

Reimagining Multidimensional Child Poverty Solutions in Kagera, Tanzania: The Role of Artificial Intelligence Within a Bioecological Systems Framework

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ABSTRACT

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Multidimensional child poverty in Tanzania's Kagera Region affects nearly half of the children, with 44% living with three or more deprivations in housing, water and sanitation, education, health, nutrition, information and communication, and protection. This narrative review explains how Artificial Intelligence (AI) could be a hope and help in solving these deep-seated issues. Following evidence identified in peer-reviewed databases and grey literature, the review employs Bronfenbrenner's Bioecological Systems Theory (Process–Person–Context–Time (PPCT) framework) to guide the discussion. Results show that AI holds immense potential for predictive modelling of high-risk household contexts and service delivery gaps (Process), early risk identification of health and nutrition (Person), strengthening education, health, and protection systems (Context), and monitoring patterns of poverty across generations and assessing the long-term impact of interventions (Time). However, by embracing AI, we also need to be sensitive to the ethical issues that come with it. These include addressing issues like data privacy, building trust among the populace, fighting biases in algorithms, and ensuring fair access to technological infrastructure. This study emphasizes the need for building AI systems that are participatory, child-needs-oriented and premised on the contexts of the communities where they are to be used. In doing so, AI will hold transformative potential to disrupt poverty cycles in Kagera and beyond.

Contribution/Originality: This paper presents a novel perspective on using AI to combat multidimensional child poverty in Kagera. Drawing on Bronfenbrenner's Bioecological Systems Theory, it explores how various interconnected systems affect child development over time. By integrating AI with this framework, the review highlights how predictive analytics and machine learning can enhance personalized interventions across different dimensions of child development.

1. Introduction

Situated in the distant northwest corner of Tanzania, the Kagera Region is in a unique and strategic geographical position. Fostered along the western shores of Lake Victoria, Kagera is the only region within the country that is directly bounded by four countries: Uganda, Rwanda, Burundi, and Kenya (UNDP & ESRF, 2019). This positioning locates the region as a critical crossroads, not just for domestic Tanzanian development but also for East African integration and cross-border trade. Despite this strategic geographical location, the daily reality for most of the children in the region is one of deepening deprivation. According to the National Bureau of Statistics (NBS) and United Nations Children's Fund (UNICEF) (NBS & UNICEF, 2023a), about 44% of the children of Kagera are multidimensionally poor, the highest percentage among mainland Tanzania's 26 administrative regions. Such poverty is not only about the lack of income, but about the combined lack of several rights and basic services that form the substratum of a child's welfare and development (NBS & UNICEF, 2023a, 2023b).

To really know what the nature of this problem is, one needs to understand what multidimensional poverty would be as experienced by a child in Kagera. The NBS and UNICEF's (2023a) official approach identifies seven key dimensions of deprivation: housing, water and sanitation, communication, education, health, nutrition, and protection. In Kagera, children are slipping through the net on all of these levels, frequently encountering multiple, intersecting forms of deprivation. One of the most troubling statistics is that 97% of children in the region lack access to clean water and proper sanitation, a statistic that is not only appalling in leaving them vulnerable to waterborne illnesses but also speaks to deep infrastructural injustices (NBS & UNICEF, 2023a). Here, 94% lack access to hygienic sanitation facilities, 61% rely on unsafe water points, and 30% live in homes with no access to a constant water source whatsoever (NBS & UNICEF, 2023a, 2023b). These are not figures; these are daily battles for dignity, health, and survival.

The issue transcends water and sanitation. Kagera is the country's second most deprived region for children's access to health care (5%) and communication equipment (28%), both of which are necessary to manage illness, receive assistance, and stay well-informed (NBS & UNICEF, 2023b). It is the fourth most deprived in education (23%), and tenth in housing (88%), where overcrowding, poorly constructed houses, and poor ventilation add a physical and emotional burden to young lives (NBS & UNICEF, 2023a, 2023b). Altogether, when viewed, these deprivations amount to a dense web of barriers which trap children and families in cycles of poor health, low prospects, and reduced potential (Sunday & Malek, 2025). But within this bleak scenario lie two firm questions: What if the very severity of these issues might be the key to resolving them? What if there were tools that could monitor not just individual problems, but trends, correlations between school performance and diets, between home income levels and access to sanitation, or between regional policy efforts and child illness rates? This is where artificial intelligence (AI) comes into play, a game-changing technology that can process massive datasets, identify underlying connections, and advance more precise, fact-driven choices in real time (Ogunwale et al., 2025; Sukums et al., 2023).

The paper takes a novel perspective on how AI can change the fight against multidimensional child poverty in Kagera. Rather than focusing on poverty as a static outcome, it thinks about how AI allows us to understand its dynamic, context-based, and systemic nature, reaching conclusions generally not attainable with conventional

methods. But this is not armchair theory. It draws on Bronfenbrenner's Bioecological Systems Theory (2007), a developmental science theory that has been around for decades, viewing child development as the outcome of numerous interconnected systems that interact across time, ranging from child-specific qualities to proximal family environment, broader community, and cultural context. By uniting the power of AI with this bioecological understanding, this review explains how predictive analytics, decision-support systems, and machine learning algorithms may be organized in harmony with every PPCT¹ dimension to produce more effective, personalized interventions.

2. Research Methods

2.1. Study Design and Rationale

This paper employed a narrative review method to examine the possibility of leveraging artificial intelligence (AI) in addressing multidimensional child poverty in Tanzania's Kagera Region. The narrative review was deemed suitable due to its ability to synthesize various interdisciplinary sources like empirical research, policy briefs, conceptual frameworks, and emerging technological advances (O'Donnell, 2024). This approach is most appropriate for combining heterogeneous data from disciplines, i.e., child development, poverty studies, public policy, and artificial intelligence, while permitting depth based on a theoretical model. In this case, Bronfenbrenner's Bioecological Systems Theory was used as the framework for structuring and examining the literature, offering a model for explaining the reciprocal dynamic interaction between a child's development, their immediate contexts, and the influence of technological interventions over time.

2.2. Scope and Objectives of the Review

The scope of this review was purposefully broad yet theoretically anchored. The primary objective was to investigate how AI technologies, ranging from data analytics and predictive modelling to digital health tools, could be applied to support interventions that alleviate child poverty across multiple dimensions in the Kagera Region. The interventions and their interfaces with the several layers of a child's environment, as described in Bronfenbrenner's PPCT model (2007), have received special attention. The review is thus constructed to not only provide some form of summary of current knowledge but also to reimagine future possibilities within the region of high child poverty burdens and unique cross-border dynamics.

2.3. Search Strategy

The literature search was conducted in two main phases from 12th January 2025 to 30th April 2025. The first phase focused on retrieving peer-reviewed literature from established academic databases, including Scopus, Web of Science, PubMed, ScienceDirect, and Google Scholar. A list of search terms was then crafted and refined iteratively with Boolean operators to capture literature at the intersection of child poverty, artificial intelligence, and ecological systems theory. Some of the key terms involved combinations of "multidimensional child poverty," "artificial intelligence,"

¹ Process-Person-Context-Time (PPCT)

“machine learning,” “child development,” “Bronfenbrenner,” “bioecological systems theory,” “Tanzania,” “Kagera Region,” and “AI for development.”

In the second phase of the search, efforts were expanded to include grey literature, which especially proves highly important in research contexts where formal peer-reviewed publications may lag behind on-the-ground innovations. Grey literature sources included reports, newspapers, and working papers from organizations such as UNICEF Tanzania, the National Bureau of Statistics (Tanzania), UNDP, the World Bank, REPOA, and the African Child Policy Forum. Institutional repositories from Tanzanian universities, including Mzumbe University, the Institute of Accountancy Arusha, and the University of Dar es Salaam, were also consulted to retrieve locally grounded insights. These sources provided a rich trove of contextual data on child poverty trends, regional development challenges, and early-stage technology applications in East Africa that have not yet reached mainstream academic publication.

Documents were included in the review if they addressed one or more of the following criteria: multidimensional child poverty (defined beyond income alone), AI applications in health, education, or public service delivery; relevance to the ecological dimensions of child development; or empirical and conceptual contributions to East African or Tanzanian contexts. Sources were excluded if they focused only on income-based poverty, addressed AI in a manner unrelated to developmental or policy relevance, and were written in languages other than English.

2.4. Data Extraction and Thematic Synthesis

Once relevant documents were identified, a thematic data extraction was conducted. This systematic approach allowed the analysis to move beyond surface-level synthesis and construct toward a stratified level of understanding of how AI technologies could engage with the multiple dimensions of child poverty, developmental (Person), relational (Process), environmental (Context), and temporal (Time). The analysis was undertaken employing a thematic narrative structure, where inductive initial coding was utilized to establish recurring ideas and intervention patterns, and subsequent grouping was performed deductively in relation to the four dimensions of the Bronfenbrenner model.

2.5. Quality Assurance and Limitations

Articles were evaluated based on theoretical clarity and methodological rigour, while grey literature was assessed based on institutional authors, transparent data, and findings that were coherent with other sources. In spite of the strengths of this methodology, the review does concede some limitations. Most significantly, excluding non-English sources might have resulted in excluding some extremely valuable local insights. Additionally, according to [Usmanova et al. \(2022\)](#), AI in social development has only recently become a focus area; however, there is limited evaluative data on the long-term effects of AI in poverty predictions. Lastly, the interpretive use of Bronfenbrenner's theory in this synthesis is conceptual, rather than empirical; so, while it provides a useful structure for evidence synthesis, it does not substitute for primary field-based verification.

3. Results and Discussion

3.1. An Overview of Bronfenbrenner's Bioecological Systems Theory

Bronfenbrenner's Bioecological Systems Theory is one of the important theoretical frameworks that can be used to explain the relationship between Artificial Intelligence and multidimensional child poverty (Bronfenbrenner & Morris, 2007; Veiga et al., 2023). The theory, also known as the Process-Person-Context-Time (PPCT) model or the Bioecological model of human development, offers the ideal prism through which to explore the intertwined nature of child poverty in Kagera (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 2007; Sadownik, 2023). The "Person" dimension seeks to address children's biological and psychological characteristics that shape their interaction with the world, nutritional status, emotional strength, or vulnerabilities to illnesses such as respiratory infections (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 2007). The "Process" dimension deals with the nature of relationships and interaction between children and the home, school, and peer worlds, such as parental involvement, exposure to domestic violence, or teacher bonding (Bronfenbrenner & Morris, 2007; Veiga et al., 2023). The "Context" dimension expands to the daily larger systems a child resides in, neighbourhood safety and access to care, environmental risk and institutional support (Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 2007). And the "Time" dimension for the dynamic nature of those systems, how early childhood deprivation compounds over the life course of a child and how acute social or environmental shocks, like climate events or financial crashes, can alter developmental trajectories (Bronfenbrenner & Morris, 2007).

Essentially, the theory recognizes that children learn and develop through repeated exposure to their environments, where their unique characteristics, both genetic and cognitive, as well as emotional abilities, are not static forces but active forces that shape their development (Bronfenbrenner, 1994; Bronfenbrenner et al., 1986; Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 2007; Sadownik, 2023; Veiga et al., 2023).

3.2. The Role of AI in the Process Dimension

The "process" aspect of Bronfenbrenner's Bioecological systems theory focuses on children's relationships that they form in their daily lives, most importantly with family members, caregivers, and peers (Bronfenbrenner & Morris, 2007; Sadownik, 2023). These are not significant interventions but daily habits, such as whether a caregiver smokes at home or whether a parent gives medical attention when their child coughs. Such habits, decisions, and interactions that, day after day, construct a path of development (Bronfenbrenner, 1994). As shown in Table 1, AI is no longer a futuristic luxury; it has already demonstrated promise in other regions, the potential to enhance learning, provide maternal health advice, and provide early disease detection (Isangula & Haule, 2024; Nwankwo et al., 2024; Rwegoshora, 2023). In the context of Kagera, AI can be a subtle ally in the fight against child poverty. It can support mothers with prenatal and postnatal care, prompt caretakers to respond to signs before symptoms become emergencies, and help teachers identify learning issues early. What was once dependent on human memory, custom, or availability can now be supported by intelligent, accessible, and responsive tools. If these solutions have yielded quantifiable gains elsewhere, there is good reason to hope they can illuminate a comparable path forward for children in Kagera, not merely survival, but the possibility of flourishing.

Table 1: AI's Role in Addressing Multidimensional Child Poverty in the Process Dimension

System	AI's Role	Examples in Tanzania & Developing Countries	Source
Process (P)	AI enhances learning, health, nutrition, protection, and social services through personalized interventions and predictive analytics.	AI-powered e-learning platforms (e.g., "Twende Digital," designed by the Tanzanian government in collaboration with Google). This exciting initiative aims to empower students by providing them with personalized learning resources, adaptive evaluations that adjust to their pace, and virtual tutors who guide them along their educational journey. Tools like Carnegie Learning's Cognitive Tutor and adaptive learning platforms such as Smart Sparrow tailor lessons to individual needs, making learning more engaging and effective. Moreover, AI tools like Turnitin and Gradescope help teachers streamline assessments and grading, allowing them to focus more on teaching and mentoring. Additionally, virtual teaching assistants and chatbots, like IBM Watson Assistant, provide students with instant support, creating a more interactive and supportive classroom environment.	Rwegosho ra (2023)
	AI-driven chatbots provide maternal health advice, improving child nutrition and early development.	In South Africa, IDinsight, in collaboration with Praekelt.org, developed a friendly AI-powered tool named "Ask-A-Question" (or "AAQ") for a national helpline dedicated to maternal and childcare. This innovative plug-in helps mothers by automatically sharing health information that answers their specific questions.	Mathew & Mgina (2024)
	AI-based early disease detection (e.g., pneumonia diagnosis using smartphone imaging) improves child healthcare outcomes.	An artificial intelligence (AI)-powered cough audio classifier has been used for detecting respiratory conditions, including active tuberculosis (TB), asthma, and chronic obstructive pulmonary disease (COPD) in rural Tanzania. In the Kibaha district of Tanzania's Coastal region, a digital system named Afya-Tek facilitated care, resulting in 33% of children exhibiting pneumonia symptoms receiving Amoxicillin, 34% of those with diarrhoea symptoms getting oral rehydration solutions and zinc, and 4,203 referrals to nearby health facilities.	Verma (2022)
			Isangula & Haule (2024)
			Dillip et al. (2024)

3.3. The Role of AI in the Person Dimension

The "person" dimension of Bronfenbrenner's Bioecological Systems theory acknowledges that every child is born with some combination of traits; some innate, while some are acquired over the years, influencing how they grow, respond to their world, and how others react to them (Bronfenbrenner, 1993, 1994; Bronfenbrenner &

[Morris, 2007](#)). In Tanzania's Kagera Region, personal qualities such as age, sex, temperament, and even disability can determine risk or resilience. AI helps to understand these individual elements to care not just for poverty or illness, but for the child as a whole ([Ayeni et al., 2024](#); [Mitra, 2024](#); [Nwankwo et al., 2024](#); [Porayska-Pomsta et al., 2018](#)). As shown in Table 2, this involves supporting children with hearing impairments in education, detecting emotional distress in children or recommending personalized diets based on a child's age and health status ([Ishengoma & John, 2024](#); [Janssen et al., 2024](#); [Mitra, 2024](#); [Porayska-Pomsta et al., 2018](#)).

Table 2: AI's Role in Addressing Multidimensional Child Poverty in the Person
Dimension

System	AI's Role	Examples	Source
Person (P)	AI-powered speech-to-text technology supports children with disabilities and disorders in education.	Generative AI chatbots such as ChatGPT, Gemini, Copilot, and Claude can assist individuals with Attention-Deficit Hyperactivity Disorder (ADHD) by helping them grasp and remember written information more effectively. Combining the power of AI with personal human connections has proven to be an effective way to support the social communication skills of autistic children in a school intervention program in the United Kingdom.	Mitra (2024)
	AI-assisted mental health support detects emotional distress in children.	Generative AI models can recognize and understand how children's behaviours and emotions change over time. By considering patterns in the information they learn from, these models help us keep track of these changes in a more relatable way.	Porayska-Pomsta et al. (2018)
	AI-driven nutrition apps recommend personalized diets based on a child's age and health status.	Assessing dietary habits in children and adolescents is challenging due to reliance on parental input, which can lead to recall bias and misreporting. AI-assisted tools offer a promising solution by enabling more accurate and engaging reporting of food intake among youth. Recent studies, including Ghanaian and Kenyan-origin children, show that both Intelligent Dietary Assessment systems and wearable technology can enhance dietary assessments, leading to more reliable insights into the nutritional needs of children and adolescents.	Ogunwale et al. (2025) Phalle & Gokhale (2025); Janssen et al. (2024)

3.4. The Role of AI in the Context Dimension

The “context” dimension in Bronfenbrenner’s Bioecological Systems theory (2007) captures the layered environments influencing a child’s life, between their close household (microsystem), interactions between school and home (mesosystem), broader community systems (exosystem), and finally the broader sociopolitical and cultural environment (macrosystem). In the Kagera region, AI can weave these complex environmental layers together into a clear map, as shown in Table 3. With the analysis of satellite imagery, mobile health reports, and social service gaps, AI can identify communities in which children have the most polluted air to breathe, walk the longest distance to care, or suffer the greatest degree of systemic neglect (Alturif et al., 2024; Nwankwo et al., 2024; Nzelibe, 2024; Ogundaini & Mlitwa, 2024; Sukums et al., 2023). It takes scattered context and makes it insightful, so we no longer vaguely suppose who needs help, but we know it with accuracy (Dillip et al., 2024). In so doing, AI not only sees the context but also helps redesign it, converting information into opportunities for the children who need it most (Phalle & Gokhale, 2025; Sukums et al., 2023).

Table 3: AI’s Role in Addressing Multidimensional Child Poverty in the Context Dimension

System	AI’s Role	Examples in Tanzania & Developing Countries	Source
Context (C)	Microsystem: AI-powered telemedicine services bring healthcare to remote areas, benefiting children directly.	TanzMED is an innovative AI-powered telemedicine app in Tanzania designed to bridge the healthcare gap in remote areas, benefiting children. Featuring an interactive chatbot, this app enables users to engage directly with medical professionals, bringing essential healthcare services to those who need them most. Available for free on both Android and iOS, TanzMED is already making a positive impact, as evidenced by its growing community of over 2,000 subscribers.	Citizen (2024)
	Mesosystem: AI improves coordination between schools, hospitals, and social welfare services to enhance child well-being.	The Afya-Tek program is designed to enhance collaboration between public-sector Community Health Workers (CHWs) and health facilities, as well as private-sector Accredited Drug Dispensing Outlets (ADDOs) in the Kibaha district of Tanzania’s Coastal region. This initiative aims to ensure that mothers, children, and adolescents receive seamless care through a user-friendly digital referral system using a mobile app.	Dillip et al. (2024)

Exosystems: AI helps government agencies predict food insecurity and allocate resources efficiently.	MkulimaGPT, a text and voice chatbot that uses generative Artificial Intelligence (AI) technology and is accessible through WhatsApp, can enhance food security by providing farmers with real-time agricultural guidance, enabling them to grow more productive crops. Offering its services in Swahili helps overcome language barriers, ensuring that even marginalized groups can access vital information. This inclusive approach empowers farmers, particularly women, to make informed decisions that contribute to a stable food supply, essential for children's health and well-being.	Maginga et al. (2024)
Macrosystem: AI influences national education and healthcare policies by providing data-driven insights.	AI-driven assessments can facilitate continuous and unbiased evaluations, supporting educators in identifying learners' strengths and areas for improvement.	United Republic of Tanzania (2025)

3.5. The Role of AI in the Time Dimension

The “time” dimension, or the chronosystem, of Bronfenbrenner’s Bioecological Systems theory brings to mind the fact that childhood does not happen in a flash but over an interval, marked by incremental changes and sweeping transformation ([Bronfenbrenner, 1993, 1994; Bronfenbrenner et al., 1986; Bronfenbrenner & Morris, 2007; Sadownik, 2023; Veiga et al., 2023](#)). For example, in Kagera, not only is a child’s vulnerability to respiratory disease determined by where he or she is born, but also by when, if he or she is growing up during a drought, an economic downturn, or a global pandemic. Time flows through a child’s life in unique and temporal cycles: the long-term toll of child poverty, the cumulative effect of being malnourished, or the sporadic presence of polluted air that gradually wears down frail lungs. It also includes transitions, like a family moving, a parent losing their job, or a policy shifting overnight, which have the power to destabilize or reinforce a child’s trajectory. And this is where Artificial Intelligence can become an essential tool. By tracking health statistics trends month by month or year by year, AI can track warning signs of chronic risk ahead of time, predicting where ARI outbreaks will surge, or which seasons stretch the household thinnest ([Alturif et al., 2024; Ogunwale et al., 2025; Usmanova et al., 2022](#)). It allows us to not only see the story as it unfolds but to predict the sequel, as shown in Table 4.

Table 4: AI's Role in Addressing Multidimensional Child Poverty in the Time Dimension

System	AI's Role	Example	Source
Time (T) (Changes over time and across child development stages)	AI-generated policy simulations predict the effectiveness of poverty alleviation strategies over decades.	The one-dimensional Convolutional Neural Network (1D-CNN) has been effectively employed to project scores for Sustainable Development Goal 1 (No Poverty) from 2024 to 2030. This analysis encompassed key countries including the United States, Sweden, Saudi Arabia, Egypt, and China. By utilizing deep learning techniques, the model exploited temporal connections in historical data from 2000 to 2022, enabling precise estimations of each nation's advancement towards the goal of eradicating poverty. The results underscore the model's ability to identify and evaluate trends in multidimensional child poverty alleviation in the context of the Kagera region, facilitating reliable forecasts that align with anticipated global trends in sustainable development.	Alturif et al. (2024)

3.6. Challenges and Ethical Considerations

Though the potential of Artificial Intelligence in transforming child poverty response in Kagera is beguiling, its utilization is beset with profound challenges that bear witness to infrastructure and socio-political conditions. The region is faced with poor digital infrastructure, interrupted electricity, poor internet penetration, and poor digital literacy, which constrain the utilization and sustenance of AI-powered solutions. Even after the provision of tools, local communities might lack the equipment, training, or material means to leverage them to good effect ([United Republic of Tanzania, 2022, 2025](#)). The discrepancy between technological potential and capacity in reality threatens to create new exclusions: those who are able to access AI-driven interventions and those who are not. Unless handled well, this digital divide threatens to widen inequalities instead of weakening them, particularly for kids in isolated or disadvantaged neighbourhoods.

Aside from technical problems, the ethical concerns related to data privacy, surveillance, and consent are paramount in the lives of children ([Sukums et al., 2023](#)). In Kagera, where community norms are shaped through oral culture and collective decision-making, the concept of owning personal data and digital rights may be unfamiliar. Gathering sensitive health, education, or family circumstances data, which are often required by AI systems, poses questions regarding who has ownership over such data, how it is protected, and whether families are involved and informed ethically ([Mathew & Mgina, 2024](#)). Without culturally nuanced models of how to deploy ethical AI, there is a real danger that data collection would undermine trust, place vulnerable children in ways that they could not imagine being harmed, or entrench stigma, particularly in areas like disability, child protection, or HIV status. The virtual nature of algorithms also

makes accountability difficult, so that communities cannot challenge unfair outcomes or prejudice encoded into automated rulings.

No less crucial is the potential to neglect the interpersonal connections that are indispensable to children's development. AI can provide efficacy and prescience but lacks the compassion of a teacher, the warmth of a caregiver, or the moral sense of a community leader (De Togni et al., 2021; Qayyum et al., 2024). There is a danger of over-reliance on algorithmic tools depersonalizing care and commodifying children as data points (De Togni et al., 2021). In Kagera's social fabric of community, interventions that avoid bypassing local voices or cultural knowledge could fall into disapproval or distrust. The moral path forward, then, is to place co-design with the community first, explainability in the operation of AI, and guarantees that AI augments instead of replacing the human touch. Child-centred AI solutions must not only be intelligent, but they must also be inclusive, culturally sensitive, and human in their essence (De Togni et al., 2021; Qayyum et al., 2024).

4. Future Research Direction and Policy Recommendation

In the future, research will need to transcend the thrill regarding the technological potential of AI to deeply analyze its situational relevance, social acceptability, and developmental equity in regions like Kagera. While the majority of global research identifies the potential of machine learning to predict poverty or optimize service provision (Alturif et al., 2024; Mwogosi & Simba, 2025; Usmanova et al., 2022), few studies are based on localized experiences of hardship within a framework as conceived by Bronfenbrenner's Bioecological Systems Theory (Aftab et al., 2024; Veiga et al., 2023). Researchers should explore how AI operates in the unique rhythms of rural life in Kagera, where care systems, beliefs, and survival intersect across generations, kinship networks, and informal economies. Mixed-methods research combining quantitative prediction models with ethnographic inquiry can unpack how AI interfaces with the person, process, context, and time dimensions of child poverty. This also involves exploring how local stakeholders, village health workers, mothers, teachers, and religious leaders see, trust, or resist AI technologies, and how protection must be afforded in order to maintain children's rights and voices at the centre of digital innovation.

Policy-wise, Tanzania's national and regional development plans have notably responded to digital transformation as an accelerator of human development instead of an economic agenda (United Republic of Tanzania, 2022, 2025). For Kagera, this means positioning AI policies as child-centred, inclusive, and sensitive to multidimensional poverty. This includes setting clear guidelines on protecting data consent, involving the community, and making algorithms transparent. It's also essential to foster collaboration among various sectors, such as the Ministry of Health, the Ministry of Education, the Ministry of Water, the Ministry of Community Development, Gender, and Children, and the Ministry of Communication and Information Technology, so that AI solutions are developed together, all working toward the common goal of improving children's lives (United Republic of Tanzania, 2022). Investing in local digital infrastructure, community training programs, and inclusive data systems is vital to making this vision a reality (Ndibalema, 2025; Sanga & Kiwango, 2024).

Moreover, policy-making and future research need to give emphasis to sustainability and resilience. In the absence of anchorage in real feedback loops and local knowledge

systems, AI technologies will be extractive or useless. Therefore, participatory design methods, under which users design AI tools and policies jointly, should be made the norm. This participatory mechanism ensures that AI drives families toward Kagera's intergenerational aspirations: not just surviving poverty but breaking out of its cycle and nurturing children's fullest potential. Lastly, AI must not be conceived as a rapid fix, but as a companion in a long human journey toward dignity, justice, and opportunity for all children.

5. Conclusion

In the Kagera region of Tanzania, where traditions weave the rhythms of rural life, childhood is shaped not just by love and culture but also by layered hardships. These hardships, whether poor housing, unsafe water, inadequate schools, limited healthcare, or chronic undernutrition, rarely exist in isolation (NBS & UNICEF, 2023a, 2023b). Instead, they intersect across households, communities, institutions, and generations. This analysis has shown that the multidimensionality of childhood poverty in Kagera requires similarly multidimensional solutions, those not only clever but also fair, equitable, and sensitive to context. By framing the challenge in terms of Bronfenbrenner's Bioecological Systems Theory, we are reminded that children don't live in data points; they grow in relationships, contexts, and timelines (Bronfenbrenner et al., 1986; Bronfenbrenner & Morris, 2007). It is here that Artificial Intelligence (AI), in a well-crafted and ethically deployed fashion, has the potential to change.

AI is not a silver bullet for child poverty. It can, though, be an important tool, predicting risk, customizing services, enhancing communication, and facilitating timely intervention along the child's well-being dimensions. When aligned with the Person, Process, Context, and Time dimensions of development, AI can aid in revealing obscured patterns of deprivation, optimizing health and education reach, and strengthening systems in place to protect and support children (Ayeni et al., 2024; Barakabitze et al., 2023; Dillip et al., 2024; Aftab et al., 2024; Mathew & Mgina, 2024; Mitra, 2024; Ogunwale et al., 2025). But this is only possible if AI is embedded in a participatory, locally focused, and ethically robust development agenda. The children of Kagera's future require not just innovation but listening innovation; innovation that hears them in all their humanity and understands the contexts in which they live and become.

Ultimately, this review is an appeal to action, not merely for researchers and technologists, but also policymakers, carers, development actors, and the global academic community. It urges us to reinvent technology not as an afar solution, but as a fellow traveller in our shared effort to end child poverty. In the hands of a people most intimate with their children and guided by a theory that values every level of their experience, AI might have the power not to displace care, but to enrich it. And in that care, the seeds of justice, hope, and transformation for all of Kagera's children may finally take root.

Ethics Approval and Consent to Participate

Not applicable.

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Conflict of Interests

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References

- Aftab, M. J., Amjad, F., & Chaudhry, H. (2024). Exploring the Role of AI-Driven Speech Recognition System in Supporting Inclusive Education for Hearing Impaired Students in Pakistan. *Annals of Human and Social Sciences*, 5(3), 492-504. [https://doi.org/10.35484/ahss.2024\(5-III\)43](https://doi.org/10.35484/ahss.2024(5-III)43)
- Alturif, G., Saleh, W., El-Bary, A. A., & Osman, R. A. (2024). Using artificial intelligence tools to predict and alleviate poverty. *Entrepreneurship and Sustainability Issues*, 12(2), 400–413. <https://doi.org/10.9770/b8436764898>
- Ayeni O. A., Ovbiye E. R., Onayemi A. S., & Ojedele K. E. (2024). AI-driven adaptive learning platforms: Enhancing educational outcomes for students with special needs through user-centric, tailored digital tools. *World Journal of Advanced Research and Reviews*, 22(3), 2253–2265. <https://doi.org/10.30574/wjarr.2024.22.3.0843>
- Barakabitze, A. A., Jonathan, J., & Sanga, C. (2023). AI driven Internet of Agro-Things Adaptive Farm Monitoring Systems for Future Agricultural Production and Food Systems in Africa. *Tanzania Journal of Agricultural Sciences*, 22(22–33).
- Bronfenbrenner, U. (1993). The ecology of cognitive development: Research models and fugitive findings. In R. H. Wozniak & K. W. Fischer (Eds.), *Development in context: Acting and thinking in specific environments* (pp. 3–44). Lawrence Erlbaum Associates.
- Bronfenbrenner, U. (1994). Ecological models of human development. *International encyclopedia of education*, 3(2), 37-43.
- Bronfenbrenner, U., Arastah, J., Hetherington, M., Lerner, R., Mortimer, J. T., Pleck, J. H., Pulkinnen, L., Rutter, M., Schneewind, K., & Slaughter, D. (1986). Ecology of the Family as a Context for Human Development: Research Perspectives. *Developmental Psychology*, 22(6), 723–742. <https://doi.org/10.1037/0012-1649.22.6.723>.
- Bronfenbrenner, U., & Evans, G. W. (2000). Developmental Science in the 21st Century: Emerging Questions, Theoretical Models, Research Designs and Empirical Findings. *Social Development*, 9(1), 115–125. <https://doi.org/10.1111/1467-9507.00114>
- Bronfenbrenner, U., & Morris, P. A. (2007). The bioecological model of human development. *Handbook of child psychology*, 1.
- Citizen. (2024, July 23). *New digital medical App launched in Dar es Salaam*. <https://www.thecitizen.co.tz/tanzania/news/national/new-digital-medical-app-launched-in-dar-es-salaam-4699876>

- De Togni, G., Erikainen, S., Chan, S., & Cunningham-Burley, S. (2021). What makes AI 'intelligent' and 'caring'? Exploring affect and relationality across three sites of intelligence and care. *Social Science and Medicine*, 277, 113874. <https://doi.org/10.1016/j.socscimed.2021.113874>
- Dillip, A., Kahamba, G., Sambaiga, R., Shekalaghe, E., Kapologwe, N., Kitali, E., Kengia, J. T., Haonga, T., Nzilibili, S., Tanda, M., Haroun, Y., Hofmann, R., Litner, R., Lampariello, R., Kimatta, S., Ketende, S., James, J., Fumbwe, K., Mahmoud, F., ... Sarkar, N. (2024). Using digital technology as a platform to strengthen the continuum of care at community level for maternal, child and adolescent health in Tanzania: introducing the Afya-Tek program. *BMC Health Services Research*, 24(1), 865. <https://doi.org/10.1186/s12913-024-11302-7>
- Isangula, K. G., & Haule, R. J. (2024). Leveraging AI and Machine Learning to Develop and Evaluate a Contextualized User-Friendly Cough Audio Classifier for Detecting Respiratory Diseases: Protocol for a Diagnostic Study in Rural Tanzania. *JMIR Research Protocols*, 13(1), e54388. <https://doi.org/10.2196/54388>
- Ishengoma, F., & John, E. (2024). Factors influencing the adoption of mobile-based AI services in Tanzanian manufacturing SMEs. *Vilakshan-XIMB Journal of Management*. <https://doi.org/10.1108/XJM-11-2023-0214>
- Janssen, S. M., Bouzembrak, Y., & Tekinerdogan, B. (2024). Artificial Intelligence in Malnutrition: A Systematic Literature Review. In *Advances in Nutrition*, 100264. Elsevier B.V. <https://doi.org/10.1016/j.advnut.2024.100264>
- Maginga, T. J., Kutuku, S. J., Hamza, H. M., Mulokozi, G. G., & Nsenga, J. (2024). MkulimaGPT: Equitable AI Use Via a Swahili Chatbot for Maize Farming System in Tanzania. *African Journal of Agriculture and Food Science*, 7(4), 172–188. <https://doi.org/10.52589/AJAFS-VERNTB5I>
- Mathew, M. N., & Mgina, J. H. (2024). Utilization of Educational Artificial Intelligence Tools in Higher Learning Institutions in Tanzania and the Challenges Encountered. A Literature Review. *International Journal of Novel Research and Development*, 9(4).
- Mitra, S. (2024). AI-Powered Adaptive Education for Disabled Learners. *Available at SSRN 5042713*. <https://doi.org/10.2139/ssrn.5042713>
- Mwogosi, A., & Simba, R. (2025). Integration of AI into teaching methodologies in health training institutions in Tanzania. *Journal of Research in Innovative Teaching and Learning*. <https://doi.org/10.1108/JRIT-03-2025-0069>
- Nwankwo, E. I., Emeihe, E. V., Ajegbile, M. D., Olaboye, J. A., & Maha, C. C. (2024). Integrating Telemedicine and AI to Improve Healthcare Access in Rural Settings. *International Journal of Life Science Research Archive*, 7(1), 59–77. <https://doi.org/10.53771/ijlsra.2024.7.1.0061>
- NBS, & UNICEF. (2023a). *The State of Mainland Tanzania's Children: Evidence from the Mainland Household Budget Surveys (2007–2018)*.
- NBS, & UNICEF. (2023b). *The State of Mainland Tanzania's Children: Evidence from the Mainland Household Budget Surveys (2007–2018)*.
- Ndibalema, P. (2025). Perspectives on barriers to learning opportunities among deaf children in Tanzania. *International Journal of Educational Research Open*, 9, 100468. <https://doi.org/10.1016/j.ijedro.2025.100468>
- Nzelibe, I. U. (2024). Satellite and artificial intelligence in mapping multidimensional poverty in Africa: A review study. *African Journal on Land Policy and Geospatial Sciences*, 7(1), 325–347. <https://doi.org/10.48346/IMIST.PRSM/ajlp-gs.v7i1.44087>
- O'Donnell, O. (2024). Health and health system effects on poverty: A narrative review of global evidence. *Health Policy*, 142. <https://doi.org/10.1016/j.healthpol.2024.105018>

- Ogundaini, O., & Mlitwa, N. (2024). Artificial Intelligence for Assistive Learning to Support Physically Impaired Learners in Sub-Saharan Africa. *EDULEARN24 Proceedings*, 1, 156–163. <https://doi.org/10.21125/edulearn.2024.0070>
- Ogunwale, A., Smith, A., Fakorede, O., & Ogunlesi, A. O. (2025). Artificial intelligence and forensic mental health in Africa: a narrative review. *International Review of Psychiatry* 37(1), 3-13. <https://doi.org/10.1080/09540261.2024.2405174>
- Phalle, A., & Gokhale, D. (2025). Navigating next-gen nutrition care using artificial intelligence-assisted dietary assessment tools—a scoping review of potential applications. *Frontiers in Nutrition*, 12, 1518466. <https://doi.org/10.3389/fnut.2025.1518466>
- Porayska-Pomsta, K., Alcorn, A. M., Avramides, K., Beale, S., Bernardini, S., Foster, M. E., Frauenberger, C., Good, J., Guldborg, K., Keay-Bright, W., Kosyvaki, L., Lemon, O., Mademtzi, M., Menzies, R., Pain, H., Rajendran, G., Waller, A., Wass, S., & Smith, T. J. (2018). Blending human and artificial intelligence to support autistic children's social communication skills. *ACM Transactions on Computer-Human Interaction*, 25(6), 1-35. <https://doi.org/10.1145/3271484>
- Qayyum, A., Bukahri, M., Zulfiqar, P., & Ramzan, M. (2024). Balancing Artificial Intelligence and Human Insight in Early Childhood Education: Implications for Child Development. *Social Science Review Archives*, 2(2), 1520–1536. <https://doi.org/10.70670/sra.v2i2.207>
- Rwegoshora, F. (2023, July 21). Strategies to Embrace Tanzanian Education with AI-Powered Tech. *Tanzania Digest*. <https://www.digest.tz/strategies-to-embrace-tanzanian-education-with-ai-powered-tech/>
- Sadownik, A. R. (2023). Bronfenbrenner: Ecology of Human Development in Ecology of Collaboration. In *(Re) theorising More-than-parental Involvement in Early Childhood Education and Care* (pp. 83-95). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-031-38762-3_4
- Sanga, H., & Kiwango, T. (2024). The Implication of Telemedicine on Healthcare Delivery, Patient Outcomes, and Cost-Effectiveness in Tanzania. In *The African Conference of Applied Informatics*. <https://doi.org/10.59645/acai.v4i1.424>
- Sukums, F., Mzurikwao, D., Sabas, D., Chaula, R., Mbuke, J., Kabika, T., Kaswija, J., Ngowi, B., Noll, J., Winkler, A. S., & Andersson, S. W. (2023). The use of artificial intelligence-based innovations in the health sector in Tanzania: A scoping review. *Health Policy and Technology*, 12(1), 100728. <https://doi.org/10.1016/j.hlpt.2023.100728>
- Sunday, A. L., & Malek, N. M. (2025). Unmasking the Silent Crisis: How Socioeconomic and Cultural Forces Perpetuate Multidimensional Child Poverty in Tanzania. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 10(2), e003285. <https://doi.org/10.47405/mjssh.v10i2.3285>
- UNDP, & ESRF. (2019). *Kagera Region Investment Guide*.
- United Republic of Tanzania. (2022). *Policy Framework for Artificial Intelligence in Tanzania Health Sector*.
- United Republic of Tanzania. (2025). *National Guidelines for Artificial Intelligence in Education*.
- Usmanova, A., Aziz, A., Rakhmonov, D., & Osamy, W. (2022). Utilities of Artificial Intelligence in Poverty Prediction: A Review. *Sustainability*, 14(21), 14238. <https://doi.org/10.3390/su142114238>
- Veiga, G. R. S., da Silva, G. A. P., Padilha, B. M., & Lima, M. de C. (2023). Determining factors of child linear growth from the viewpoint of Bronfenbrenner's Bioecological Theory. *Jornal de pediatria*, 99(3), 205-218. <https://doi.org/10.1016/j.jpmed.2022.10.009>

Verma, T. (2022, November 14). *Using AI to improve maternal health chatbots in South Africa*. <https://www.idinsight.org/article/using-ai-to-improve-maternal-health-chatbots-in-south-africa/>