction in intermediaries not only minimizes the risk of corruption but also cuts down on administrative overheads, ensuring a more efficient and direct flow of resources.

Blockchain technology addresses a critical issue in humanitarian aid by providing decentralized identity systems, offering secure and verifiable identities for displaced populations. Displaced populations often lack proper identification, hindering their ability to access essential services (Chen, et. al., 2020, Ren, et. al., 2021). Blockchain's decentralized identity systems enable the creation of secure and verifiable digital identities. Each individual can have a unique digital identity stored on the blockchain, accessible and immutable, thereby overcoming the challenges associated with physical documentation loss during displacement. The implementation of decentralized identity systems facilitates more efficient and dignified aid delivery. Aid organizations can verify the identities of recipients without the need for traditional documents, streamlining the distribution process. This not only enhances the speed of aid delivery but also preserves the dignity of beneficiaries by eliminating the need for extensive paperwork or cumbersome verification processes.

Several real-world applications of blockchain in humanitarian aid underscore the transformative impact of this technology (Connolly, Nam & Goodman, 2023, Treiblmaier & Rejeb, 2023). The World Food Programme (WFP) implemented the Building Blocks project, leveraging blockchain to enhance efficiency in cash-based transfers for refugees. Through blockchain, the WFP ensured secure and transparent transactions, reducing fraud and ensuring that aid reached the intended recipients. UNICEF's Project Connect focuses on providing connectivity to every school worldwide. By utilizing blockchain technology, UNICEF aims to create a decentralized identity for every school, ensuring that each educational institution has a verifiable and secure identity. This initiative streamlines the distribution of resources, enabling efficient and targeted support to schools in need.

While blockchain holds immense promise for humanitarian aid, challenges such as scalability, regulatory frameworks, and technological literacy persist. The scalability of blockchain networks is crucial to handle the increasing volume of transactions in large-scale humanitarian operations. Additionally, clear regulatory frameworks are needed to ensure the legality and acceptance of blockchain applications in the humanitarian sector. Moreover, efforts to enhance technological literacy among aid organizations and beneficiaries are essential for the successful implementation and adoption of blockchain solutions (Baharmand, et. al., 2021, Coppi & Fast, 2019).

Blockchain technology has the potential to revolutionize humanitarian aid, addressing longstanding challenges in transparency, efficiency, and identity verification. Transparent and tamper-resistant transactions, facilitated by smart contracts, streamline aid distribution, reduce corruption risks, and ensure timely responses. Decentralized identity systems empower displaced populations with secure and verifiable identities, fostering efficient and dignified aid delivery. As blockchain continues to evolve, ongoing research, collaboration, and the development of scalable solutions are crucial to fully realize its transformative impact in humanitarian aid, paving the way for a more equitable and efficient global response to crises (Aysan, Bergigui & Disli, 2021, Taylor & Martin, 2019).

#### **1.4. Supply Chain Transparency**

Supply chain transparency is a pivotal factor in ensuring the effectiveness and integrity of humanitarian aid and business operations alike. The advent of blockchain technology has brought forth a transformative solution to the challenges associated with supply chain management. This paper delves into the ways blockchain enhances supply chain transparency, specifically focusing on the traceability of donations and its profound impact on reducing fraud in supply chain management and guaranteeing the authenticity of goods reaching beneficiaries (Dubey, et. al., 2020, Gardner, et. al., 2019, Montecchi, Plangger & West, 2021).

Blockchain's implementation in supply chain management introduces an unprecedented level of traceability to the donation process, thereby reducing the risk of fraudulent activities. Blockchain's core characteristic of immutability ensures that once a transaction is recorded, it cannot be altered. This significantly reduces the likelihood of fraudulent practices such as embezzlement, misappropriation of funds, or the creation of false transactions within the supply chain. Every donation, from its origin to its final destination, is securely documented on the blockchain, creating an auditable and transparent trail. Smart contracts, self-executing agreements with predefined rules, play a crucial role in enhancing accountability. These contracts can be programmed to automatically execute actions based on specific conditions being met. In the context of supply chain management, smart contracts can stipulate that funds are released only upon the successful completion of predefined milestones. This not only minimizes the risk of mismanagement but also ensures that resources are directed to their intended purposes (Dutta, et. al., 2020, Gonczol, et. al., 2020, Jabbar, et. al., 2021).

In humanitarian aid and various industries, ensuring the authenticity of goods is paramount. Blockchain offers a robust solution to guarantee the legitimacy and safety of products within the supply chain. Each product within the supply chain can be assigned a unique identifier, and its journey from manufacturing to distribution is recorded on the blockchain. This creates an immutable record of every stage, providing stakeholders with a transparent and unalterable history of each product. Counterfeiting and tampering are mitigated as beneficiaries and stakeholders can verify the authenticity of goods through these unforgeable records. Blockchain enables real-time tracking of goods, allowing stakeholders to monitor the movement of products at each stage of the supply chain. This proactive approach to tracking reduces the likelihood of counterfeit goods entering the supply chain and ensures that beneficiaries receive genuine and safe items.

Several notable initiatives have successfully utilized blockchain to enhance supply chain transparency and address issues of fraud and authenticity. Everledger employs blockchain to trace the origin and journey of diamonds, ensuring authenticity and reducing the risk of trade in conflict or illicit diamonds. While not directly related to humanitarian aid, this initiative illustrates the broader potential of blockchain in verifying the authenticity of goods within a supply chain. Provenance uses blockchain to trace the supply chain of food products, providing consumers with information about the origin, journey, and ethical considerations of the products they purchase. This use case highlights how blockchain can be applied to ensure the authenticity and transparency of goods, which is equally relevant in humanitarian aid scenarios.

Despite the promises of blockchain in supply chain transparency, challenges such as scalability, interoperability, and the integration with existing systems need attention. Scalability is vital for accommodating the vast number of transactions within large-scale supply chains. Interoperability ensures seamless collaboration between different blockchain platforms and traditional supply chain systems, fostering comprehensive transparency (Cole, Stevenson & Aitken, 2019, Sunny, Undralla & Pillai, 2020).

Blockchain technology stands as a beacon for advancing accountability and transparency in supply chain management. The traceability of donations through blockchain significantly reduces fraud, enhancing the integrity of supply chains in humanitarian aid and beyond. Furthermore, guaranteeing the authenticity of goods reaching beneficiaries is paramount for ensuring the safety and efficacy of aid efforts. As technology evolves, continued research, collaboration, and practical implementations are essential to overcoming challenges and unlocking the full potential of blockchain in revolutionizing supply chain transparency. The transformative impact of blockchain on supply chains signifies a new era of accountability and trust in the global movement of goods and aid.

### **1.5. Social Initiatives and Decentralized Autonomous Organizations (DAOs)**

In the landscape of social initiatives, the advent of blockchain technology has given rise to innovative models of governance and community-driven collaboration. Decentralized Autonomous Organizations (DAOs) stand at the forefront of this evolution, offering a novel approach to collective decision-making, resource management, and fostering a sense of empowerment and ownership within communities. This paper explores the transformative potential of DAOs in social initiatives, delving into their foundational principles and the ways in which they incentivize positive behaviors through token economies.

Decentralized Autonomous Organizations are entities that operate on blockchain technology, governed by smart contracts and characterized by a decentralized decision-making structure. Unlike traditional organizations with hierarchical structures, DAOs rely on the collective intelligence and consensus of their members to make decisions and manage resources. The core principles of transparency, decentralization, and trustless interactions define the essence of DAOs (Hidayati, et. al., 2023, Lingayat, et. al., 2021).

DAOs fundamentally alter the governance paradigm by shifting decision-making authority from a centralized body to a decentralized network of participants. Each member typically has voting power proportional to their stake in the DAO, ensuring a democratic and inclusive decision-making process. Smart contracts, self-executing contracts with predefined rules, play a pivotal role in DAOs. These contracts automate various aspects of decision-making and resource allocation. For example, a DAO might use smart contracts to automatically distribute funds for approved projects based on the consensus of its members. DAO members can submit proposals outlining initiatives, projects, or resource needs. The community then votes on these proposals, and if accepted, the smart contracts execute the allocation of resources accordingly. This collective decision-making mechanism ensures that community members have a direct say in the direction and impact of social initiatives (George, et. al., 2023, Karjalainen, 2020).

DAOs foster inclusive participation, allowing individuals from diverse backgrounds to contribute and influence decision-making. This inclusivity ensures that a variety of perspectives and experiences are considered when shaping the direction of social initiatives. DAO members have a direct stake in the success of the initiatives. As owners of the DAO, they are invested not only financially but also emotionally in the outcomes. This sense of ownership fosters a greater commitment to the success of social initiatives, leading to increased accountability and engagement.

The absence of a central authority in DAOs means that leadership emerges organically from the community. This decentralized leadership model encourages collaboration, shared responsibility, and the cultivation of leadership skills within the community, empowering individuals to take on meaningful roles. DAOs often employ token economies to incentivize positive behaviors that contribute to the success of social initiatives. Members may receive tokens as rewards for active participation, successful project contributions, or other positive actions within the community. The use of tokens aligns individual incentives with the broader goals of the DAO. As members accumulate tokens, they gain more influence in decision-making processes, creating a self-reinforcing cycle where positive contributions lead to increased influence, encouraging sustained engagement. Token economies in DAOs can prioritize social impact by rewarding activities that align with the mission of the organization. For example, a DAO focused on environmental sustainability might incentivize actions that contribute to carbon reduction, afforestation, or clean energy projects (Drasch, et. al., 2020, Lamberty, de Waard & Poddey, 2020).

Several successful DAOs in the realm of social initiatives showcase the practical implementation of these principles. MolochDAO is a decentralized grant-giving DAO focused on supporting Ethereum development projects. Members pool funds, collectively decide on grant allocations, and use token-based voting to determine project funding. This DAO exemplifies the power of decentralized decision-making and resource allocation. Giveth is a decentralized platform for building and funding charitable projects. It operates as a DAO, enabling transparent and community-driven governance. Giveth uses tokenomics to incentivize positive contributions, aligning individual interests with the broader mission of supporting social initiatives (Medaglia & Damsgaard, 2020, Napieralska & Kępczyński, 2023).

While DAOs offer a revolutionary approach to social initiatives, challenges such as governance scalability, legal frameworks, and user education need to be addressed. Overcoming these challenges will be crucial for the continued growth and impact of DAOs in driving positive change. Decentralized Autonomous Organizations represent a paradigm shift in the way social initiatives are governed and executed. By fostering collective decision-making, empowering communities, and implementing token economies, DAOs create a dynamic and inclusive model for achieving positive social impact. As the landscape of social initiatives continues to evolve, DAOs stand as a beacon of decentralized collaboration, enabling communities to drive meaningful change with ownership, transparency, and shared incentives at its core.

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## 2. Challenges and Considerations

While the potential of blockchain for social good is immense, the journey is not without its challenges. This paper explores key hurdles and considerations, ranging from scalability issues and regulatory uncertainties to addressing technological literacy barriers, that must be navigated to unlock the full transformative power of blockchain in serving societal needs.

One of the primary challenges facing blockchain technology is its inherent scalability limitations. Traditional blockchain networks, like Bitcoin and Ethereum, struggle with processing a high volume of transactions per second. As social good initiatives scale up, the demand for increased transaction throughput becomes crucial to accommodate the growing number of participants and transactions (Khan, Jung & Hashmani, 2021, Nawari & Ravindran, 2019).

The proof-of-work consensus mechanism, employed by some blockchains, contributes to scalability challenges due to its energy-intensive nature. As the network expands, the environmental impact of mining activities becomes a concern. Transitioning to more sustainable consensus mechanisms, such as proof-of-stake, is a potential solution but requires widespread adoption and consensus among stakeholders. As the number of users and transactions on a blockchain increases, network congestion becomes a prevalent issue. Slow transaction confirmations and higher fees during peak times can hinder the efficiency of social initiatives relying on blockchain, affecting the user experience and potentially discouraging participation.

The regulatory landscape surrounding blockchain technology is currently evolving, presenting uncertainties and challenges for social good applications. Varied and often ambiguous regulations worldwide contribute to a lack of standardized legal frameworks. The absence of clear guidelines on compliance, taxation, and legal recognition may impede the adoption and growth of blockchain initiatives in the social sector. Blockchain's transparent and immutable

nature can clash with evolving data protection regulations, such as the European Union's General Data Protection Regulation (GDPR). Balancing the transparency benefits of blockchain with individuals' right to privacy poses a challenge, as blockchain transactions are typically publicly accessible and permanent.

Governments and regulatory bodies may exhibit a level of caution or hesitation in embracing blockchain technology due to its relatively recent emergence. Regulatory lag, the delay in adapting laws to accommodate technological advancements, may result in an uncertain environment for social initiatives seeking to leverage blockchain for positive societal impact.

Blockchain technology can be complex, requiring a certain level of technical understanding for effective utilization. Social initiatives often involve diverse stakeholders, including non-technical participants, who may find the intricacies of blockchain challenging to comprehend. Bridging this knowledge gap is crucial for fostering widespread adoption. The user interface and experience of blockchain applications play a vital role in overcoming technological literacy barriers. Developing intuitive and user-friendly interfaces that paper the complexity of blockchain technology can enhance accessibility and encourage broader participation in social initiatives. Promoting technological literacy through educational initiatives is paramount. Training programs, workshops, and awareness campaigns can empower individuals, organizations, and communities to understand the potential of blockchain for social good and equip them with the skills needed for effective engagement.

UNICEF's Innovation Fund, while not directly focused on blockchain, highlights the challenges of implementing new technologies in the social sector. The fund invests in startups developing open-source solutions that can benefit children globally. Bridging the gap between technology and social impact requires navigating challenges, including scalability and regulatory considerations. Initiatives like the Self-Sovereign Identity (SSI) movement aim to empower individuals with control over their digital identities. These projects face challenges in educating users about the advantages of decentralized identity solutions and addressing regulatory concerns related to identity verification (Mora, et. al., 2021, Seyedsayamdost & Vanderwal, 2020).

Advancements in blockchain technology, such as layer-two scaling solutions and alternative consensus mechanisms, are actively being explored to address scalability issues. The industry's collaborative efforts and research endeavors aim to enhance the capacity of blockchain networks, making them more robust and scalable for social initiatives. Collaborative efforts between blockchain industry stakeholders, social initiatives, and regulatory bodies are essential for creating a conducive regulatory environment. Proactive engagement, advocacy, and dialogue can contribute to the development of clear and supportive regulatory frameworks that foster innovation and responsible blockchain use for social good. Empowering communities through educational initiatives and community engagement is key to overcoming technological literacy barriers. Organizations and projects should prioritize user education, offering resources, training, and support to ensure that participants feel confident in utilizing blockchain for social impact (Fritsch, et. al., 2021, Tanwar, 2022).

While challenges persist in harnessing the full potential of blockchain for social good, the commitment to overcoming these obstacles through collaboration, innovation, and education remains strong. Addressing scalability issues, navigating regulatory uncertainties, and enhancing technological literacy are crucial steps toward creating a more inclusive, transparent, and impactful future where blockchain serves as a catalyst for positive societal change. As the technology matures and stakeholders work collectively to overcome these challenges, the transformative impact of blockchain on social initiatives is poised to reach new heights.

## 2.1. Case Studies

Blockchain technology has transcended its origins in cryptocurrency to become a catalyst for positive change in humanitarian aid and social initiatives (Pantin, (2023, Venegas, 2021). This paper explores case studies that showcase successful applications of blockchain in addressing challenges, enhancing transparency, and fostering innovation in the realms of humanitarian aid and social impact initiatives.

The World Food Programme (WFP) initiated the Building Blocks project to revolutionize cash-based transfers in humanitarian aid using blockchain. Building Blocks leverages blockchain to streamline the distribution of cash assistance to beneficiaries. By recording transactions on a transparent and immutable blockchain, the project ensures the traceability of funds, reducing the risk of fraud and corruption. The success of Building Blocks demonstrates how blockchain enhances accountability and efficiency in humanitarian aid, ultimately leading to more impactful assistance for those in need.



UNICEF's Project Connect is a prime example of leveraging blockchain for social good by focusing on connectivity for schools worldwide. The initiative aims to create a decentralized identity for every school, ensuring that each educational institution has a verifiable and secure identity on the blockchain. This decentralized identity system facilitates efficient and transparent resource allocation, streamlining the distribution of funds, and ensuring that educational institutions receive the support they need. Project Connect exemplifies how blockchain can be a game-changer in enhancing transparency and accountability in the allocation of resources for social causes.

Giveth is a decentralized platform that utilizes blockchain technology to transform charitable giving. By creating a transparent and traceable donation ecosystem, Giveth ensures that donors have visibility into how their contributions are utilized. Smart contracts automate the distribution of funds based on community-approved proposals, reducing the need for intermediaries. Giveth showcases how blockchain empowers individuals to directly contribute to social initiatives while fostering trust and accountability within the decentralized ecosystem.

Kiva, a nonprofit organization focused on financial inclusion, has embraced blockchain technology to enhance its micro-lending platform. The Kiva Protocol utilizes blockchain to create a decentralized identity system for individuals lacking traditional documentation. This innovative approach enables marginalized populations to establish secure and verifiable identities, unlocking access to financial services. By leveraging blockchain, Kiva enhances financial inclusion and empowers individuals in underserved communities to participate in the global economy. The Human Rights Foundation (HRF) utilizes blockchain technology to support human rights activists and promote financial sovereignty. Through the Bitcoin Development Fund, HRF channels funds to support developers working on privacy-focused and censorship-resistant technologies. Blockchain, specifically Bitcoin in this case, serves as a tool for financial autonomy, enabling activists in restrictive environments to access resources without dependence on traditional financial institutions. This case demonstrates how blockchain can be a powerful tool for promoting human rights and empowering individuals to resist censorship.

These case studies collectively highlight the transformative impact of blockchain in fostering transparency and accountability. Whether in humanitarian aid or social initiatives, the use of blockchain ensures that transactions, resource allocations, and fund disbursements are transparent, traceable, and resistant to tampering. This transparency builds trust among stakeholders, including donors, beneficiaries, and the wider community.

Blockchain's ability to automate processes through smart contracts contributes to increased efficiency in resource management. Smart contracts streamline the allocation of funds, automate verification processes, and eliminate the need for intermediaries. This automation not only reduces operational costs but also accelerates the pace at which aid is delivered and social initiatives are executed. Blockchain facilitates empowerment and financial inclusion by creating decentralized identity systems. Whether in educational initiatives, micro-lending platforms, or human rights advocacy, blockchain empowers individuals with secure and verifiable identities. This empowerment is foundational to financial inclusion, enabling marginalized populations to access essential services, participate in economic activities, and assert their rights.

While these case studies exemplify successful applications of blockchain in humanitarian aid and social initiatives, challenges such as scalability, regulatory uncertainties, and technological literacy barriers persist. Overcoming these challenges requires ongoing collaboration, research, and advocacy to ensure that the potential of blockchain is fully realized for the benefit of society (Balcerzak, et. al., 2022, Li & Kassem, 2021, Wang, et. al., 2019).

The case studies presented underscore the transformative potential of blockchain in reshaping humanitarian aid and driving positive social impact. From transparent and traceable cash transfers to decentralized identity systems and innovative charitable giving platforms, blockchain technology is proving to be a powerful force for good. As these success stories continue to inspire and inform, the collective efforts of stakeholders, including governments, organizations, and communities, are crucial to overcoming challenges and realizing the full potential of blockchain in creating a more equitable and transparent world.

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### 3. Future Directions

As blockchain technology continues to evolve, its potential for catalyzing positive change in social good initiatives becomes increasingly evident. To ensure the continued growth and success of blockchain in this domain, it is crucial to address research gaps, provide policy recommendations, and foster collaborative efforts for ongoing innovation. This paper explores future directions and recommendations to guide the trajectory of blockchain in serving societal needs.

One prominent area for further exploration lies in scalability solutions for blockchain networks. As social initiatives scale up, the need for networks capable of handling a high volume of transactions becomes paramount. Research into novel consensus mechanisms, layer-two scaling solutions, and interoperability protocols is essential to address the scalability challenges associated with widespread adoption (de Oliveira, Ghobakhloo & Figueira, 2023, Shin & Ibahrine, 2020). Research focusing on the environmental impact of blockchain technology is imperative. While the technology holds promise, the energy consumption associated with certain consensus mechanisms, such as proof-of-work, raises concerns. Investigating and implementing eco-friendly consensus mechanisms will contribute to the long-term sustainability of blockchain solutions for social good. Exploring effective governance models for decentralized autonomous organizations (DAOs) is an area that warrants attention. The development of robust frameworks for decision-making, dispute resolution, and accountability within DAOs will enhance their functionality and resilience. Research into inclusive governance structures that accommodate diverse stakeholder perspectives will be instrumental in ensuring the success of DAO-driven social initiatives.

Research focusing on improving the user experience of blockchain applications is vital for broader adoption. Simplifying user interfaces, enhancing educational resources, and conducting user-centric studies can help bridge the technological literacy gap. Understanding user motivations, preferences, and pain points will contribute to the creation of more accessible and user-friendly blockchain solutions for social initiatives. Policymakers should work towards establishing clear and supportive regulatory frameworks for the integration of blockchain in social good initiatives. Providing legal clarity on issues such as smart contract enforceability, data protection, and tax implications will foster a conducive environment for innovation while ensuring compliance with existing laws.

Policymakers should encourage interdisciplinary collaboration between government agencies, blockchain experts, and social organizations. Collaborative initiatives can help design policies that balance the innovative potential of blockchain with the need for regulatory oversight. Engaging stakeholders from diverse fields will result in well-informed and inclusive policies. Governments can consider offering incentives for responsible blockchain innovation in the social sector. This might include grants, tax incentives, or regulatory sandboxes that allow organizations to experiment with blockchain solutions without facing immediate regulatory constraints. Such incentives can stimulate responsible experimentation and accelerate the development of impactful social initiatives. Policymakers should proactively address data privacy concerns associated with blockchain technology. Striking a balance between the transparency benefits of blockchain and individuals' right to privacy is crucial. Creating guidelines for privacy-focused implementations and ensuring compliance with existing data protection regulations will build trust in blockchain applications for social good.

The transformative potential of blockchain in addressing global challenges requires international collaboration. Governments, NGOs, businesses, and academic institutions should collaborate on a global scale to share insights, best practices, and lessons learned. Cross-border partnerships can accelerate the development and deployment of blockchain solutions that have a meaningful impact on a global scale. Engaging a diverse set of stakeholders is key to the success of blockchain in social initiatives. Governments, industry leaders, academia, and civil society organizations should come together to form multi-stakeholder coalitions. These coalitions can facilitate dialogue, share resources, and collaboratively address challenges, ensuring a holistic and inclusive approach to blockchain implementation. Continued investment in education and training programs is essential to build a skilled workforce capable of driving blockchain innovation. Governments, educational institutions, and industry partners should invest in initiatives that promote blockchain literacy, skill development, and knowledge transfer. This investment will empower individuals to contribute meaningfully to the ongoing development of blockchain solutions. Governments and philanthropic organizations should provide support for pilot projects that explore the application of blockchain in diverse social contexts. Funding, mentorship, and access to resources can help these projects navigate challenges and demonstrate the real-world impact of blockchain technology. Supporting early-stage initiatives will foster a culture of innovation and experimentation (Chang, Iakovou & Shi, 2020, Schulz, Gstrein & Zwitter, 2020).

The future of blockchain in serving social good is both promising and challenging. By addressing research gaps, implementing thoughtful policy recommendations, and fostering collaborative efforts, we can navigate these challenges and unlock the full potential of blockchain technology. The evolution of blockchain for social impact relies on a collective commitment to innovation, inclusivity, and responsible deployment. As we embark on this journey, the continued collaboration between technologists, policymakers, and communities will shape a future where blockchain contributes significantly to positive societal transformation.

#### 4. Recommendation

Throughout this review, we have delved into the transformative applications of blockchain in humanitarian aid and social initiatives. Notable case studies, such as the World Food Programme's Building Blocks project and UNICEF's Project Connect, have exemplified how blockchain enhances transparency, accountability, and efficiency in resource allocation. From decentralized identity systems to smart contracts automating aid distribution, blockchain has demonstrated its potential to revolutionize the landscape of social good.

The findings underscore a resounding affirmation of blockchain's transformative potential for social good. The technology's inherent features, including transparency, immutability, and decentralized governance, address critical challenges in humanitarian aid and social initiatives. Blockchain empowers communities, enhances accountability, and streamlines processes, offering a paradigm shift in how we approach and implement social impact initiatives.

As we conclude this review, it is essential to emphasize the significance of continued research and implementation efforts in harnessing blockchain for social good. The journey has only just begun, and there are still challenges to overcome, such as scalability issues, regulatory uncertainties, and technological literacy barriers. However, these challenges should be viewed as opportunities for growth and refinement.

Ongoing research should focus on scalability solutions to accommodate the growing demands of humanitarian aid and social initiatives. Exploring alternative consensus mechanisms, layer-two scaling solutions, and interoperability protocols will contribute to the development of more robust and scalable blockchain networks. Policymakers and researchers should collaborate to establish clear regulatory frameworks that facilitate the integration of blockchain in social good initiatives. Addressing legal uncertainties, data privacy concerns, and ensuring compliance with existing laws will create a supportive environment for blockchain innovation. Efforts should be intensified to bridge the technological literacy gap, making blockchain more accessible to a wider audience. Educational initiatives, user-friendly interfaces, and community engagement play crucial roles in empowering individuals and organizations to leverage blockchain technology effectively.

The global community should encourage innovation that transcends geographical boundaries. Collaborative efforts between governments, NGOs, businesses, and academia will foster a culture of innovation with a global impact. Investing in pilot projects, supporting grassroots initiatives, and sharing best practices will contribute to a more inclusive and diverse blockchain ecosystem. In envisioning the future, blockchain stands as a powerful tool for positive societal transformation. The potential to create decentralized, transparent, and inclusive systems that empower individuals and communities is unprecedented. As we move forward, let us collectively commit to realizing this vision by embracing the principles of collaboration, innovation, and ethical deployment of blockchain technology.

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#### 5. Conclusion

In conclusion, blockchain for social good is not merely a concept but a tangible force driving change. The success stories showcased in this review illuminate the path forward, and the potential for even greater impact is within our grasp. Let us build upon these foundations, learn from challenges, and work collaboratively to shape a future where blockchain serves as a catalyst for positive and sustainable social change. Through ongoing research, thoughtful implementation, and a shared commitment to making a difference, blockchain can truly be a force for good in the service of humanity.

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#### Compliance with ethical standards

##### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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