Article

Artificial Intelligence for Social Innovation: Beyond the Noise of Algorithms and Datafication

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Abstract: In an era of rapid technological advancement, decisions about the ownership and governance of emerging technologies like Artificial Intelligence will shape the future of both urban and rural environments in the Global North and South. This article explores how AI can move beyond the noise of algorithms by adopting a technological humanistic approach to enable Social Innovation, focusing on global inequalities and digital justice. Using a fieldwork Action Research methodology, based on the Smart Rural Communities project in Colombia and Mozambique, the study develops a framework for integrating AI with SI. Drawing on insights from the AI4SI International Summer School held in Donostia-San Sebastián in 2024, the article examines the role of decentralized Web3 technologies—such as Blockchain, Decentralized Autonomous Organizations, and Data Cooperatives—in enhancing data sovereignty and fostering inclusive and participatory governance. The results demonstrate how decentralization can empower marginalized communities in the Global South by promoting digital justice and addressing the imbalance of power in digital ecosystems. The conclusion emphasizes the potential for AI and decentralized technologies to bridge the digital divide, offering practical recommendations for scaling these innovations to support equitable, community-driven governance and address systemic inequalities across the Global North and South.

Keywords: AI; social innovation; web3; blockchain; DAOs; data cooperatives; decentralization; political economy; digital justice; global south

1. Introduction: Can AI Alleviate World Poverty (In the Global South)?

The decisions that societies make today about the ownership and governance of emerging technologies, such as AI, can set the course for the next century [1–6]. In the era of accelerated algorithmic advancement, AI emerges as both a transformative and disruptive reality [7–11]. Consequently, the transformative potential of AI has become a central focus in contemporary discussions on technology, governance, and global development [12–17]. With promises of revolutionizing industries and creating unprecedented efficiencies, AI is being positioned as a key driver of economic growth and urban modernization. However, amid the excitement surrounding these capabilities, a more critical question emerges: Can AI alleviate world poverty, particularly in the Global South [18]? This question is not

merely rhetorical but underscores the broader challenges of integrating AI into sustainable development strategies that prioritize inclusivity, equity, and justice [19–29].

AI technologies and industries are often celebrated for enhancing data-driven decision-making, optimizing urban infrastructures, and improving the delivery of public services [30]. These advancements have the potential to reshape economies, offering opportunities for greater precision in resource allocation and more responsive governance models. In countries where technological innovation has taken root, AI's impact on urban planning, healthcare, agriculture, and education has been largely framed as beneficial, increasing both efficiency and productivity. Yet, these developments have also prompted critical debates about the uneven distribution of AI's benefits between the Global North and the Global South, raising concerns over the digital divide, algorithmic bias, and the potential for reinforcing existing social inequalities [18,31–37].

In this article, the title "AI for Social Innovation: Beyond the Noise of Algorithms and Datafication" is designed to encapsulate the central thesis of this article while offering a critique of the current discourse around AI. The term "noise" refers to the overwhelming focus on technical efficiency and algorithmic complexity, often obscuring the more critical, humanistic applications of AI, particularly in the context of Social Innovation (SI). By moving beyond this noise, the title invites readers to explore how AI can be harnessed not only for technical advancements but also for fostering inclusive, decentralized, and equitable solutions. The second sentence of the title directly builds on the first by emphasizing the shift from algorithmic obsession to actionable social impact, framing the discussion around AI's transformative potential in addressing systemic inequalities, especially within marginalized communities in both the Global North and South. This structure aims to offer an informative and cohesive entry point into the article's core argument, making the title both engaging and deeply connected to the content.

This article aims to critically explore how AI can contribute to alleviating global socio-economic disparities, particularly in the Global South, through its integration into SI. By examining AI's potential for addressing systemic inequalities and promoting digital justice, this study seeks to develop a framework for leveraging decentralized technologies, such as Blockchain, Decentralized Autonomous Organizations (DAOs), and Data Cooperatives, to empower marginalized communities. The central objective is to evaluate whether AI can be effectively utilized to reduce global poverty while fostering sustainable, inclusive, and community-driven development models.

Consequently, the perception of AI as a "magic tool" capable of solving a wide range of societal problems has gained significant traction, particularly within popular and media narratives [38]. This view often positions AI as a catch-all solution that can seamlessly address issues ranging from poverty alleviation to healthcare access, while glossing over the complexities of implementation and local contexts. The notion of AI as a technological panacea, however, is not without its critiques. Scholars and practitioners alike have raised concerns that this overly optimistic framing can obscure the underlying socio-economic, political, and infrastructural challenges that accompany AI deployment, especially in regions with fragile governance systems and limited technological infrastructure [39].

In tandem with this "magic tool" discourse is the "noise" surrounding AI—an over-abundance of hype and unrealistic expectations, often perpetuated by tech industries and media outlets [40]. This noise amplifies the perception that AI can effortlessly transform urban and rural landscapes, creating smarter cities and more efficient public services, all while downplaying the nuanced realities of implementation [41]. The emphasis on AI's potential to revolutionize sectors like healthcare, education, and agriculture can overshadow the necessary groundwork required for such technologies to be effective and sustainable [42]. As a result, this "noise" can distort the policy landscape, pushing governments and organizations to adopt AI-driven solutions without fully understanding their limitations or the socio-technical investments needed to realize their full potential [43].

The combined effect of AI being framed as both a magic tool and surrounded by noise can foster a reliance on top-down, technocratic approaches that fail to engage with local

knowledge, cultural specificities, and community-driven solutions. Such approaches risk exacerbating existing inequalities, particularly in the Global South, where the digital divide is most pronounced. Viewing AI as a "magic tool" ignores the fact that the success of AI-driven initiatives depends not just on the technology itself, but on the socio-political and economic ecosystems into which it is introduced. In reality, AI requires careful calibration to the needs and capacities of local communities, as well as sustained investment in infrastructure, education, and governance mechanisms that promote equitable outcomes [44].

Moreover, the framing of AI as a miracle solution often fails to account for the ethical and practical challenges related to data sovereignty, privacy, and accountability. AI systems, particularly those relying on machine learning algorithms, are only as effective as the data they are trained on [43]. In many parts of the Global South, the lack of comprehensive, high-quality datasets limits the effectiveness of AI solutions and, in some cases, introduces significant risks of bias and error. Without proper oversight and participatory governance models [18], AI can easily become another tool for reinforcing the dominance of the Global North, leading to new forms of digital colonialism and exploitation [45–47].

Thus, while AI holds tremendous potential, treating it as a "magic tool" that can singlehandedly resolve complex social and economic issues and succumbing to the "noise" surrounding its capabilities are both misleading and dangerous. It risks diverting attention from the structural reforms and long-term investments needed to address the root causes of inequality and underdevelopment [48]. A more nuanced, human-centred approach to AI is required—one that emphasizes collaboration, context sensitivity, and the co-creation of solutions with local stakeholders to ensure that AI serves as a tool for SI rather than deepening existing divides [49,50].

The rapid expansion of AI technologies has thus created both opportunities and risks, particularly in contexts where governance structures and socio-economic infrastructures are less resilient [51]. In the Global South, where many countries already face challenges related to poverty, lack of access to digital tools, and socio-political instability, the introduction of AI technologies requires a careful assessment of their long-term implications. Can AI truly drive inclusive development, or will it exacerbate existing divides between the technologically advanced and those left behind [52]? Additionally, how can AI contribute to addressing pressing global challenges such as hunger, health crises, and education disparities, without further entrenching global inequality?

Addressing these questions involves not only technological innovation but also SI [49,50,53], aligning AI deployment with ethical frameworks that emphasize human rights and digital justice. Therefore, the critical issue remains whether AI can indeed serve as a tool for equitable development or whether it risks becoming another instrument of technological hegemony that reinforces the dominance of the Global North over the Global South [54,55]. Before delving into these issues in depth, we must consider a preliminary question that frames this inquiry: How can AI be effectively integrated into global development policies in ways that ensure equity, justice, and sustainability? And thus, ultimately, we ask the main research question of this article: Can AI Alleviate World Poverty (in the Global South) [56,57]?

This article seeks to explore the complexities of AI's role in addressing socio-economic disparities and data colonialism [45,46], with a particular emphasis on the Global South. Rather than approaching AI as a panacea, the discussion frames AI within the broader landscape of digital transformation, focusing on its potential to foster SI [56,57]. Drawing insights from the AI4SI International Summer School held on 2–3 September 2024 in Donostia-San Sebastián (https://www.uik.eus/en/activity/artificial-intelligence-social-innovation-ai4si, accessed on 1 October 2024), this article examines how AI, when combined with decentralized Web3 technologies—such as blockchain, decentralized autonomous organizations (DAOs), and data cooperatives—can enhance digital justice and contribute to more equitable, community-driven development models [7,58–63]. By situating AI within the context of decentralized digital infrastructures, this analysis also highlights the potential for disruptive innovations to challenge existing data-opolies and centralized

power structures [64–67]. Furthermore, it reflects on the sustainability of such data-driven initiatives, exploring whether they can foster emancipatory datafication strategies in both global and local contexts [7,68].

At the heart of this inquiry lies a provocation: Can AI transcend its traditional economic applications and serve as a tool for social good [69–72]? While techno-utopian visions such as Fully Automated Luxury Communism (FALC) by Aaron Bastani [73] argue for AI's capacity to generate material abundance in the Global North, these theories often overlook the socio-economic and infrastructural realities of the Global South [74,75]. In the Global North, the emphasis on AI often centres around maximizing efficiency, productivity, and profitability within well-established technological ecosystems, which tend to benefit from higher levels of digital literacy, robust infrastructure, and concentrated wealth. Bastani's vision suggests that AI could automate labour to such an extent that the wealth generated could be redistributed, leading to an era of post-scarcity. Yet, the assumption of universal benefit is problematic when considered in a global context where access to AI and its benefits is highly uneven [76].

More grounded approaches like WorldCoin advocate for the use of AI and cryptocurrency to provide Universal Basic Income (UBI) in the Global South [77,78]. By leveraging blockchain technology and biometric data, WorldCoin proposes an egalitarian system of wealth distribution, particularly aimed at communities lacking access to traditional financial systems. However, while this proposal holds promise in addressing poverty and financial exclusion, it also raises significant concerns regarding data sovereignty, privacy, and the long-term sustainability of relying on cryptographic systems in regions where technological infrastructure is fragile. This tension highlights the complex dynamics at play when applying AI solutions across diverse socio-political landscapes [79,80].

These contrasting perspectives underscore the divergent challenges and opportunities AI presents in different global contexts, particularly regarding technological adoption, infrastructure, and governance. In the Global North, the conversation often focuses on the ethical regulation of AI within a largely stable and well-resourced digital environment. In contrast, the Global South faces structural barriers such as inadequate infrastructure, limited internet access, and uneven digital literacy, which must be addressed before AI can fully contribute to SI. Moreover, while concepts like UBI suggest a redistribution of wealth, there is a risk that the implementation of AI could reinforce digital colonialism, where data and decision-making power remain concentrated in the hands of a few global corporations, primarily in the North [81].

In this regard, the article not only examines the technical and ethical dimensions of AI but also emphasizes the need for a joint Global North-South 'decolonial' approach that aligns AI applications with the principles of digital justice [18,82–84]. As the following sections will argue, AI's potential to alleviate poverty and foster inclusive development hinges not just on its technological capacities but on the frameworks we establish to ensure its equitable distribution and meaningful community engagement. This discussion connects directly to the Special Issue's focus on Smart Cities and Smart Villages, situating AI within broader debates on sustainability, digital transformation, and community empowerment.

In order to respond to the main research question, from the next section onwards, the article presents the context of the method by elucidating (i) three hypotheses, (ii) three methodological objectives, and (iii) two operational research questions that will be answered in the final section alongside the main research question presented in this section. In addition, the article is structured as follows: after the introduction, which presents the main research question, the second section revolves around the methodology. The methodology used was the International Summer School AI4SI, taking place on 2–3 September 2024, as a Knowledge Exchange Fieldwork Action Research (AR). The third section will elaborate on the findings and the framework built called AI4SI. The result of this article, stemming from the findings achieved in the International Summer School 2024 as a knowledge exchange fieldwork AR process, is to present a joint AR framework to intertwine the Global South and Global North for an emerging and equitable tech agenda. The article

concludes with a discussion, a connection with the Special Issue, by responding to the main research question and two operational research questions, limitations of the article, and future research avenues.

2. Methods: International Summer School AI4SI as a Knowledge Exchange Fieldwork Action Research (AR)

AR, as a methodological guideline, is particularly valuable in contexts where real-world application and continuous learning are central to the research process. Its participatory nature involves not only the researchers but also community stakeholders, allowing for a cyclical process of planning, acting, observing, and reflecting [18]. In the context of the AI4SI 2024 International Summer School and previous initiatives in Colombia and Mozambique around the *Smart Rural Communities* (*SRC*) project, AR enabled the integration of emerging technologies into rural and urban development efforts through a collaborative and iterative process [85,86]. This methodology prioritizes the co-creation of knowledge, ensuring that both the research and its outcomes are responsive to local needs and informed by diverse perspectives.

The significance of AR lies in its ability to directly engage with real-world challenges and iteratively develop solutions in a manner that evolves alongside those challenges. In the case of the SRC (2019) and the AI4SI (2024) International Summer Schools, the process of AR provided a structure for continuous adaptation, ensuring that technological innovations were not just theoretical but practically applied within communities. By incorporating local stakeholders, practitioners, and researchers into every stage of the research, this approach fosters a dynamic exchange of knowledge and creates solutions that are both locally relevant and globally informed. It should be noted that the role played by the NGO Ayuda en Acción during the SRC International Summer School in 2019 and the most recent AI4SI International Summer School in 2024 was and has been essential during this long strategic process now being capitalized by the newly created Unit of Innovation and Impact, Ayuda en Acción, led by Mr. Jaime Díaz and Mr. Iban Askasibar. This participatory framework also supports the scaling and sustainability of technological solutions, as it is rooted in community engagement and driven by the evolving needs of participants from both the Global North and South [18].

In this article, AR serves as the primary methodological framework, specifically within the context of *Knowledge Exchange Fieldwork*. AR is widely recognized as a dynamic and participatory method, particularly suited to research contexts that prioritize real-world application, continuous reflection, and collaboration between researchers and participants [18]. Rather than relying on traditional methods like surveys or research panels, this study leverages the collaborative, iterative nature of AR to foster deep engagement with participants from various geographical and disciplinary backgrounds. This is essential in exploring complex phenomena like AI and SI in diverse settings, especially where digital justice and equity are concerned.

Knowledge Exchange as Action Research: The AI4SI International Summer School provided a rich setting for Knowledge Exchange, blending academic inquiry with practical, community-driven engagement. Knowledge Exchange as a method emphasizes the co-production and sharing of knowledge between researchers and stakeholders, fostering a dialogue that transcends disciplinary boundaries and incorporates both local and global perspectives. This process is particularly valuable when addressing the real-world challenges of integrating AI into SI frameworks, especially within the marginalized contexts of the Global South.

In this article, Knowledge Exchange was not merely an ancillary activity but a central research method. It involved the active participation of a diverse group of stakeholders, including practitioners, scholars, policymakers, and activists from various countries. The iterative nature of AR allowed for a cyclical process of planning, acting, observing, and reflecting, which is integral to the development of solutions that are both theoretically sound and practically applicable.

Fieldwork in AR by Expanding the Traditional Boundaries: Fieldwork in AR goes beyond data collection and analysis. In the AI4SI International Summer School, fieldwork was conceptualized as a *Knowledge Exchange platform* where participants co-created solutions to pressing societal challenges. Rather than applying surveys or panels, which may limit the depth and scope of engagement, this approach integrated collaborative discussions, scenario planning, and dynamic interactions between participants. This facilitated a collective learning process, allowing the participants to contribute actively to the development of AI solutions that are relevant to their specific socio-political and economic contexts. It goes without saying that this method is essentially a qualitative social science method not necessarily being complemented by surveys and panels as many quantitative scholars still might think [18].

The Role of Qualitative AR Dynamics: AR in this context does not rely on quantitative surveys or structured panels but instead employs qualitative methods that prioritize the lived experiences of participants. Workshops, facilitated group discussions, and scenario-building exercises enabled participants to engage in reflective dialogues and to co-construct knowledge that is directly applicable to the communities they represent. These methods align with the Knowledge Exchange framework, where the focus is on collaborative learning rather than extracting data through traditional methods. The qualitative nature of this AR dynamic is particularly suitable for the study of AI's social impact, where context and local specificity are critical to understanding and implementing technological solutions.

Justifying Knowledge Exchange Fieldwork AR: The Knowledge Exchange Fieldwork AR model employed in this study represents an innovative approach to research, where the emphasis is placed on the co-creation of knowledge and the practical application of emerging technologies in real-world contexts. This is not a "mental shortcut" but a robust, iterative research method that encourages ongoing learning and adaptation. Rather than presenting a static research process, this method is dynamic and evolves as new insights are gained through participant interaction and reflection. The iterative cycles of AR—planning, acting, observing, and reflecting—allow for continuous improvement and adaptation, ensuring that the research remains relevant and responsive to the evolving needs of the participants.

Moreover, this method challenges the traditional boundaries of research by moving beyond data collection and analysis, towards a more holistic and participatory approach that involves all stakeholders in the co-creation of solutions. The AI4SI International Summer School exemplifies how AR, when paired with Knowledge Exchange, can serve as a legitimate and innovative research method, enabling the study to address complex, context-specific issues such as AI and digital justice in both the Global North and South.

In summary, the methodology employed in this study is rooted in AR, stemming from previous AR conducted through fieldwork in Mozambique and Colombia in 2017, entitled SRC [85,86]. This project also concluded with the International Summer School SRC in 2019: https://www.uik.eus/en/activity/smart-rural-communities-src-hacia-un-nuevo-modelo-desarrollo-rural-inteligente-cooperacion (accessed on 1 October 2024). Thus, in 2019, the SRC International Summer School laid the foundation for exploring how emerging technologies can drive sustainable rural development, focusing on smart villages in the Global South. In 2024, building on this, the *Artificial Intelligence for Social Innovation (AI4SI)* International Summer School expanded the discussion by integrating AI and Web3 technologies, such as blockchain and decentralized autonomous organizations (DAOs), to enhance SI and digital justice in both rural and urban contexts. These themes align directly with the Special Issue titled *Smart Cities and Smart Villages and the Global Digital Transformation: Strategy and Community Engagement*, which seeks to explore how smart technologies can bridge the urban-rural divide through inclusive governance and community participation. Together, these initiatives emphasize the need for equitable digital transformation, addressing disparities between the Global North and Global South while fostering community-driven technological innovation.

AR, in this context, has evolved through several key phases [85,86]: (i) The first phase involved fieldwork AR conducted in Colombia and Mozambique in 2017, where the focus was on addressing rural development challenges using emerging technologies in real-world settings through Living Labs. (ii) This was followed by the SRC International Summer School in 2019, which expanded the exploration of community-driven 'smart' technological solutions for rural areas. (iii) The most recent phase is represented by the AI4SI International Summer School held in 2024, which further integrated AI and decentralized technologies, such as blockchain and DAOs, into the framework of SI. These International Summer Schools brought together a diverse group of over 200 participants offline and 300 participants online, including practitioners, scholars, policymakers, industry representatives, PhD students, consultants, tech entrepreneurs, activists, lecturers, and researchers, creating a rich environment for knowledge exchange and collaborative scenario planning.

This section outlines the methodological approach used in the study, focusing on the AR process with AI4SI 2024 International Summer School participants, totalling 100 offline and 150 online participants representing 15 countries (Costa Rica, Mexico, Brazil, Guatemala, Peru, Colombia, Kenya, Mozambique, South Africa, Malawi, Spain, the USA, Belgium, the UK, and Switzerland). The AI4SI 2024 International Summer School engaged participants through several dynamics, blending the speaker and participants around different questions and tasks, either offline or online.

Methodologically speaking, the AR process was arranged within the scope of the AI4SI International Summer School 2024 as a Knowledge Exchange fieldwork activity by discussing these three methodological elements to respond to the research question of this article: *'Can AI Alleviate World Poverty (in the Global South)?'* presented in the first section of this article: (i) these three hypotheses, (ii) followed by three methodological objectives, and (iii) two operational research questions as follows:

2.1. Methodological Hypotheses

Hypothesis 1. *The Hammer of AI. The pervasive belief that AI is the universal solution to every societal challenge echoes Abraham Maslow's famous metaphor: "If the only tool you have is a hammer, you tend to see every problem as a nail". This fixation on AI often overshadows the equally critical process of datafication—the transformation of various forms of social life into quantifiable data. By focusing predominantly on AI, we risk neglecting the broader context in which data is generated, processed, and governed, leading to an incomplete understanding of the technological landscape. The challenge is to decouple our obsession with AI as a standalone solution and consider the integral role of datafication in shaping our digital futures.*

Hypothesis 2. *The Illusion of Decentralization. As cited in the White Paper published by DRC and MSI by Michael Cooper entitled "Decentralized Possibilities for Locally-Led Development", while decentralized technologies, such as blockchain and Decentralized Autonomous Organizations (DAOs), are heralded as the harbingers of digital democratization, there is a paradoxical risk that they may reinforce existing power structures or create new forms of centralization. The governance models of many decentralized systems often concentrate power among a small group of technically proficient actors, undermining the democratic ideals they purport to uphold. This raises the question: Are we truly decentralizing power, or are we merely shifting it into the hands of a new elite under the guise of technological innovation?*

Hypothesis 3. *The Ethical Mirage of Technological Neutrality. There is a persistent belief that technologies, particularly AI, are neutral tools that merely reflect the data and algorithms they are based on. However, this ignores the complex socio-political contexts in which these technologies are developed and deployed. The design and application of AI systems are inherently value-laden, influenced by the biases, assumptions, and interests of their creators. This raises critical ethical concerns: Whose values are being embedded in these systems, and who benefits from their deployment? Acknowledging the non-neutrality of technology is crucial for fostering a more inclusive and equitable approach to AI-driven SI. These caveats aim to provoke deep reflection and*

discussion on the underlying assumptions driving current debates around AI and datafication, encouraging participants to critically engage with the complexities and contradictions inherent in these technologies.

2.2. Methodological Objectives

Methodological Objective 1. *To position the debate beyond the noise of algorithms and datafication caused by AI within the contrasting contexts of the Global South and Global North.*

Methodological Objective 2. *To adopt a fair and equitable stance on the integration of emerging technologies by exploring decentralized approaches, such as Web3, while emphasizing the involvement of vulnerable communities in discussions around digital justice.*

Methodological Objective 3. *To provide a platform to not only critically but also constructively analyse how AI can either bridge or exacerbate the socio-economic and techno-political disparities between the Global South and Global North.*

2.3. Operational Research Questions

Operational Research Question 1. *How can we implement SI processes that not only embrace technology and AI but also contribute to promoting just and ethical social change? This question aims to explore the integration of SI with emerging technologies like AI to ensure that these technologies serve civil society in a just and ethical manner.*

Operational Research Question 2. *How can we serve civil society with technology and not the other way around? This question emphasizes the need to prioritize the interests of civil society in the development and deployment of AI and other technologies, rather than allowing technological advancements to dictate social norms and priorities.*

3. Results: AI4SI AR Framework

The AI4SI International Summer School 2024 highlighted the critical role of decentralization in crafting a robust AR framework that integrates advanced technologies such as blockchain, DAOs, and data cooperatives. This framework emerged from an iterative process of discussions and collaborative activities involving 100 offline and 150 online participants from 15 countries. The integration of these technologies into the AI4SI framework advances SI and digital justice. Here, we delineate the five key results derived from the AI4SI initiative, underscoring the strategic importance of decentralization: (i) Empowering Local Communities and Promoting Data Sovereignty; (ii) Mitigating Power Concentration and Enhancing Digital Justice through Web3; (iii) Catalysing SI through Data Cooperatives; (iv) Building Resilient and Sustainable SRC; and (v) Driving Ethical and Transparent Technological Humanism.

3.1. Five Key Results

3.1.1. Empowering Local Communities and Promoting Data Sovereignty

Decentralization has proven instrumental in empowering local communities by fostering data sovereignty. Data cooperatives [61,62,87], a key component of the framework, enable communities to control their data, thereby enhancing their sense of ownership and agency. This approach aligns with the principle of data sovereignty, allowing individuals and communities to manage their data based on their needs and values rather than being subjected to centralized control by large entities or data monopolies. Through this empowerment, communities can better leverage their data to drive local development and innovation. www.salus.coop, as a referential model of data co-operatives, was presented in the scope of the International Summer School alongside a new platform called www.designingopportunities.org led by the NGO Ayuda en Acción that aims to serve as a platform to bridge Global North and Global South disparities. The discussions focused on two main areas: (i) critical factors for AI4SI platforms to be able to scale up, given the scalability issue identified as the core one [62], and (ii) necessary alliances and collabora-

tions among the public, private, and civil society, including entrepreneurs, activists, and academia, the so-called Penta Helix [88].

The recent Data Cooperatives Report by People-Centered Internet, launched at the UN Science Summit Digital Governance Series, further emphasizes the importance of decentralization and collective data governance, which aligns with the AI4SI framework [87]. Data cooperatives represent a model of participatory data management that allows communities to retain control over their data while ensuring that the benefits are distributed equitably. As highlighted in the report, the integration of Digital Asset Registries (DARs) within data cooperatives enables secure and transparent data sharing, fostering trust among participants. This structure not only supports data sovereignty but also promotes inclusivity and ethical data usage, which were core objectives of AI4SI's International Summer School. The discussions at the AI4SI International Summer School echoed the report's findings, emphasizing the scalability of such decentralized models and the necessity of building multi-stakeholder alliances to ensure their success.

3.1.2. Mitigating Power Concentration and Enhancing Digital Justice through Web3

The AI4SI framework's emphasis on decentralization plays a pivotal role in mitigating the concentration of power that characterizes many centralized systems. In traditional centralized models, control over data and resources tends to be monopolized by a few dominant corporations, which can exacerbate social and economic inequalities. Such monopolization often results in a lack of transparency and accountability, where decision-making power is concentrated in the hands of a limited few, leaving marginalized communities and smaller stakeholders without a voice or equitable access to digital resources.

By integrating blockchain and Decentralized Autonomous Organizations (DAOs) into its framework, AI4SI promotes a redistribution of power and ensures more equitable access to digital resources. Blockchain technology, by its nature, decentralizes control over data and decision-making, providing a transparent and immutable ledger of transactions and interactions that is accessible to all participants in the network. This fosters trust and accountability, ensuring that all stakeholders, regardless of their size or influence, have an equal opportunity to contribute and benefit.

The Ethics of Decentralized Social Technologies report highlights similar concerns [89], noting that while decentralized technologies like blockchain can help mitigate the concentration of power, they also bring new ethical challenges, as clearly emphasized in the second hypothesis of this article. The concept of prudent vigilance is introduced, emphasizing the need for continuous oversight and governance to prevent the emergence of new forms of power imbalances. As blockchain and DAOs enable decentralized governance, the report underscores the importance of ensuring that these systems remain transparent and accountable, particularly in preventing domination by a small group of actors in decentralized networks. This careful monitoring is essential to ensure that the benefits of decentralization—such as equity, inclusion, and data sovereignty—are not undermined by unintended consequences [89–91].

DAOs further enhance this dynamic by enabling decentralized governance [92]. Instead of a central authority making decisions, DAOs operate through smart contracts that execute decisions based on predefined rules, with all members of the organization having voting rights. This decentralized decision-making structure ensures that the interests of a broader range of stakeholders are represented, thus democratizing access to power and resources.

This shift is particularly significant in the Global South, where centralized power structures often marginalize underrepresented communities and limit their access to the benefits of digital innovation. By fostering decentralized ecosystems, the AI4SI framework addresses these disparities, creating pathways for the Global South to participate on equal footing in the global digital economy. Decentralized technologies, such as data cooperatives [93], enable local communities to retain control over their data, ensuring that the benefits are distributed more equitably. This enhances digital justice by challeng-

ing entrenched power structures, reducing inequalities, and promoting a more inclusive digital ecosystem.

Decentralization is not only a technological advancement but a socio-political imperative for advancing digital justice. In regions where centralized authorities and corporations have historically held disproportionate power, decentralized models provide a means to redistribute agency and resources, empowering communities to shape their digital futures. The AI4SI International Summer School highlighted this shift as a critical step towards achieving greater digital justice, with discussions centring on how decentralized frameworks can disrupt existing power imbalances and promote more participatory governance models.

The Ethics of Decentralized Social Technologies report also stresses the importance of user autonomy and non-domination. It discusses how decentralized technologies, when combined with self-sovereignty principles, can empower individuals and communities to assert control over their digital interactions and identities. However, the report also warns that trustless systems, such as those found in blockchain, do not guarantee fairness by themselves. Thus, careful governance and experimentation are necessary to avoid reinforcing existing inequalities in the Ethics of Decentralized Social Technologies [89].

By mitigating the concentration of power through decentralized technologies, the AI4SI framework aligns itself with the global push for digital justice. It not only ensures more equitable access to data and resources but also fosters collaboration among diverse stakeholders—including the Global North and Global South—to create a more just and inclusive digital landscape.

3.1.3. Catalysing SI through Data Cooperatives

The integration of data cooperatives within the AI4SI framework has catalysed SI by encouraging collaborative approaches to problem-solving. These cooperatives facilitate data sharing and collaborative innovation among diverse stakeholders, including SMEs and local communities [94]. This collaborative environment allows for the pooling of data to address social challenges and develop solutions that have a broader impact. By leveraging collective data, data cooperatives enable stakeholders to harness the power of shared resources for social good, thus driving meaningful innovation [58–62].

The Data Cooperatives Report further emphasizes how the collaborative pooling of data resources empowers communities to exert control over their data while enhancing their collective bargaining power [87]. This cooperative structure is particularly vital in fostering SI, as it enables the democratization of data use and decision-making, ensuring that all members have an equal voice in how data is governed and applied.

One of the key benefits of data cooperatives is their ability to align data governance with human values, enabling ethical data sharing that respects privacy, consent, and equitable benefit distribution. These cooperatives empower stakeholders to pool insights and knowledge that would otherwise remain siloed, unlocking new opportunities for addressing social challenges, such as healthcare disparities, environmental sustainability, and economic development. The report highlights successful models such as *Salus.coop*, a health data cooperative that exemplifies how collective data management can be used for the public good, particularly in health research and innovation.

Moreover, data cooperatives play a crucial role in fostering innovation across sectors, particularly in regions and industries where digitalization has been slower to take hold. For example, *Bauform eG*, a data cooperative in the construction sector, demonstrates how SMEs can collaborate to overcome barriers to digital transformation by pooling data for shared insights and innovation. This approach to collective data governance not only promotes innovation but also strengthens the resilience and adaptability of communities, making it easier to respond to emerging social and economic challenges.

In conclusion, data cooperatives are not only a tool for redistributing control over data but also a powerful catalyst for SI. They enable communities and stakeholders to

collaboratively address pressing societal issues, foster trust through transparent governance, and promote sustainable, inclusive innovation.

3.1.4. Building Resilient and Sustainable SRC

Decentralization contributes significantly to the resilience and sustainability of digital infrastructures. The AI4SI framework utilizes blockchain and DAOs to eliminate single points of control, thereby reducing vulnerability to system failures and cyber-attacks. This robustness is essential for maintaining long-term support for SI initiatives, especially in rural areas where digital infrastructure may be less developed. By enhancing the resilience of digital systems, decentralization ensures that they can effectively support and sustain community-driven projects over time.

The SRC framework [85,86], as illustrated in the research conducted in Colombia and Mozambique, demonstrated how contextual factors play a key role in building robust infrastructures. One of the central findings from the SRC initiative was the importance of integrating Information and Communication Technologies (ICT) and community-driven approaches to bolster local economies and create sustainable development pathways. In rural and remote areas, where digital infrastructure may be fragmented, the decentralization of power and resources might be currently essential for fostering local resilience [90]. The Living Labs model used in these regions allowed for real-time testing of digital technologies, such as telemedicine and e-learning platforms, which are vital for addressing access challenges to healthcare and education.

Moreover, the SRC initiative emphasized community ownership of digital infrastructures. This aligns with the AI4SI framework's goal of enhancing resilience by reducing dependence on centralized systems. Decentralized technologies, such as solar-powered energy grids and local data cooperatives, contribute to the self-sufficiency of rural communities, enabling them to address their unique challenges, including energy shortages and limited access to high-speed internet. By fostering local governance (probably now it could have been deployed through DAOs), communities in Bolivar, Colombia, and Pemba, Mozambique, could develop and maintain their own digital ecosystems that are resilient to external shocks, such as political unrest or economic downturns [91,95,96].

Furthermore, the SRC framework highlighted the role of SI in driving resilience. By involving local stakeholders, including women, youth, and marginalized groups, the SRC model promotes inclusivity, ensuring that the benefits of digital infrastructures are equitably shared. This bottom-up approach not only strengthens the technical resilience of rural communities but also builds social capital, which is crucial for long-term sustainability. The focus on participatory governance and community-driven innovation reflects the principles of decentralization embedded in the AI4SI framework [18,79], emphasizing the need for local control over digital resources.

3.1.5. Driving Ethical and Transparent Technological Humanism

Decentralization within the AI4SI framework fosters an ethical and transparent approach to technology. By embedding transparency and accountability into digital systems, decentralized technologies uphold the principles of technological humanism, which prioritize serving human needs over commercial interests. This approach ensures that AI and other digital tools are used in a manner that is responsible and beneficial to society as a whole. The focus on ethical considerations helps address concerns about the misuse of technology and promotes a more inclusive and equitable digital landscape.

The Ethics of Decentralized Social Technologies report further reinforces the importance of transparency and accountability in decentralized systems as discussed in the AI4SI International Summer School [89]. As highlighted in the report, ethical frameworks must be ingrained in the design and governance of decentralized technologies to prevent unintended negative consequences, such as the concentration of power within a select few or the marginalization of vulnerable populations. The concept of prudent vigilance outlined in the report advocates for continuous monitoring and governance of decentralized systems

to ensure that they remain ethical and equitable. In a similar vein, AI4SI International Summer School participants advocated for a prudent interplay between stakeholders.

In decentralized systems such as blockchain and DAOs, ethical considerations are paramount. These technologies offer the promise of greater transparency by creating immutable, auditable records that enhance trust among users. However, without proper oversight, these same systems can also lead to power imbalances, where a small group of actors with technical expertise or financial resources can dominate governance processes. By integrating democratic decision-making and inclusive governance mechanisms, the AI4SI framework works to counteract these risks, ensuring that technological humanism remains central to the deployment of decentralized technologies.

Furthermore, by decentralizing power away from corporations and centralized entities, the AI4SI framework supports data sovereignty—a principle that ensures individuals and communities retain control over their own data. This is a critical component of ethical technological humanism, as it gives users autonomy over how their data is shared and used. Data cooperatives, as integrated into the AI4SI framework, provide a model for ethical data sharing where participants actively decide on the terms of data usage, thus fostering transparency and trust. This approach contrasts with the traditional model, where data is often harvested without clear consent or benefit to the individuals whose data is being utilized.

Another ethical dimension of decentralization that was discussed in the AI4SI International Summer School was the promotion of technological inclusivity. By ensuring that communities, particularly those in underrepresented or marginalized regions, have access to decision-making processes and digital resources, the AI4SI framework works to prevent the digital divide from growing wider. In practice, this means ensuring that decentralized platforms are not only accessible to those with technical knowledge but also user-friendly and inclusive for a broader range of participants, including those with limited digital literacy.

In conclusion, decentralization within the AI4SI framework not only enhances transparency and accountability but also serves as a foundation for building an ethical digital future. The focus on technological humanism ensures that the development and deployment of decentralized technologies prioritize human well-being, address systemic inequalities, and prevent the exploitation of technological advancements for purely commercial gains. By driving ethical considerations to the forefront, the AI4SI framework ensures that technology serves as a tool for empowerment and inclusion rather than domination or exclusion. In summary, decentralization is a strategic imperative for the AI4SI AR Framework. It empowers local communities, mitigates power imbalances, fosters innovation, enhances resilience, and drives ethical technology use. The integration of blockchain, DAOs, and data cooperatives into the framework not only advances SI and digital justice but also ensures that digital ecosystems are inclusive and sustainable. The results from the AI4SI International Summer School 2024 reinforce the critical role of decentralization in creating a more equitable and resilient digital future.

3.2. AI4SI: Keywords

In order to elaborate on the AI4SI Framework, this section illustrates the findings of the AI4SI International Summer School by creating a list of keywords that were part of the discussions and the iterative process with participants through AR in the AI4SI International Summer School 2024. This subsection uses as a reference point the seminal work by the Welsh anthropologist, Raymond Williams.

Raymond Williams' concept of Keywords, as introduced in his seminal work *Keywords: A Vocabulary of Culture and Society* (1976), provides a critical lens through which to understand the evolution of language in relation to changing societal contexts. Williams' approach emphasizes that certain words—what he calls "keywords"—are not static in meaning but evolve over time, reflecting deeper cultural, social, and political shifts. In the context of technological frameworks like AI4SI, the use of *Keywords* serves as a tool

to map the discourse surrounding emerging technologies, societal impacts, and ethical considerations. How to use Raymond Williams' concept in the AI4SI Framework:

In the AI4SI framework, adopting Williams' *Keywords* approach can help create a shared vocabulary that reflects the intersection of technology, society, and ethics [97]. By identifying and defining specific keywords, such as decentralization, data sovereignty, and digital justice, the framework can foster a deeper understanding of these complex concepts and how they relate to SI and digital transformation. Williams' methodology is particularly relevant for AR, as it highlights the power of language in shaping collective thinking, policies, and practices related to digital technologies and societal change.

In the context of AI4SI International Summer School 2024, keywords provided a way to anchor the broader themes of decentralization, equity, and digital rights in concrete terms that were discussed, debated, and acted upon by diverse stakeholders during 2 and 3 September 2024. Each keyword not only represents a concept but also serves as a point of entry for collaborative problem-solving and the development of solutions that align with the framework's ethical and social justice goals. For instance, the keyword Data-opolies addresses the concentration of data power, while Technological Humanism emphasizes the ethical use of technology to serve human needs.

(i)   Historical and Contextual Reflection: Just as Williams analysed the historical and cultural significance of words like "culture", "democracy", and "technology", AI4SI's keywords can be analysed within the context of global digitalization, the emergence of new technologies, and the fight for digital justice. For instance, Platformisation can be critically examined in terms of how digital platforms have transformed global economies and social interactions while often reinforcing inequalities;

(ii)   Dynamic Meanings: Williams' central idea is that keywords are dynamic, changing as society evolves. Similarly, AI4SI's keywords should be treated as living concepts that might shift in meaning as the framework evolves. For example, the meaning of Web3 today—focused on decentralized applications—could expand as the technology matures and its societal implications become clearer;

(iii)   Cultural Significance: Williams believed that keywords reveal cultural values. In AI4SI, keywords like Decentralized Tech and Equitable Tech not only reflect technological trends but also convey deep cultural and ethical values about who should control technology and who benefits from it. By engaging with these keywords, stakeholders in the AI4SI framework can interrogate whose values and needs are being prioritized in technological innovation;

(iv)   Collaborative Process: AI4SI's use of *Keywords* can be a participatory process, reflecting the collaborative and iterative nature of AR. Through workshops, discussions, and feedback loops, participants in the AI4SI International Summer School refined and redefined keywords as they experimented with and implemented decentralized technologies. This mirrors Williams' idea of language as a site of contestation and change, where diverse groups negotiate meanings and priorities;

(v)   Ethical Framing: Williams emphasized that words carry not just descriptive but also normative meanings, shaping how we understand what is right, just, or ethical. In the AI4SI framework, keywords like Digital Justice and Emancipatory Datafication Strategies are not just neutral terms but embody a normative commitment to using technology for social good, challenging exploitative practices, and promoting equity.

Incorporating Raymond Williams' Keywords approach into the AI4SI framework enhances the ability to critically engage with the language and concepts that shape discussions around technology, democracy, society, and ethics [98,99] (Table 1). By continually revisiting and refining the meaning of these keywords through AR, the AI4SI framework ensures that its technological developments remain aligned with human values and social justice goals [100]. In this way, Williams' methodology not only provides a linguistic tool but also a broader ethical framework for ensuring that technology serves humanity, not the other way around.

The following Table 1 defines each keyword as a result of an iterative process with participants. Insofar as the author of this article served as the conductor and director of the International Summer School AI4SI, the definitions of each keyword were summarized after the iterative process of the event.

Table 1. AI4SI Keywords.

| Keyword	Definition
Digitalisation [101]	The process by which traditional activities, processes, and services are transformed into digital formats and integrated into the digital ecosystem. In the context of AI4SI, digitalisation is seen as a key enabler of SI, helping to bridge the gap between technology and societal needs, particularly in the Global South.
Datafication [68]	The transformation of social action into online quantified data, allowing for real-time tracking and predictive analysis. For AI4SI, datafication is a double-edged sword; while it offers new possibilities for innovation, it also raises concerns about privacy, surveillance, and the ethical use of data.
Platformisation [102]	The rise of digital platforms as dominant economic and social structures, reshaping industries, labor markets, and societal interactions. AI4SI views platformisation critically, particularly in its potential to centralize power and perpetuate inequalities, necessitating more equitable and decentralized approaches.
Technological Humanism [70]	A philosophy that advocates for the development and deployment of technology in ways that enhance human dignity and societal well-being. In AI4SI, technological humanism is a guiding principle, ensuring that AI and digital technologies serve humanity and promote social justice.
Data-opolies [19,66]	A term describing the monopolistic control of data by a few large corporations, often referred to as Big Tech. AI4SI emphasizes the need to challenge these data-opolies through decentralized and equitable data governance models, such as data cooperatives.
Decentralization [90]	The distribution of power and decision-making away from central authorities, often through the use of blockchain and similar technologies. In AI4SI, decentralization is crucial for fostering digital justice and enabling local communities, particularly in the Global South, to have greater control over digital resources.
Web3 [7,63]	A new iteration of the internet that leverages decentralized technologies like blockchain to create more user-centric, transparent, and secure digital ecosystems. AI4SI sees Web3 as a transformative force for democratizing digital infrastructure and enabling more equitable participation in the digital economy.
GenAI (Generative AI) [65,103]	A category of AI that can generate new content, such as text, images, and music, based on learned patterns. Within AI4SI, GenAI is recognized for its potential to drive innovation, but also for the ethical challenges it presents, particularly in terms of data use and the potential for misuse.
Decentralized Tech [7,14,89]	Technologies that operate without a central authority, typically through peer-to-peer networks or blockchain. AI4SI promotes decentralized tech as a means to empower communities, reduce inequalities, and foster innovation that is aligned with social good.
Equitable Tech [59]	Technologies designed to be accessible and beneficial to all, regardless of socioeconomic status, geography, or other disparities. AI4SI advocates for the development and deployment of equitable tech to ensure that the benefits of digital innovation are widely shared.
Disruptive Tech [58]	Technologies that fundamentally alter existing industries, markets, or societal norms. AI4SI explores the potential of disruptive tech to catalyze SI, while also addressing the risks and unintended consequences that can arise.
Digital Justice [87]	The pursuit of fairness and equity in the digital realm, ensuring that all individuals and communities have the rights, access, and opportunities to benefit from digital technologies. AI4SI views digital justice as a cornerstone of responsible and inclusive technological development.
Blockchain [95,96]	A decentralized ledger technology that enables secure, transparent, and tamper-proof record-keeping. In AI4SI, blockchain is seen as a key enabler of decentralized governance, data sovereignty, and new forms of SI.

Table 1. *Cont.*

Keyword	Definition
DAOs (Decentralized Autonomous Organizations) [92]	Organizations that operate on blockchain technology, with decision-making processes codified in smart contracts. AI4SI considers DAOs as innovative governance models that can democratize decision-making and foster greater community involvement in digital projects.
Platform Cooperatives [62]	Cooperatively owned and democratically governed digital platforms that offer an alternative to traditional corporate-owned platforms. AI4SI supports platform cooperatives as a way to reclaim digital economies for the benefit of workers and users.
Data Cooperatives [61]	Organizations where individuals pool their data and collectively decide how it is used, often for mutual benefit. AI4SI promotes data cooperatives as a model for equitable data governance, challenging the dominance of data-opolies.
Digital Rights [46,104]	The rights of individuals to access, use, create, and share digital content, as well as to protect their privacy and personal data, are emphasized by AI4SI as a means of ensuring that all individuals can participate fully and safely in the digital age.
Data Sovereignty [46,61]	The concept that data generated by individuals or communities should be controlled by them, rather than by external corporations or governments. AI4SI advocates for data sovereignty as a means of empowering communities, particularly in the Global South, to control their digital futures.
Data Divide [105]	The gap between those who have access to data and the means to leverage it, and those who do not. AI4SI aims to bridge the data divide by promoting equitable access to data and the tools necessary to use it effectively.
SI [49,56,57,88]	The process of developing and deploying new solutions to address societal challenges, often through collaboration across sectors. AI4SI focuses on how AI and digital technologies can drive SI, particularly in underserved communities.
Emancipatory Datafication Strategies [68,82–84]	Approaches to datafication that aim to liberate rather than oppress, by ensuring that data practices empower individuals and communities. AI4SI supports these strategies as a way to use data for social good, rather than for exploitation or control.
Data Sustainability [68]	The responsible and ethical management of data over its lifecycle, ensuring that data practices are sustainable and do not harm individuals or communities. AI4SI emphasizes data sustainability as crucial for long-term SI.
Data Devolution [14]	The transfer of control over data from centralized entities to local communities or individuals. AI4SI advocates for data devolution as a means to empower communities and promote more democratic data governance.

3.3. AI4SI: Framework

The AI4SI Framework integrates (i) Blockchain, (ii) DAOs, and (iii) Data Cooperatives into a cohesive structure designed to advance digital justice and foster SI. This framework emerges from a robust AR process, iteratively developed through stakeholder engagement in the AI4SI International Summer School 2024. The framework aims to decentralize power, promote data sovereignty, and ensure transparent, ethical governance in both local and global contexts.

The framework's design is illustrated in Figure 1 by the interplay between Blockchain, DAOs, and Data Cooperatives, each playing a distinct yet interconnected role in supporting AI-driven SI and equitable digital ecosystems.
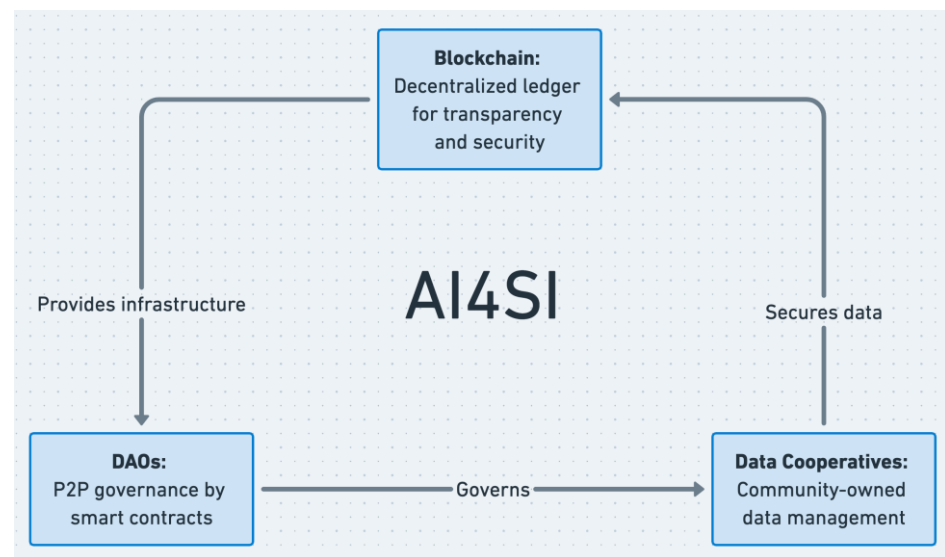
Figure 1. AI4SI Framework: Blockchain, DAOs, and Data Cooperatives.

3.3.1. Blockchain: The Foundation of Transparency and Security

In the AI4SI Framework, blockchain serves as the decentralized ledger that ensures transparency, security, and immutability of data. Blockchain technology underpins the entire system, providing an infrastructure where transactions, decisions, and data exchanges are securely recorded [106,107]. This transparency is crucial for building trust among stakeholders, as all data and interactions are visible, verifiable, and tamper-proof.

- Core Function: Blockchain serves as the distributed ledger technology (DLT) that secures transactions, facilitates transparent governance, and ensures the integrity of the system;
- Governance: Inherently decentralized, blockchain requires no centralized governance, relying on cryptographic protocols to validate transactions.
- Challenges: Issues related to scalability, energy consumption, and regulatory challenges remain critical considerations for blockchain integration in the framework;

Blockchain's primary contribution to the AI4SI framework is to decentralize control, ensuring that no single entity can dominate the system or manipulate data, which aligns with the framework's focus on promoting digital justice and equitable governance [14,15].

3.3.2. DAOs: Decentralized Governance through Smart Contracts

DAOs add a governance layer to the AI4SI Framework, allowing decentralized decision-making to occur automatically through smart contracts [91]. DAOs play a pivotal role in the governance of blockchain systems, and within the AI4SI Framework, they ensure that governance is peer-to-peer and community-driven.

- Core Function: DAOs govern the AI4SI framework through rules encoded in smart contracts. These contracts execute decisions based on consensus from community members, ensuring transparency and inclusivity in governance processes;
- Participation: Stakeholders participate by holding governance tokens or voting rights, ensuring that decision-making is not concentrated but distributed across a wide array of stakeholders;
- Scalability: DAOs offer high scalability potential, as decision-making can be automated and adapted as the system grows.

By embedding transparent and accountable governance into the AI4SI framework, DAOs prevent the concentration of power that typically plagues centralized systems. They ensure that the framework remains inclusive and democratic, providing marginalized communities with a voice in decision-making processes that affect their digital futures.

3.3.3. Data Cooperatives: Collective Data Ownership and Governance

Data cooperatives represent the SI aspect of the AI4SI framework, emphasizing community ownership of data. These cooperatives enable local communities to pool their data, collectively decide how it is used, and share the benefits of that data, aligning with principles of data sovereignty [87].

- Core Function: Data cooperatives manage community-owned data through a cooperative governance model. This model allows communities to collectively determine how their data are used, shared, and monetized, ensuring that data benefits remain within the community;
- Trust Mechanism: Trust is maintained through transparent governance, where decisions on data use are agreed upon by cooperative members;
- Challenges: Data cooperatives face challenges related to scalability, governance complexity, and ensuring equitable benefit distribution, especially when scaling across larger populations.

Within the AI4SI framework, data cooperatives provide a model for equitable data governance. By promoting data sovereignty, they empower communities—particularly in the Global South—to control their digital assets, counteracting the influence of data monopolies and ensuring that data remain a public good rather than a privatized commodity.

The structure illustrated in Figure 1 highlights the interaction between blockchain, DAOs, and data cooperatives in the AI4SI Framework. Blockchain provides the infrastructure and security backbone, ensuring that all transactions are transparent and immutable. DAOs govern the system through smart contracts, enabling decentralized decision-making. Data cooperatives function as community-owned entities, allowing for collective data management and ensuring that the benefits of data remain within the community.

The relationships can be summarized as follows:

1. Blockchain provides transparency and security;
2. DAOs govern the system using decentralized smart contracts;
3. Data cooperatives manage data collectively and ensure community ownership.

AI4SI uses this structure to promote SI, digital justice, and ethical data governance.

Table 2 presents a detailed comparison of blockchain, DAOs, and data cooperatives, illustrating the specific roles each decentralized technology plays within the framework. This table outlines key elements such as core function, governance, transparency, and participation, providing a clear view of how each technology contributes to the overarching goals of decentralization, transparency, and equitable governance.

- Blockchain serves as the foundational infrastructure, offering transparency, decentralization, and immutable record-keeping;
- DAOs provide the governance structure, enabling peer-to-peer decision-making and ensuring that ownership and control are decentralized;
- Data cooperatives facilitate collective data ownership, allowing communities to manage and govern their data in a way that ensures data sovereignty and equitable access.

The AI4SI Framework integrates advanced decentralized technologies to address the pressing need for SI and digital justice. By combining blockchain, DAOs, and data cooperatives, the framework creates a robust, transparent, and equitable system that can support both rural and urban communities, particularly in the Global South.

The final result of this framework is a decentralized, community-driven approach to governance and data management that empowers local communities, mitigates power imbalances, fosters innovation, enhances resilience, and drives ethical technology use. It is a strategic and transformative step toward achieving a more equitable digital future, aligning with the overarching goals of the AI4SI initiative.

Table 2. AI4SI Framework: Blockchain, DAOs, and Data Cooperatives.

Element	BLOCKCHAIN	DAOs	DATA COOPERATIVES
Core Function	Distributed ledger technology for secure transactions	Decentralized governance through blockchain	Collective governance and management of data generated by cooperative principles
Governance	Typically no inherent governance (protocol dependency)	Blockchain is governed by smart contracts on blockchain	Varies: can be decentralized, federated, or cooperatively managed
Transparency	Full, due to immutable ledger	High, with all decisions and transactions on-chain	Transparency according to cooperative principles, potentially using DAO structures
Decentralization	Full, with no central authority	High, with decentralized decision-making	Depends on the model, can vary from centralized to fully decentralized
Trust Mechanism	Cryptographic security and consensus protocols	Trust embedded in the code and smart contracts	Depends on cooperative agreement and blockchain integration
Participation	Open to anyone with network access	Members participate through voting mechanisms	Varies: open or federated and managed by cooperative agreements
Ownership	Ownership of digital assets or tokens, highly limited by protocol opacity	Members own governance tokens or shares	Shared data pools, collective ownership, agreements on data use
Scalability	Typically high, depending on protocol design	Potentially high, depending on DAO capacity	Varies: cooperatives may face scaling challenges
Use Cases	Cryptocurrencies, smart contracts, energy consumption, resolving regulatory issues	Governance of digital communities, funding platforms	Sharing platforms, digital commons, collective action
Challenges	Energy consumption, scalability, regulatory issues	Complexity of smart contracts, legal recognition	Privacy concerns, governance complexity, equitable benefit distribution

4. Conclusions: Discussion, Special Issue, Main Research Question and Two Operational Research Questions, Limitations, and Future Research Avenues

4.1. Discussion

This dual nature of AI—its potential to drive progress and its risk of reinforcing existing inequities—demands a critical examination of the power structures that control this technology. Ayona Datta's [82–84] work on urban transformations in the Global South, particularly her insights from the *Regional Futures* project (https://www.regionalfutures.org/, accessed on 1 October 2024), highlights the profound impact of digital technologies on urban governance and social equity. Datta argues that without inclusive policies, the benefits of digital transformation may be unequally distributed, exacerbating existing disparities.

By contrast, Primavera de Filippi's work on blockchain and decentralized technologies, particularly her insights from the *Blockchain Gov* project (https://blockchaingov.eu/, accessed on 1 October 2024), offers interesting contrasts regarding the potential of such technologies. In a similar vein, the current developments at the Decentralization Research Centre (DRC) advocate for decentralization and Web3 technologies as solutions to these challenges. Spelliscy's vision of leveraging decentralized digital identity offers a pathway to enhancing data sovereignty and digital self-governance [107]. These technologies promise to democratize data ownership and empower communities, potentially mitigating the risks associated with centralized control by data-opolies. However, the question remains: are the Global South and Global North aligned in terms of AI policies for SI?

The disparities between the Global North and Global South in AI policy development and implementation are stark. In the Global North, AI policies often prioritize economic growth and technological advancement, sometimes at the expense of social equity. In

contrast, the Global South faces unique challenges, including limited access to digital infrastructure and the pressing need for policies that address social and economic inequalities. Datta's research underscores the importance of contextualizing AI policies within the specific socio-economic and cultural landscapes of the Global South [82–84]. As indicated in her keynote at the International Summer School AI4SI, without this geographic contextualization, there is a risk of replicating the very power imbalances that decentralization promises to dismantle amid AI disruptions [63].

Consequently, this article aimed to delve into how AI can transcend its role from merely being a tool for economic and efficiency gains to becoming a pivotal enabler of SI, particularly in addressing the disparities between the Global North and Global South. It articulated an AR methodology by including the AI4SI International Summer School that took place in September 2024 in St. Sebastian, organized by the NGO Ayuda en Acción as a knowledge exchange activity between stakeholders. This event builds on insights from previous fieldwork interventions such as the SRC project in Colombia and Mozambique in 2017. By scrutinizing the possibilities and challenges of leveraging decentralized Web3 technologies—such as blockchain, DAOs, and data cooperatives—this article explored how these innovations can enhance data sovereignty, digital self-governance, and foster a more inclusive and emancipatory data-driven democracy by resulting in the AI4SI framework.

4.2. Special Issue

The discussion around decentralized technologies and their ability to promote SI is directly relevant to this Special Issue of *Sustainability* on Smart Cities and Smart Villages and the Global Digital Transformation: Strategy and Community Engagement. This Special Issue examines how advances in sophisticated information and communication technology (ICT) broaden the range of opportunities to develop sustainable development strategies for smart cities and smart villages at local, regional, and global levels and across issue areas [108–112].

The AI4SI framework closely aligns with the Special Issue's objectives by demonstrating how decentralized technologies—blockchain, DAOs, and data cooperatives—can support smart cities and smart villages in both the Global North and Global South. These technologies are crucial for ensuring that the digital transformation is not just driven by economic gains but is also equitable, inclusive, and community-focused.

The AI4SI framework contributes to the Special Issue's theme by providing concrete examples of how decentralized systems can be implemented to enhance social equity in both rural and urban settings. The key results of the AI4SI framework—such as empowering local communities through data sovereignty, mitigating power concentration, and catalysing SI—offer insights into how decentralized technologies can create resilient, sustainable infrastructures in smart cities and villages.

Furthermore, the Special Issue's focus on strategy and community engagement is exemplified in the participatory approach of the AI4SI framework [18]. The AI4SI International Summer School facilitated knowledge exchange among stakeholders, bridging the gap between academia, industry, and civil society. This aligns with the Special Issue's aim to foster community engagement in the digital transformation process.

In conclusion, the AI4SI framework and its focus on decentralization provide a valuable contribution to the Special Issue on Smart Cities and Smart Villages and the Global Digital Transformation. The framework demonstrates how blockchain, DAOs, and data cooperatives can address disparities between the Global North and South by promoting digital justice and SI. Through inclusive governance, data sovereignty, and ethical AI deployment, the AI4SI framework reflects the goals of the Special Issue—paving the way for a more equitable digital future that bridges the urban-rural divide.

4.3. Main Research Question and Two Operational Research Questions

In response to the main research question: *Can AI Alleviate World Poverty (in the Global South)* [56,57]?

The answer to this question, based on the findings of the article and the AI4SI framework, is both yes and no, depending on the context in which AI is applied, the policies that govern it, and the extent to which decentralized technologies are integrated into the AI ecosystem.

1. AI as a Tool for Economic Growth vs. Social Equity:

    ○   In its current state, AI is largely being deployed in ways that prioritize economic growth, particularly in the Global North [76,81]. AI technologies often focus on increasing efficiency, productivity, and innovation in fields such as finance, manufacturing, and services [73]. However, these advancements do not necessarily translate to alleviating poverty in the Global South, where access to digital infrastructure and inclusive AI policies is limited [113];

    ○   Ayona Datta's work highlights that without inclusive policies, AI could exacerbate existing inequities, particularly in urban settings where AI is used to manage infrastructure but often overlooks marginalized communities [114].

2. Decentralized Technologies as Enablers of SI:

    ○   The AI4SI framework presents decentralized technologies—such as blockchain, DAOs, and data cooperatives—as tools that can transform the impact of AI in the Global South [14,15,89]. These technologies enable local governance of AI systems and promote data sovereignty, thus allowing marginalized communities to benefit from AI in ways that are tailored to their specific needs;

    ○   By empowering local communities to govern their own data and AI systems through decentralized technologies, there is potential for AI to directly contribute to SI, which is a key component in alleviating poverty. Data cooperatives, for example, allow communities to own their data and monetize it for local development purposes.

3. Contextual AI Policies in the Global South:

    ○   AI can only be a pivotal enabler of poverty alleviation if it is contextualized within the socio-economic and cultural landscapes of the Global South. As pointed out by Datta and Filippi [115], AI policies need to account for the specific challenges faced by the Global South—such as limited digital infrastructure, economic disparities, and unequal access to education and technology;

    ○   The success of AI in alleviating poverty hinges on policy frameworks that prioritize digital justice, equity, and community engagement, as well as on leveraging decentralized systems that ensure local participation in the development and deployment of AI technologies.

Thus, AI has the potential to alleviate world poverty in the Global South, but only when it is deployed with a focus on equity, inclusivity, and decentralization.

Operational Research Question 1. *How can we implement SI processes that not only embrace technology and AI but also contribute to promoting just and ethical social change? SI processes can be implemented by integrating decentralized technologies like blockchain and DAOs to ensure equitable access and participation in decision-making. These technologies enable local communities to control data and resources, fostering inclusive governance. Ethical AI deployment, with built-in transparency and accountability, ensures that technology is applied in ways that address social inequities and promote justice.*

Operational Research Question 2. *How can we serve civil society with technology and not the other way around? Technology should serve civil society by promoting data sovereignty through models like data cooperatives, where communities retain control over their data. Decentralized identity systems allow individuals to govern their digital presence, reducing dependency on centralized entities. By aligning technology with community needs and fostering participatory governance, AI and digital systems can be deployed to empower rather than exploit.*

4.4. Limitations

One limitation of this study is the geographical scope, which primarily focuses on insights gathered from fieldwork in the Global South, particularly through the SRC project and International Summer School in 2017 and the AI4SI International Summer School in 2024. While these events and fieldwork processes provide valuable perspectives on the use of decentralized technologies, they may not capture the full complexity of AI implementation across different cultural, socio-political, and technological contexts. Another limitation is the early stage nature of decentralized technologies like blockchain and DAOs. While these technologies show promise, their scalability, governance models, and long-term sustainability remain uncertain, particularly in regions with limited digital infrastructure. Additionally, the study acknowledges the difficulty of generalizing findings given the rapid evolution of both AI and decentralized systems, which are constantly reshaped by technological innovations and policy shifts.

4.5. Future Research Avenues

Future research should explore the scalability and long-term viability of decentralized technologies, especially in under-resourced regions where digital infrastructure is less developed. Comparative studies between the Global North and Global South would offer deeper insights into how AI and decentralized technologies can be adapted to diverse socio-economic landscapes. Additionally, research could investigate the role of AI ethics and data governance in shaping inclusive policies that promote digital justice. Another promising avenue lies in examining the intersection of AI and decentralized digital identity systems, particularly biometrics, exploring how these technologies can enhance data sovereignty and self-governance at both local and global levels.

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