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## Editorial Note

This edition of HURIA Journal (Vol 32 (2), December 2025) brings together twelve peer-reviewed articles that speak to urgent development priorities across Africa and beyond. Collectively, the papers demonstrate how scholarship in education, governance, economics, technology, environment, health, peace and culture can advance the United Nations Sustainable Development Goals (SDGs) through evidence-based insights and practical recommendations.

The first article “Assessment of Teachers’ Awareness and Utilization of Community Resources for Teaching and Learning Biology in Kwara Central, Nigeria” investigates how biology teachers draw on community-based learning resources to improve classroom instruction. By highlighting both the benefits and constraints of using local resources such as nature centres, professional guest speakers, and science-related facilities, the study contributes to SDG 4 (Quality Education) and SDG 17 (Partnerships for the Goals) through strengthened school–community collaboration for experiential learning.

The second article “Examining the Impact of Female-Headed Households on Learning Achievements in Tanzanian Secondary Schools” explores how gendered household dynamics shape students’ academic outcomes. The findings indicate that female-headed households can support improved learning outcomes—especially where women are educated and community support is strong—while also drawing attention to urban pressures that constrain parental engagement. This work aligns with SDG 4 (Quality Education), SDG 5 (Gender Equality), and SDG 10 (Reduced Inequalities) by informing policies that strengthen women’s socio-economic empowerment and student support.

In the third paper “Endurance and Change: The Historical Trajectory of Agricultural Marketing Cooperatives Under Four Decades of Economic Reforms in Tanzania (1984–2024)”, the authors trace how Agricultural Marketing Cooperative Societies (AMCOS) have endured, adapted, and transformed across successive policy reform phases. By proposing a balanced pathway that combines autonomy, governance strengthening, sustainable financing, and digital transformation, the article contributes to SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), and SDG 9 (Industry, Innovation and Infrastructure) through stronger and more resilient agricultural value-chain institutions.

The fourth article “Impact of Local Government Authorities’ Development Budget on Project Performance in Tanzania: A Case of

Muheza District Council” examines how budgeting practices shape the performance of local development projects. The results highlight the importance of project planning, effective management, and timely budget allocation, while also pointing to persistent inefficiencies in budget utilization. This study supports SDG 16 (Peace, Justice and Strong Institutions) and SDG 11 (Sustainable Cities and Communities) by strengthening accountability and delivery capacity within local governance systems.

The fifth article “A Framework for Assessing Adoption of Emerging Technologies in Oil Distribution Networks in Tanzania: The Case of TANOIL and PUMA Energy” assesses the technological, organizational, and environmental conditions shaping digital transformation in downstream petroleum distribution. By showing that technological readiness and organizational capacity are key drivers of adoption-while external environmental pressures remain weak-the study advances SDG 9 (Industry, Innovation and Infrastructure) and SDG 12 (Responsible Consumption and Production) through improved operational efficiency, transparency, and safer distribution systems, with implications for reduced losses and spill risks.

The sixth article “Structural and Political Barriers to Effective Enforcement at the African Court on Human and Peoples’ Rights” interrogates why non-compliance with the Court’s judgments persists nearly two decades after operationalization. Drawing on case law and implementation experiences, the article argues that the Court’s legitimacy and impact depend on political will alongside institutionally reform and strengthened enforcement mechanisms. This contribution directly aligns with SDG 16 (Peace, Justice and Strong Institutions) and SDG 17 (Partnerships for the Goals) by reinforcing regional human rights accountability.

In the seventh paper “Assessment of the Vulnerability of Residential Areas to Floods in Mabatini Ward in Mwanza City Council, Tanzania”, the authors combine spatial analysis, satellite imagery, and community inputs to map flood risk and identify vulnerability hotspots. The study links unplanned urban growth and loss of vegetation cover to heightened runoff and prolonged inundation, recommending improved drainage, land-use planning, early warning systems, and community awareness. This work supports SDG 11 (Sustainable Cities and Communities) and SDG 13 (Climate Action) by strengthening urban resilience and disaster preparedness.

The eighth paper “Role of Technology Transfer Offices in Patenting and Commercialization of Research Results in Public Funded University: Case of South Africa” investigates how Technology Transfer Offices (TTOs) support patenting, licensing, and commercialization in publicly funded universities. By identifying constraints such as limited buyers, gaps in commercialization expertise, weak start-up policies, and inadequate research funding, the study advances recommendations for stronger innovation governance. It aligns with SDG 9 (Industry, Innovation and Infrastructure) and SDG 8 (Decent Work and Economic Growth) through strengthened pathways from research to market impact.

In the ninth article “Foreign Remittance and Economic Growth in Nigeria: An Empirical Survey”, the authors examine the relationship between international remittances, foreign portfolio investment, foreign direct investment, and Nigeria’s economic growth using time-series evidence. The findings show a strong positive association and recommend policy harmonization and financial inclusion measures to maximize development impacts. This study aligns with SDG 8 (Decent Work and Economic Growth), SDG 10 (Reduced Inequalities), and SDG 17 (Partnerships for the Goals) by highlighting the role of cross-border finance in national development.

The tenth paper “Is traditional medicine controversial in Africa? A critical review” assesses the debate around traditional medicine’s integration into formal health systems. While emphasizing accessibility, affordability and cultural relevance, the review also notes concerns relating to scientific validation, safety, standardization, regulation, and sustainability of medicinal plant resources. The article supports SDG 3 (Good Health and Well-being) and SDG 15 (Life on Land) by calling for stronger evidence, regulation, and sustainable resource use.

The eleventh article “Young Adults’ Perception of Peacebuilding System for Sustainable Development and Security” highlights young adults as critical stakeholders in peace processes. Using survey evidence, the authors recommend inclusive, multi-sector programming that combines peacebuilding initiatives with socio-economic support-especially employment creation-to improve sustainable peace outcomes. This work aligns with SDG 16 (Peace, Justice and Strong Institutions) and SDG 8 (Decent Work and Economic Growth) by linking youth inclusion to stability and development.

Finally, the twelfth paper “Matumizi ya Akiliunde Katika Kutafsiri Matini za Kiutamaduni: Changamoto na Suluhisho” examines the use of Artificial Intelligence (AI) in translating culturally grounded texts from

Kiswahili to English. Guided by Skopos theory, the study highlights challenges such as limited cultural-context sensitivity, ambiguity in polysemous expressions, and concerns around privacy and safety, emphasizing the need for human expertise in ensuring accurate cultural communication. This paper contributes to SDG 9 (Industry, Innovation and Infrastructure) and SDG 11.4 (Safeguarding Cultural Heritage) by promoting responsible and context-aware use of AI in language services.

Together, these scholarly contributions provide a multidisciplinary view of development challenges and opportunities, offering research-based insights that resonate with the SDGs. They reaffirm that knowledge-when translated into policy and practice-remains a vital driver of sustainability, inclusivity, and resilience.

As Chief Editor, I acknowledge all contributing authors for their dedication and scholarly excellence. Special thanks go to the peer reviewers for their insightful critiques. We invite our readers to engage with these papers critically and constructively as we continue the collective journey towards the achievement of SDGs come 2030.

Prof. Deus D. Ngaruko  
Chief Editor,  
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## **Assessment of Teachers' Awareness and Utilization of Community Resources for Teaching and Learning Biology in Kwara Central, Nigeria**

**Hafsat Imam Alabi<sup>1\*</sup>, Musa Mohammed Sulaiman<sup>1</sup>, Sodiq Adewale Adeoti<sup>1</sup>, Grace Atinuke Aijotan<sup>1</sup>, Moridiyah Omotayo Afolabi<sup>1</sup> and Ramat Babatunde Alikinla<sup>1</sup>**

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### **Abstract**

*One of the problems affecting the effective teaching and learning of biological concepts is lack of mass. This problem could be remediated with the use of resources within students' communities. Hence the need to explore biology teachers' awareness and utilization of community resources in senior secondary schools in Kwara Central, Nigeria adopting the mixed-method approach. The research utilised a survey design for the quantitative aspect, sampling 271 biology teachers through simple random techniques, and thematic analysis of interviews with 42 purposively selected participants for the qualitative aspect. Data collection instruments included a validated structured questionnaire, "Biology Teachers' Awareness and Utilisation of Community Resources (BTAUCR)," and an open-ended interview guide. Quantitative data were analysed using descriptive statistics, t-tests, and ANOVA, while qualitative data underwent thematic analysis with NVivo 12.0. Findings revealed that biology teachers were most aware of accessible community resources like nature centres (56.1%), zoological gardens (57.6%), and professional guest speakers (60.9%), while awareness of specialised resources, such as seed banks (35.1%) and ranches (34.7%), was limited. Utilisation patterns showed frequent use of resources such as professional guest speakers ( $M=2.18$ ) and nature centres ( $M=2.11$ ), while biological libraries ( $M=1.67$ ) were underutilised. The interviews enriched these findings, highlighting diverse challenges and benefits associated with integrating community resources into teaching.*

**Keywords:** *Biology Education, Community Resources, Teaching and Learning.*

## INTRODUCTION

Education is a prominent factor in the social, economic, and manpower development of all nations. Secondary education prepares students for tertiary institutions and trains manpower for technology, applied sciences and commerce at sub-professional grades. Secondary education is the level of education that prepares students for future careers. In pursuance of the realisation of educational goals in Nigeria, all tiers of government should partake in developing reading clubs in schools, community libraries and other resources that can enhance learning (Federal Republic of Nigeria, 2013). This is to say that the establishment and use of educational resources are a collective effort of federal, state, and local governments, especially in Nigeria, where formal education is ever-increasing. The increase in formal education consequently results in inadequate learning and infrastructural resources, as expressed by (nye & Edafe 2020). The inability of government and school proprietors to provide adequate learning and infrastructure resources necessitates the use of community resources to supplement the inadequate ones. Hence, there is a need to utilise the available resources in the community to alleviate the problem associated with teaching biology. This is in light that community involvement in education is a common phenomenon across the globe. Community participation in funding, provision of manpower and material resources, and students' achievement is crucial to students' learning, as well as to the social and economic progress of a nation. In this regard, the effective and efficient biology teaching and learning cannot be separated from the community in which learning takes place. Educational finance has been reported by Ezema et al. (2021) to be at a minimal level in developing countries like Nigeria. Educational funding involves the construction of classrooms and toilets; it can also involve the provision of infrastructure and social amenities such as furniture, portable water, electricity, etc. However, other forms of community intervention could include providing free teaching to schools with inadequate or non-professional teachers (Kitigwa & Onyango, 2023).

Utilising community resources in teaching and learning is another intervention that goes a long way in imbuing in students the appropriate values required for meaningful learning. This is to say that conceptual understanding of scientific concepts depends greatly on the concretisation of teaching and learning processes. One of the ways of concretising classroom activities is by utilising community resources to supplement

teaching and learning tasks. Community resources are human and non-human resources found within the geographical location of the teachers and used to enhance instructional delivery. Odera (2018) defined community resources as common places and experiences located outside the school within the community. Teachmint (2023) described community resources as those resources that could be used to facilitate and enhance the lives of people in a community. They include zoological and botanical gardens, museums, ranches, industries, educational institutions, waterfalls, parks, etc.

Researchers have documented the significant role of these resources in instructional transfer and learners' development. Odera (2018) affirmed the need for countries of the world to incorporate the use of community in their educational system. The author was of the view that the proper implementation of community resources helps in the attainment of economic and technological development. Teachers and students conversant with their environment will assist greatly in solving some community-based problems. This aligned with the assertion of Akpan and Babayemi (2022) that the lack of knowledge of the immediate environment by learners had deprived them of utilising the knowledge on the daily basis.

Persistent use of community resources in teaching and learning has a lot of benefits, some of which are inspiring teachers' and students' experiences, putting reality into students' learning, and providing students with prominent roles of institutions in their community (Teachmint, 2023). Brew (2023) highlighted the significance of community resources in improving learning, and information and as a good source of inspiration and experience to learners. This is to say that utilising community resources cannot be separated from meaningful and experiential learning.

The primary purpose of this study was to identify the community resources Biology teachers are aware of in the Kwara Central region, evaluate the degree to which Biology teachers utilise the community resources in their teaching of Biology, investigate the perceptions of Biology teachers regarding the influence of community resources on students engagement in Biology, and ascertain the challenges encountered by Biology teachers in the successful integration of community resources within their teaching practices.

The following research questions were set to be answered in this study. First, what are the community resources Biology teachers in Kwara Central Senatorial District are aware of? Second, to what degree do Biology teachers utilise community resources in teaching Biology? Third, what perceptions do Biology teachers hold concerning the influence of community resources on students' engagement in Biology? Finally, what are the challenges faced by Biology teachers in the effective utilisation of community resources within their teaching methodologies?

## **LITERATURE REVIEW**

The significance of experiential learning in substantiating textbook information cannot be over emphasised. This is evident from the literature on community participation in education across the world. Teachers and students should be involved in the anticipated positive results. Odera (2018) reported that schools with more community resources appear to perform better than those with fewer resources. Likewise, Kabesa and Okioma (2019) have demonstrated the effectiveness of community learning resources of parks, biological gardens, school grounds, museums, resource persons, models, and dioramas in process skills acquisition. These resources were found to increase students 'process skills acquisition.

Some of the prominent roles expected of 21st-century teachers for the successful use of community resources are those of relationship builders, collaborators, and designers. Effective use of community resources requires that the teacher establish cordial relationships with community members and parents in which the school is situated. This aligned with the assertion of Iyenger (2021) on the need to have project-driven community engagement with problem-based and experiential learning. The teacher is also expected to network with experts, artisans, or heads of places of interest to facilitate communication and the use of their resources. After this, the teacher then designs the activities to suit the needs of the involved students. This is the only way to achieve the desired outcome of using resources within the community. Some instance of teacher use of community resources is discussed as follows.

Atubi (2021) explored teachers' perception and usage of community resources in social studies and civic education in Delta State, Nigeria. The researcher employed the quantitative method to x-ray the extent to which teachers utilised the community resources. The finding reported low

usage of community resources by teachers in the area. It was, however, suggested that teachers should make good use of the resources within the community. In a like manner, Nnamuma and Obikeze (2021) examined the utilisation of community resources in the implementation of environmental adult education. Using descriptive research, the study presented various community resources that could be used to promote environmental health education. One of the paper's recommendations was that community resources are germane to effective teaching and learning.

Brew (2023) assessed teachers' knowledge based on community resources used in appraising social studies concepts. Qualitative research was used to hear their views on the use and impact of community resources on social studies teaching. Evidence from the study was that teachers sparingly use community resources due to insufficient time allocated to teaching the subject, monetary constraints, and the administrative processes involved in seeking permission from the schools. Mensah *et al.* (2023) attributed the nonuse of external resources by Accra teachers to several problems, including over-reliance on textbooks, non-cooperation by parents and other stakeholders, transport fares, and rigid timetables. The researchers recommend using community resources in teaching social studies. Tibane *et al.* (2024) attributed severe lack of resources, over-reliance on out-dated and borrowed materials and heavy burden on teachers to supply resources as some of the key constraints to effective teaching and learning. The researchers recommended integrating technologies in teaching mathematics.

It could be inferred from the reviewed study within and outside the country that researchers agree that the usage of community resources tends to enhance students' learning. However, several factors have been inhibiting its effectiveness, among which are financial constraints, administrative procedures, and over-reliance on textual materials, among others. In contrast to antecedent research, the current investigation employed a mixed-methods framework, thereby facilitating a more nuanced comprehension of biology educators' cognisance and application of community resources. Additionally, it incorporates thematic analysis through the utilisation of NVivo software to elucidate teachers' perceptions and experiences regarding community resources within the Kwara Central Senatorial District.

## **METHODOLOGY**

This investigation employed a mixed-methods framework, amalgamating both quantitative and qualitative methodologies to facilitate a comprehensive exploration of Biology educators' cognisance, application, perceptions of impact, and obstacles concerning community resources in Kwara Central. The quantitative segment adopted a descriptive survey design to procure numerical data regarding educators' recognition, degree of application, and perceptions. Simultaneously, the qualitative segment employed a thematic analysis methodology through comprehensive interviews to investigate the intricate experiences and perspectives of Biology educators regarding the incorporation of community resources into their pedagogical practices. The target demographic for this investigation comprised all Biology educators in senior secondary institutions within Kwara Central. Using the research advisor, a total of 271 Biology educators were selected from the population of 987 for the quantitative survey employing simple random sampling techniques to ensure a representative cohort. For the qualitative interviews, 42 Biology educators were purposefully sampled to yield rich, detailed insights into the phenomena under scrutiny.

For the data collection purpose, two primary tools were developed: The Biology Teachers' Awareness and Utilisation of Community Resources (BTAUCR) Questionnaire and an open-ended interview guide designed by the researcher himself. Section B of the BTAUCR questionnaire focused on the community resources available and their utilisation, which was captured primarily using a Likert scale. The interview guide enabled the researcher to conduct detailed semi-structured interviews and gather rich and detailed responses. Both instruments were considered appropriate for this study because they complement each other in making a detailed submission in both quantitative and qualitative manner. To confirm the accuracy and precision of the research instruments, both face and content validity were established by presenting them to three expert supervisors to obtain their evaluative comments and incorporating their suggested revisions. The researcher then conducted a pilot study with 20 participants who did not constitute the main sample for the study, which further refined the instruments. The questionnaire reliability was calculated using split-half and Cronbach's Alpha methods, producing a coefficient of 0.78, which indicates good internal consistency. For the interview guide, reliability was tested using KR-20, obtaining a coefficient of 0.82, supporting its suitability.

The data collection process was conducted in Kwara Central, strictly adhering to ethical protocols, including obtaining informed consent and ensuring anonymity. Questionnaires were administered directly, allowing sufficient time for completion, whereas interviews were conducted individually, audio-recorded with consent, and transcribed verbatim. Thematic analysis was employed to interpret qualitative data from the interviews with the aid of NVivo, Version 12.0. This structured method involved familiarisation with the data set, developing initial codes, identifying major themes by grouping relevant codes, critically evaluating and refining themes for logical consistency, defining and labelling them precisely, and then synthesising a detailed narrative report on the analysis with relevant excerpts to illustrate the findings. This provided insights into educators' perceptions, highlighting the potential advantages and considerable difficulties in using community resources for teaching Biology.

## **RESULTS**

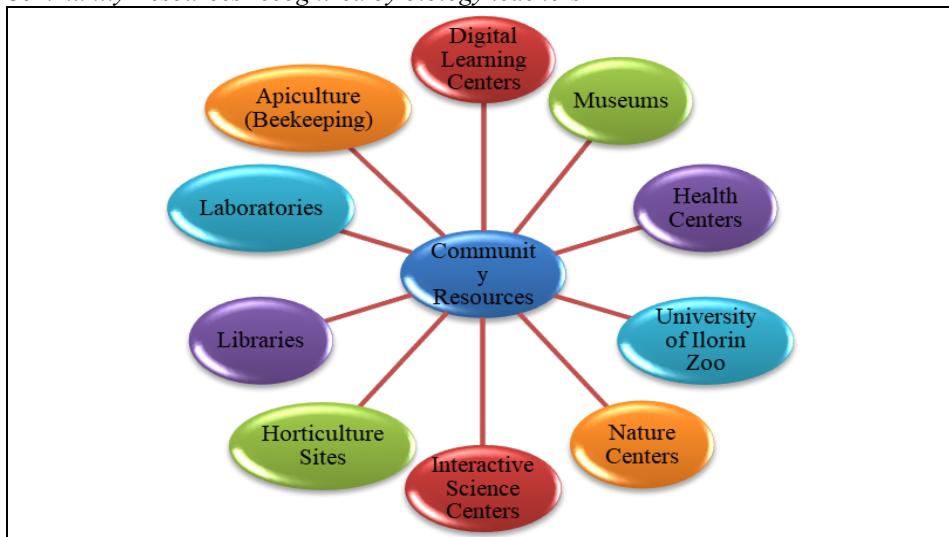
### **Community Resources Recognised by Biology Teachers in Kwara Central**

Table 1 indicates that biology teachers were quite aware of common and accessible community resources like nature centres (56.10%), zoological gardens (57.60%), mountains/rocks/hills (53.10%), and livestock farms (52.40%), likely due to their visibility and relevance to everyday teaching topics. However, awareness was notably lower for specialised resources such as seed banks (35.10%), ranches (34.70%), and biological museums (43.50%), suggesting limited exposure or promotion of these facilities. The high awareness of professional guest speakers (60.90%) underscores the value teachers place on human expertise in enhancing learning. These findings suggest a need for targeted awareness programs and partnerships with specialised institutions to expand teachers' utilisation of diverse community resources for enriching biology education.

**Table 1:***Participants' Response on their Awareness of Community Resources (N=271)*

S/N	Resources	Aware (%)	Not Aware (%)	Decision
				(%)
1	Botanical garden	122 (45.00)	149 (55.00)	Unaware
2	Nature centres, e.g., streams, rivers, etc.	152 (56.10)	119 (43.90)	Quite Aware
3	Zoological garden	156 (57.60)	115 (42.40)	Quite Aware
4	Fish ponds	138 (50.90)	133 (49.10)	Quite Aware
5	Mountains/rocks/hills	144 (53.10)	127 (46.90)	Quite Aware
6	Livestock farm	142 (52.40)	129 (47.60)	Quite Aware
7	Biological institutions (school of forestry/fishery)	129 (47.60)	142 (52.40)	Unaware
8	Biological museums	118 (43.50)	153 (56.50)	Unaware
9	Seed banks	95 (35.10)	176 (64.90)	Unaware
10	Biological library	137 (50.60)	134 (49.40)	Quite Aware
11	Ranches	94 (34.70)	177 (65.30)	Unaware
12	Use of professional guest speakers	165 (60.90)	106 (39.10)	Quite Aware

In addition to the quantitative data, interview insights from 42 biology teachers in Kwara Central, shown in Figure 1, revealed a broad awareness of community resources.

**Figure 1***Community Resources recognized by biology teachers*

Teachers frequently mentioned the University of Ilorin Zoo and interactive science centres as valuable sites, with Participant 11 noting,

“The zoo provides a hands-on experience for students to see and classify animals,” and Participant 7 adding, “Science centres *help students engage with biology beyond the classroom.*” Museums were another widely recognised resource, as Participant 25 explained, “Museums allow students to visualise historical biological artefacts and specimens.” Specialised resources also featured, such as health centres, which Participant No. 2 highlighted for “*practical learning about vaccines and health practices.*” Horticulture sites and apiculture were less common but noted by Participant No. 19, who said, “*Beekeeping and horticulture are unique areas that show students biology in action within agriculture.*” Libraries and laboratories were valued for access to scientific materials and experiments, with Participant No. 4 stating, “*The library provides essential resources for research, and the lab is where students can apply what they learn.*” This diversity of resources reflects the varied approaches teachers use to enrich biology education. The responses, analysed inductively, imply that biology teachers in Kwara centre are aware of digital learning centres, health centres, nature centres, interactive science centres, the University of Ilorin Zoo, museums, horticulture sites, libraries, apiculture (beekeeping), and laboratories.”

### **The Extent to which Biology Teachers Utilize Community Resources in Teaching Biology**

In order to explain the extent of utilisation of the community resources, a mean grade system was utilised with figures between 0.00 – 1.00 being classified as not utilised and 1.01 – 2.00 representing rarely utilised while 2.01 – 3.00 signified that the resources are often utilised. Table 2 summarises the extent to which biology teachers in Kwara State utilise various community resources in their teaching. Resources as the nature centres ( $M=2.11$ ), the zoological garden ( $M=2.04$ ), mountains/rocks/hills ( $M=2.01$ ), and professional guest speakers ( $M=2.18$ ) are “often utilised,” indicating moderate to frequent use. Conversely, fish ponds ( $M=1.99$ ) and livestock farms ( $M=1.97$ ) are categorized as “rarely utilised,” reflecting limited usage. The biological library ( $M=1.67$ ) is among the least used resources, suggesting it is “rarely utilised.” These findings reveal that while accessible resources like nature centres and guest speakers are frequently employed, others, particularly the biological library, are underutilised in biology teaching.

**Table 2**  
*Participant's Response on the Extent of Use of the Available Community Resources (N=271)*

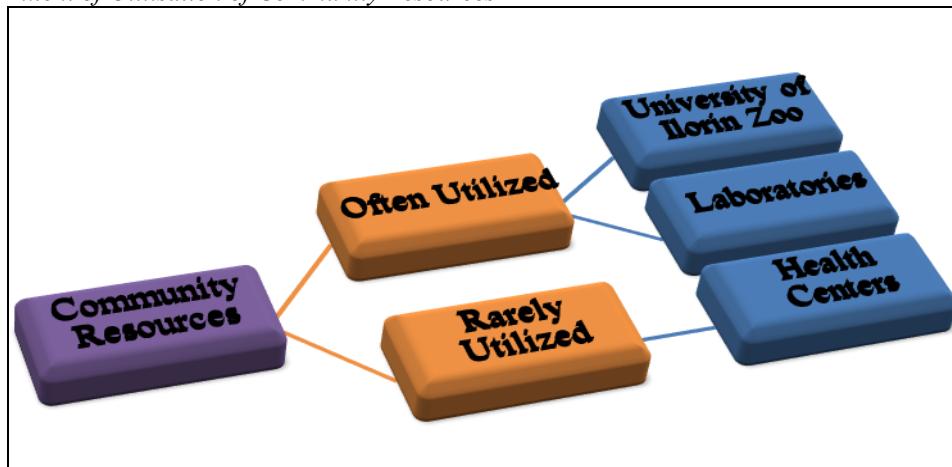
S/N	Resources	Often Utilised	Rarely Utilised	Not Utilised	Mean	Std. Dev.	Decision
2	Nature centres	105 (38.70)	91 (33.60)	75 (27.70)	2.11	0.81	Often Utilised
3	Zoological garden	103 (38.00)	77 (28.40)	91 (33.60)	2.04	0.85	Often Utilised
4	Fish ponds	87 (32.10)	93 (34.30)	91 (33.60)	1.99	0.81	Rarely Utilised
5	Mountain's/rocks/ hills	89 (32.80)	95 (35.10)	87 (32.10)	2.01	0.81	Often Utilised
6	Livestock farm	86 (31.70)	92 (33.90)	93 (34.30)	1.97	0.81	Rarely Utilised
10	Biological library	58 (21.40)	65 (24.00)	148 (54.60)	1.67	0.81	Rarely Utilised
12	Use of professional guest speakers	126 (46.50)	67 (24.70)	78 (28.80)	2.18	0.85	Often Utilised

**Key:** 0.00 - 1.00 = Not Utilised; 1.01 - 2.00 = Rarely Utilised; 2.01 - 3.00 = Often Utilised.

Figure 2 illustrates the extent to which biology teachers utilise community resources in their teaching. The resources are categorised into "rarely utilised" and "often utilised." Among the "rarely utilised" resources, health centres and laboratories are mentioned. Participant 12 occasionally takes students to health centres to learn about vaccines, while Participant 34 uses the school laboratory to explain biology concepts.

**Figure 2**

*Extent of Utilisation of Community Resources*



Despite recognising the value of these resources, their use is not a common practice among most of the participants. In discussing 'rarely utilised' resources, Participant 2 mentions:

*"I occasionally take students to health centres to learn about vaccines, but it's not something we do regularly."*

Moreover, participant No. 24 said:

*"We have a school laboratory which I use to demonstrate biology concepts, though it's not as frequently used as it could be".*

Conversely, the "often utilised" category highlights the University of Ilorin Zoo as a frequently used resource. Some of the teachers mentioned they regularly take students to the zoo to enhance their understanding of biological concepts through real-life observations. For example, with one of the teachers (Teacher No. 27) noting;

*"Visiting the University of Ilorin Zoo is a regular activity in our biology lessons. It provides invaluable real-life examples that textbooks can't match."*

The frequent utilisation of the zoo demonstrates its perceived effectiveness in making biology more interesting and engaging for students. Figure 2 reveals that half of the biology teachers sampled in this study actively utilise community resources in their teaching, with a particular preference for the University of Ilorin Zoo. This finding underscores the importance of accessible and engaging community resources in enriching the biology curriculum.

### **Perceptions of Biology Teachers on the Impact of Community Resources on Students' Engagement**

Figure 3 highlights biology teachers' perceptions of the impact of community resources on student engagement. The teachers identify several key benefits of utilising these resources in their teaching. There is consensus on the positive impact of community resources on student engagement.

**Figure 3**

*Impact of community resources on students' engagement*



The teachers recognise that community resources significantly enhance the learning experience. Enhanced understanding is another major benefit acknowledged by the teachers. The teachers also note that community resources help students connect theoretical concepts to real-life situations, leading to a deeper and more practical understanding of biology. As stated by Participant No. 41:

*"Community resources such as the University of Ilorin Zoo and museums bring biology to life for our students. They see the concepts we teach in class in a real-world context, which makes it easier for them to grasp."*

This connection is believed to make the subject matter more relatable and engaging for students. Improved participation is also highlighted by the teachers, who observe that the prospect of using community resources motivates students to be more actively involved in the learning process. The teachers also mention that community resources stimulate student interest, making the subject of biology more intriguing and exciting. Teachers believe that practical exposure to biological concepts through these resources equips students with better problem-solving abilities. Improved confidence in understanding and applying biology concepts is noted by the teachers, suggesting that community resources help build students' confidence in their academic abilities. The teachers also underscore the role of community resources in fostering stronger school-community relationships, indicating that these resources not only benefit students but also strengthen the bond between schools and their surrounding communities.

Figure 3 shows that biology teachers perceive community resources as highly beneficial for enhancing student engagement, understanding, participation, interest, problem-solving skills, and confidence, while also fostering stronger school-community relationships.

### **Challenges faced by Biology Teachers in Effectively Implementing Community Resources**

Figure 4 outlines the various challenges biology teachers face in effectively implementing community resources in biology learning. The participants' responses highlight several key barriers. Financial constraints are the most frequently mentioned challenge. For example, Teacher 1 stated;

*"Organising field trips to places like museums and the zoo requires funding beyond our school's budget. We often struggle to cover transportation and entry fees."*

These constraints include the costs associated with organising field trips and acquiring the necessary resources for hands-on learning experiences. Limited resources within the community are highlighted by the teachers. This includes a lack of available zoos, museums, and other educational

facilities in the vicinity, making it difficult for teachers to plan visits that would enhance their biology lessons. Teacher No. 34 highlighted:

*"We lack nearby zoos or museums that are adequately equipped for educational visits. This limits our options and opportunities to enhance biology lessons with real-world experiences."*

**Figure 4**

Challenges faced in using community resources



School administration concerns were also mentioned by the teachers. These concerns primarily revolve around obtaining permission for field trips, which often involves lengthy bureaucratic processes and hesitations from the administration due to budget limitations. A large student population poses a logistical challenge for organising effective field trips, as noted by Teacher No. 23. Managing and ensuring the safety of a large number of students on trips to community resources can be particularly daunting and resource-intensive. Security concerns are raised by Teacher No. 17, who mentions past experiences of theft of laboratory equipment. This makes it difficult to fully utilise community resources without worrying about the safety and security of the materials. The scarcity of educational materials is an issue highlighted by Teachers No. 5 and No. 18. The lack of adequate materials and resources within the community facilities themselves can limit the effectiveness of these visits for educational purposes.

Distance to resources is a challenge identified by Teachers No. 25 and 37. The physical location of certain community resources can be far from schools, posing significant logistical and transportation challenges. Community attitude and maintenance are concerns raised by Teachers No. 6, 32, 34, and 40. This includes issues related to the upkeep of community resources and a general lack of understanding within the community about the importance of these facilities for educational purposes. Teachers have noted student apprehension, suggesting that some students may have anxieties or fears about participating in field trips, which can affect their engagement and learning experience. Teacher No. 9 mentioned:

*"Some students are hesitant to participate in field trips due to fears or anxieties, which can impact their engagement and learning experience during these valuable outings."*

Figure 4, therefore, reveals that biology teachers face a myriad of challenges in implementing community resources in their teaching, including financial constraints, limited resources, administrative hurdles, logistical issues with large student populations, security concerns, scarcity of educational materials, distance to resources, community attitudes, and student apprehension. These barriers collectively hinder the effective integration of community resources into the biology curriculum.

## DISCUSSION

The finding that most biology teachers in Ilorin West are aware of a wide array of community resources suggests a high level of awareness and knowledge of potential teaching aids. These resources encompass visiting biological gardens, nature centres, zoological gardens, fish ponds, mountains/hills/rocks, and utilising professional guest speakers. This awareness likely stems from professional development programs and a general increase in access to information through digital means. This finding implies that teachers are in a good position to utilise these resources to enhance teaching. This finding corroborates those of Atubi (2021), who opined that social studies teachers are aware of community resources, as they are essential for effective teaching. In support of this, Olelewa, Nzeadibe, and Nzeadibe (2014) argued that the availability of educational resources makes the school environment conducive to teaching and learning. Akpan (2022) has advocated for the integration of

such resources to promote hands-on and experiential learning, which can foster better understanding and engagement among students.

Among the community resources integrated into biology instruction, botanical gardens, nature centres, zoological gardens, fishponds, mountains/rocks/hills, and professional guest speakers were found to be frequently employed. The frequent use of the University of Ilorin Zoo and laboratories by biology teachers indicates a preference for resources directly relevant to biological studies and likely easier to access. This may be due to a common belief among teachers that these resources provide the most immediate and practical benefits for enhancing students' understanding and engagement in biological concepts (Duban, Aydoğdu & Yüksel, 2019). The rare utilisation of health centres may be due to bureaucratic hurdles or a lack of perceived relevance. This finding implies that while teachers are willing to use community resources, they might be constrained by accessibility and relevance issues. This aligns with the study by Akpan (2022), which found that even when Social Studies and Civic Education teachers in Delta State perceive community resources as essential for effective teaching, their use remains low. Research by Frances et al (2025) emphasised the importance of outdoor learning in promoting multifaceted tasks for enriched learning activities by the students.

Teachers' belief that community resources significantly enhance student engagement, understanding, and other positive educational outcomes highlights the potential of experiential learning. This belief is likely rooted in their observations of increased student interest and participation during field trips and hands-on activities. The implication is that leveraging community resources can lead to more effective teaching and learning experiences. This finding is supported by the work of Duban, Aydoğdu and Yüksel (2019), who reported that students showed higher engagement and understanding when exposed to practical learning environments. Similarly, Brew (2023) found that community resources can help teachers teach more effectively by motivating students, helping them achieve learning objectives, and exposing them to positive role models and real-life situations.

The identification of financial constraints, limited resources, and other challenges as barriers to the effective implementation of community resources reflects systemic issues within the educational infrastructure.

These challenges likely stem from inadequate funding, administrative bottlenecks, and logistical difficulties. The implication is that without addressing these barriers, the potential benefits of community resources remain underutilised. This finding aligns with the study by Atubi (2019), which highlighted financial and administrative challenges as major obstacles to educational innovation in Nigeria. Similarly, there are inadequate time allocated for teaching the subject, financial constraints, bureaucratic processes involved in obtaining permission and the need to meet the requirements of external examinations. Similarly, Brew (2023) noted that challenges associated with utilising community resources include inadequate time allocated for the teaching of the subject, financial constraints, bureaucratic processes involved in obtaining permission and the need to meet the requirements of external examinations.

## **CONCLUSION**

It was concluded based on the findings that while teachers demonstrate broad awareness of diverse resources, including digital learning centres, museums, and horticulture sites, their actual utilisation primarily focuses on the University of Ilorin Zoo and laboratories, with health centres being less frequently employed. Teachers unanimously perceive these resources as pivotal in enhancing student engagement, understanding, and problem-solving skills, while also strengthening school-community relationships. However, the integration of these resources faces significant challenges such as financial constraints, logistical issues, and concerns over student participation and safety. Addressing these challenges could potentially optimise the educational benefits derived from community resources, ensuring a more enriching biology learning experience for students. Hence, it is recommended that initiatives to raise community awareness about the educational benefits of local resources like museums and horticulture sites should be prioritised to garner support and enhance student learning experiences in biology. Also, schools should encourage continuous professional development programs that highlight the benefits of community resource utilisation, aiming to foster an inclusive approach among all educators.

## **Disclosure Statement**

The authors declare that there are no competing financial or non-financial interests that have influenced the research presented in this article. All aspects of the study, including design, data collection, analysis, and interpretation, were conducted independently and without bias.

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## **Examining the Impact of Female-Headed Households on Learning Achievements in Tanzanian Secondary Schools**

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### ***Abstract***

*Families led by women frequently encounter various financial and social challenges. As a result, children in these households often face significant barriers to accessing quality education, particularly at the secondary school level. This study investigates the impact of Female-Headed Households (FHHs) on learning achievements, drawing on gendered household dynamics and child learning theory. The study employed Ordinary Least Squares regression analysis using school GPAs of 1,049 randomly selected schools of mainland Tanzania. The findings indicate that the growing number of female-headed households (FHHs) generally promotes better learning outcomes in secondary schools, especially in rural areas where community involvement and work-life balance are more supportive. The results indicate that educated FHHs play an important role in maintaining academic success in children's education. However, this positive impact diminishes as FHH prevalence increases. Furthermore, the findings suggest that urban FHHs encounter challenges in improving their children's educational progress, emphasising the impact of financial pressures and restricted time for educational engagement. Thus, the findings underscore the need for broader support systems to sustain student achievement across various settings. The study recommends for support networks that empower women economically and socially, implement policies for targeted interventions including community education as well as promoting community engagement and school-parent relationships for strengthening educational outcomes.*

***Keywords:*** *Female-headed households, learning achievements, secondary schools, Tanzania*

### **INTRODUCTION**

In recent decades, there has been an increasing emphasis on understanding the evolving dynamics of family structures and their

impact on various social and economic outcomes (Chakravorty & Goli, 2021; Zellweger et al., 2018). Among the most significant areas of research is the rise of female-headed households (FHHs), a family arrangement that has gained prominence globally due to various factors, including divorce, separation, widowhood, and single motherhood by choice (Saad et al., 2022). This shift in family structure has important implications for society as a whole. FHHs often encounter a unique set of challenges that can hinder their functioning and stability. Financial instability is a predominant issue; many women who head households struggle to secure consistent income and often work in lower-paying jobs, which can lead to economic vulnerability. This financial strain can limit their ability to meet basic needs such as housing, healthcare, and education, including access to secondary schools, ultimately impacting the overall well-being of the household (Almeida, Ghattas & Barros, 2020).

In addition to financial challenges, social marginalisation frequently affects FHHs. These families may face stigma or discrimination, which can further isolate them from community resources and support networks. The lack of social support can exacerbate feelings of stress and anxiety, making it difficult for FHHs to provide a nurturing environment for their children (Goodall & Cook, 2020). Moreover, limited access to resources is another critical challenge. Female heads of households often find themselves without the same opportunities for education and professional development that might be available to their male counterparts. This lack of access not only affects their immediate economic situation but also has long-term repercussions for their children's developmental prospects. Research has shown that children in these families are more likely to experience educational setbacks, as the financial and social barriers can impede their access to quality education, including secondary schools and extracurricular activities (Almeida et al., 2020; Solehudin et al., 2023).

Children's educational achievements from FHHs have emerged as a critical area of concern. Several studies suggest that children in these households may encounter greater barriers to academic success, including limited access to educational resources, lower economic support, and social challenges that influence learning environments (Sharma, 2023). The financial burdens on FHHs often result in fewer resources available for education, further widening gaps in learning outcomes (Heyes et al., 2023; Sharma, 2023). Additionally, the absence of a second parent may

place further responsibilities on the female head, making it difficult to provide both emotional and academic support to children, especially in navigating the demands of secondary schools (Chavda & Nisarga, 2023; Bannawi et al., 2023).

The Tanzanian context displays a multitude of aspects concerning social attributes regarding women and female-headed households in particular. The 2023 gender profile survey of Tanzania documents several attributes regarding the relationship between gender and poverty, the economy, and education. The survey indicates that female-headed households are less likely to own a variety of assets, are bigger and poorer than male-headed counterparts, and fewer women attend or graduate from different levels of education (Ministry of Community Development, Gender, Women, and Special Groups [MoCDGWSG], 2023). This may be attributed to the fact that female-headed households rely on lower-income jobs while also managing childcare and household responsibilities. Similarly, the status may be a result of educational barriers for girls and women due to the persistence of social and cultural norms (see Maro & Omer, 2024). Some of the notable challenges experienced are early marriages, as statistics indicate that by 2021, Tanzania had 19 percent of women aged 15 years and older married before 18 years (National Bureau of Statistics [NBS], 2023). This practice escalates the prevalence of FHHs in Tanzania due to increased chances of divorce. Thus, the socio-economic statuses of the female-headed households are a result of the intergenerational effects experienced at different stages of their social development. Despite the challenges, female parents struggle for improved livelihoods for their families and children in particular. Al-Samarrai and Peasgood (1997) argue that mothers have relatively stronger preferences for their daughters' education. This is evidence that, despite the challenges, FHHs have the potential to support their children's learning.

The relationship between FHHs and learning achievements is complex and influenced by several variables, such as income levels, regional disparities in education systems, and household-specific factors like secondary school size and class size (Chudgar, 2011). Research has shown that socio-economic variables, including GDP, often play a significant role in determining access to quality education, including secondary school (UNESCO, 2020). Regional educational attainment levels, school infrastructure, and class sizes are also crucial determinants of educational outcomes (Olanrewaju et al., 2014). However, the extent to

which these variables affect children in FHHs remains underexplored, particularly in developing regions, such as Tanzania.

This study, therefore, seeks to contribute to this growing body of research by examining the specific impact of FHHs on educational achievements, focusing on key variables such as GDP, regional educational attainment, secondary school size, and class size. By doing so, it aims to provide a deeper understanding of the broader implications of family structure on children's academic performance and identify potential areas for intervention to support FHHs in improving their children's educational achievements.

### **Problem Statement and Significance**

Families led by women frequently encounter a variety of challenges, both financial and social. These challenges include managing household expenses, raising children, and navigating complex social dynamics, such as provoking male behaviour (Habib, 2017). As noted by Almeida et al. (2020), FHHs often face financial constraints, struggling to meet basic household needs, such as electricity, water, and other essentials, leaving little room for investment in developmental activities. Social challenges, particularly related to child-rearing, further intensify these financial burdens. Moreover, children in these households often face significant barriers to accessing quality education, especially at the secondary school level (Solehudin et al., 2023). In many cases, women in these households seek external support from government programs, NGOs, or community networks to secure educational opportunities for their children in secondary schools. These compounded challenges suggest that the educational development of children from FHHs may be at risk. Therefore, this research aims to explore the impact of FHHs on educational achievement by focusing on four key variables: GDP, regional educational attainment, secondary school size, and class size. Specifically, the study will assess the barriers to accessing quality education in secondary schools, experienced by children in FHHs and how these obstacles affect their learning achievements. Additionally, it will evaluate the broader impact of these households on educational achievement by examining the influence of GDP, regional educational attainment, secondary school size, and class size. Understanding these factors will provide valuable insights into the broader implications of FHHs on learning achievements.

This research is significant for its potential to highlight the specific challenges FHHs face and their impact on children's educational achievements in secondary schools (Solehudin et al., 2023). These families often struggle with financial and social burdens that can limit their ability to meet basic needs and support their children's education (Almeida et al., 2020). As children from these households frequently encounter barriers to quality education, including in secondary schools, it is vital to understand the underlying causes of these challenges to inform effective policy and support solutions. By examining variables such as GDP, regional educational attainment, secondary school size, and class size, this study seeks to explore the broader effects of FHHs on educational achievements. The findings will be valuable to both researchers and policymakers, as well as organisations working to improve access to secondary schools for children in such households. Ultimately, this research will provide insights into how targeted interventions can reduce the disadvantages these families face and foster greater educational equity.

## **LITERATURE SURVEY**

### **Female-Headed Households and Educational Challenges**

FHHs face a range of unique socio-economic challenges that impact their children's educational achievements, particularly in secondary schools. Studies show that these households are disproportionately vulnerable to poverty, with limited access to resources critical for children's development (Habib, 2017; Sharma, 2023). Women in FHHs often struggle to balance work, household responsibilities, and child-rearing without the support of a partner, limiting their ability to provide sufficient educational support for their children, especially when it comes to secondary school education (Almeida et al., 2020; Bammeke, 2010). The absence of a second income earner exacerbates these challenges, leaving many families dependent on government welfare or external aid programs for survival (Tamayo & Popova, 2020). Consequently, children in these households may experience higher rates of absenteeism, lower participation in extracurricular activities, and reduced access to academic resources in secondary schools, resulting in poorer educational outcomes compared to children from two-parent households (Solehudin et al., 2023). This notion is supported by Nonoyama-Tarumi's (2017) investigation into the educational achievement of children from single-mother and single-father families in Japan. These challenges emphasise the need to explore various factors, such as GDP, regional educational

attainment, secondary school size, and class size, that influence the educational outcomes of children in FHHs.

### **Gross Domestic Product (GDP) and Learning achievements**

A country's GDP is a critical macroeconomic factor influencing the quality of education available to children, including access to secondary schools. Studies have shown a positive correlation between higher national GDP and improved educational achievements, as wealthier countries tend to invest more in educational infrastructure, teacher training, and technology in schools, including secondary education (UNESCO, 2021; Sezgin et al., 2023; Goczek et al., 2021). However, Sharma (2023), in an assessment focusing on poverty and gender determinants in female- and male-headed households with children in poverty in the USA, concluded that for children in FHHs, economic disadvantages often persist despite national economic growth. Almeida et al. (2020) also note that even in countries experiencing robust GDP growth, FHHs are frequently marginalised and remain financially insecure. This economic disparity suggests that the benefits of national growth may not extend to vulnerable families (Andersson et al., 2021). As a result, children from these households may face difficulties in accessing quality education, particularly in secondary schools, irrespective of broader economic indicators (Bustamante et al., 2021). Therefore, analysing the impact of GDP on learning achievements must consider how socio-economic inequalities within a country exacerbate educational disadvantages for FHHs.

### **Regional Educational Attainment**

Regional differences in educational attainment significantly influence the learning achievements of children from FHHs in secondary schools (Sharma, 2023; Oluwayemisi et al., 2022). In many countries, access to quality education is unevenly distributed across regions, often reflecting local economic conditions. For example, rural or economically underdeveloped areas may lack adequate secondary school infrastructure, qualified teachers, and educational resources (Smith & Watson, 2019). Studies by Solehudin et al. (2023) and Wendt et al. (2021) suggest that these regional disparities disproportionately impact children in FHHs. In areas with lower educational attainment, children from FHHs face compounded disadvantages, as these households often lack the financial and social capital needed to compensate for inadequate public education, especially in secondary schools (Filmer, 2005; Jones et al., 2008). As a

result, children in these regions tend to have lower test scores, higher dropout rates, and reduced academic engagement (Liu & White, 2017; Truña et al., 2018). Therefore, understanding the regional context is crucial for evaluating the educational achievements of children from FHHs.

### **Secondary School Size, Class Size and Educational Achievement**

Secondary school size has been identified as a significant factor influencing learning achievements. Smaller secondary schools often provide more personalised attention and foster closer relationships between students and teachers, creating a positive learning environment (Lee & Ready, 2009). In contrast, larger secondary schools may struggle to offer individualised support, leading to lower academic performance, particularly among students from disadvantaged backgrounds (Gershenson & Langbein, 2015). This notion is supported by Jepsen and Rivkin (2009), who estimated the effect of transitory changes in school size on academic achievement in North Carolina using student-level longitudinal administrative data. For children in FHHs, smaller secondary school environments may provide the additional attention and social support that is often lacking at home due to the overburdened nature of their single parent (Almeida et al., 2020). These children may benefit from smaller secondary schools where their unique needs can be identified and addressed (Iversen & Bonesrønning, 2013; Francis, 2019). However, in areas where larger secondary schools are more common, FHHs may struggle to ensure their children receive the necessary academic and emotional support, contributing to lower educational outcomes.

Conversely, class size is another critical determinant of educational achievement, particularly for students from marginalised households, including those in secondary schools (Connolly & Haeck, 2022). Research shows that smaller class sizes allow teachers to provide more individualised instruction, which is especially beneficial for students with additional academic or socio-emotional needs (Blatchford et al., 2011). This is particularly relevant for children from FHHs, who may require extra support due to the challenges they face at home (Wendt et al., 2021). Solehudin et al. (2023) argue that children in FHHs tend to perform better in smaller class sizes within secondary schools, where teachers can dedicate more time to addressing their learning gaps and providing encouragement. Conversely, overcrowded classrooms in

secondary schools often result in these students receiving less attention, which exacerbates their academic difficulties (Graham, 2023; Likuru & Mwila, 2022). This disparity in class size contributes to the educational achievement gap between children from FHHs and their peers from two-parent households.

### **Interconnected Factors and Educational Equity**

The interplay between GDP (Sezgin et al., 2023; Goczek et al., 2021), regional educational attainment (Solehudin et al., 2023; Wendt et al., 2021), school size (Francis, 2019; Almeida et al., 2020), and class size (Wendt et al., 2021; Connolly & Haeck, 2022) underscores the complexity of addressing the educational inequities faced by children from FHHs, particularly in secondary schools. While national economic growth and regional educational policies provide a broad framework for improving access to education, localised factors such as secondary school and class size play a more immediate role in shaping individual learning experiences (Maneejuk & Yamaka, 2021). Therefore, addressing the educational challenges of children from FHHs requires a multi-faceted approach that considers both macroeconomic and micro-level factors. The existing literature suggests that efforts to improve educational achievements for children in FHHs must focus on both structural interventions, such as increased government investment in education and targeted regional policies, and school-level reforms, including reducing class sizes in secondary schools and providing more individualised student support. By addressing these factors, policymakers can help reduce the educational disparities that disproportionately affect children from FHHs and foster greater equity in learning outcomes.

### **Theoretical Foundations**

This study is guided by the Gendered Household Dynamics and Child Learning Theory, an integrative approach that draws on several established theories in sociology, economics, and education. These foundational theories provide the building blocks that shape key dimensions such as gender, resource allocation, social capital, and resilience. The Social Reproduction Theory (Bourdieu, 1984) and Resource Dilution Theory (Blake, 1981) explain the economic and cultural constraints faced by FHHs, particularly in terms of their children's access to secondary schools. In contrast, Role Model Theory (Folbre, 1994) and Feminist Economics (Folbre, 1994) highlight the social and emotional strengths these households can offer. Meanwhile,

Intersectionality (Crenshaw, 1989) and Ecological Systems Theory (Bronfenbrenner, 1979) emphasise the importance of broader socio-economic and cultural contexts in shaping educational achievements.

In the context of the current study, the gendered household dynamics and child learning theory is shaped by broader economic, social, and educational factors. GDP, regional educational attainment, and school size each influence how FHHs impact children's learning achievements, especially in secondary schools. For instance, in low-GDP countries, FHHs tend to experience greater financial strain, limiting their ability to invest in educational resources for their children. The World Bank (2018) highlights that low-income families in such contexts often lack access to quality schooling and supplementary learning materials, leading to economic disparities that result in poorer learning achievements. This aligns with the gendered resource allocation aspect of the theory, where FHHs may prioritise their children's education but face constraints due to the broader economic conditions. By synthesising these theoretical perspectives, the gendered household dynamics and child learning theory provide a nuanced framework for understanding how gender, economic constraints, social capital, and resilience interact to influence children's academic performance in FHHs, particularly within the context of secondary schools.

## MATERIALS AND METHODS

The study employs a quantitative research approach to elucidate the impact of FHHs on learning achievements in secondary schools in mainland Tanzania. It employs quantitative methods to analyse the causal links between FHHs and learning achievements in secondary schools. As such, it employs quantitative statistical methods to draw inferences on the impact of FHHs on learning achievements.

### ***Research Design***

The study employed a cross-sectional survey design for the 2022 data gathered from several surveys documenting educational information and socio-economic profiles concerning the sampled schools. This predictive study aims to explain the impact of FHHs on learning achievements in secondary schools at the prevailing socio-economic conditions of the regions and districts of mainland Tanzania. The study considered the moderating effect of educational attainments of FHHs in urban and rural Tanzania to shed light on the contextual attributes affecting learning achievements, given female parenthood.

### ***Sampling Procedures***

The study used multilevel sampling procedures to obtain the sample of schools from regions and districts of mainland Tanzania. Thus, simple random sampling aided to obtain the sampled schools for the analysis. The study employed Lynch's formula to estimate the sample size of schools to be included in the analysis. According to Allibang (2020), Lynch's formula uses probability estimates to compute the sample size of the population parameters, enabling researchers to select the units of the analysis randomly. Thus, the authors obtained the sampled schools following Lynch's formula;

$$n = \frac{NZ^2 * p(1 - p)}{Nd^2 + Z^2 p(1 - p)} \quad [4]$$

Where n = Sample size, N = Population size, Z = Values of the standard variables (1.96) for the reliability level of 0.95, and d = Sampling error. Given the total number of government secondary schools (N = 4,578), Z = 1.96, p = 0.5 and d = 0.0248, the total sample size of the study becomes 1,158. The authors eliminated the sorted boarding schools as students from the same come from different regions. In that case, the authors used a web-based random number generator published by Urbaniak and Plous (2024) linked to Oxford University's website to obtain random numbers for the sample. A database of secondary schools from the Presidents' Office, Regional Administration and Local Government (PO-RALG) on students' enrolments in secondary schools in Tanzania for the year 2023 helped to obtain a sample of schools to be included in the analysis. However, the nine random numbers sorted boarding schools, which could mislead the interpretation of the results, as students from the same region come from different regions. The authors eliminated such schools; hence, the final sample comprised 1,149-day secondary schools.

### ***Data Sources and Measurements***

This paper uses secondary data from various national surveys and National Examination Council of Tanzania (NECTA) to estimate the results. The study comprises secondary school GPAs, FHH socio-demographic data, regional developments in terms of GDPs at market prices, as well as school-specific characteristics as depicted in Table 1.

#### ***Secondary School GPAs***

Tanzania uses standardised test scores in national assessments as a measure of students' learning achievement. National assessments are

administered by the National Examination Council of Tanzania (NECTA), which is also mandated to publish the results of test scores of all secondary schools in the country. The test score results of individual students yield the school GPA, which ranges from 1.00, the highest score for the best-performing schools, to 5.00 for the least performing secondary schools. This study adapts the results published by NECTA's 2023 school year as the dependent variable of the study. NECTA arranges GPA scores in a descending order, as high-performing schools are assigned the lowest score and vice versa. To easily interpret the findings, the authors reverse the scores so that high-performing schools are assigned high scores. Therefore, the authors used the inverse function to calibrate school GPAs using the following formula;

$$SGPA_{srt} = GPA_{srt}^{-1} \quad [3]$$

Where,  $SGPA_{srt}$  is the final secondary school GPA for the estimate,  $GPA_{srt}$  represents secondary school grade point average score in CSEE for school  $i$  in region  $r$  in year  $t$ . Reversing NECTA's calibrated GPAs transforms the data into percentages which reflect the performance of secondary schools in national assessments in a respective school year.

#### *FHH socio-demographic data*

This paper employs FHHs' data as independent variables. The FHHs' parameters considered significant for this study include the percentage prevalence of FHHs in a district and the percentage of FHHs that attained at least secondary education in the region. The sources of the data are mainly from the National Bureau of Statistics (NBS) of Tanzania, organised from different surveys such as National Economic Surveys (NES) conducted by the Ministry of Finance, the Population and Housing Census (PHC), and the Tanzania Demographic and Health Surveys (TDHS) conducted by the Ministry of Health. This study uses FHHs data from the PHC (2022), NES (2023), and TDHS (2022) as they are the up-to-date information currently used as indicators for social, economic, and demographic profiles of the country. The authors hypothesised that the higher the prevalence of FHHs across regions, the lower the achievements of schools in the region. This is because learning achievements in national assessments are partly affected by socio-economic challenges facing the community, including students from FHHs.

#### *Economic Statuses of Regions*

The study employs the regional GDP and Gini coefficients (wealth index)

as one of the control variables influencing learning achievements. These measures are considered plausible as the economic conditions of households of different income groups, including FHHs of respective regions, influence their spending on services, including the education sector. This study employs regional GDPs as a share of the National GDP (NGDP) as an index for the economic performance of the region. It is worth noting that individual household spending is partly constrained by consumer prices and inflation rates of goods and services; hence, changes in such variables may contribute to changes in learning success. The Gini coefficient, on the other hand, measures the distribution of wealth in the population across regions. The study considered this proxy significant as it informs the household's ability to support the learning needs of learners. The assumption is that the higher the disparity in a household's ownership of wealth, the less support there is for individuals' educational achievement. The socio-economic data is published by NBS and the Bank of Tanzania (BoT) from NES, PHC and National Accounts Surveys (NAS). This paper uses the NAS (2022) and NES (2022) statistics on regional GDPs and wealth index published by NBS, which are the updated statistics on GDPs.

#### *Secondary school's specific characteristics*

The paper uses secondary school size and class size as control variables influencing learning achievement. In this case, the authors used the number of students enrolled in a school in 2023 and those who sat for the national assessments in the same year to compute the school size. Computation of school and class size based on the Government's circular No.1 of 2007 concerning the sizes of such parameters (See MoEC, 2007). The circular categorises schools into small-sized (160 students or fewer), equivalent to 4 streams, medium-sized (161 to 320 students), making a maximum of 8 streams, and large-sized (321 to 1,280 students), with a maximum of 32 streams. Therefore, this study employs the number of streams in a school following a ratio of students enrolled in the school and those registered by NACTE to the threshold size of 40 students, which is officially recognised as the number of students in a stream at ordinary secondary education. The study also includes the number of teachers in the district to account for learning quality, given the amount of teacher support in facilitating student learning. The school surveys are documented by the Ministry of the President's Office, Regional Administration, and Local Governments, and are also published by NBS.

**Table 1**  
*Descriptive Statistics of the Variables*

Variables	Proxy and unit of measurement	Source of data	Mean	SD
School GPAs (DV)	GPA scores	NECTA's 2023	26.45	2.92
FHH socio-demographic data (IVs)	Percentage of FHHs across districts	MoFP, National Bureau of Statistics (NBS).	36.11	4.10
	Secondary educational attainment of FHHs	MoFP, National Bureau of Statistics (NBS).	9.04	4.74
Economic statuses of regions (CVs)	Regional GDPs as a share of the National GDP	MoFP, NBS, Bank of Tanzania (BoT)	4.15	3.04
	Average income distribution in the region (Wealth Index)	MoFP, NBS, Bank of Tanzania (BoT)	38.55	8.70
School-specific characteristics (CVs)	School size (Streams) as per Education Circular No.1 of 2007	NECTA and PO-RALG (2023)	17.28	11.27
	Class size (Streams) as per Education Circular No.1 of 2007.	NECTA and PO-RALG (2023)	3.11	2.26
	Average number of Teachers in a school	PO-RALG (2023)	16.66	10.12
Total (N)			1,149	

**Note:** GPAs = Grade Point Averages, GDP = Gross Domestic Product, FHHs = Female-Headed Households, NECTA = National Examination Council of Tanzania, MoFP = Ministry of Finance and Planning, PO-RALG = President's Office, Regional Administration and Local Government, NBS = National Bureau of Statistics, BoT = Bank of Tanzania. SD = Standard Deviation, DV = Dependent Variable, IVs = Independent Variables, CVs = Control Variables,

**Source:** Author's construction, 2024

### **Data Analysis**

This study aims to examine the causal influence of FHHs on learning achievement in secondary schools in Tanzania. The aim is to infer whether increases in FHHs' prevalence impact students' success in secondary education. Thus, the study employed Ordinary Least Squares (OLS) regression analysis to generate the results. Therefore, the following empirical strategies guided the analysis of the findings.

$$GPA_{srd} = \alpha + \beta FH_{dr} + \gamma X_r + \delta Z_{sd} + \varepsilon_{dr} \quad [1]$$

$$LR_{dri} = \alpha + \beta X_r + \gamma Z_{sd} + \delta [FH_{dr} \cdot U_{dr}] + \varepsilon_{dr} \quad [2]$$

Where,  $GPA_{srd}$  is the national assessment GPA for school  $s$  in region  $r$  in district  $d$ ;  $FH_{dr}$  represents percentage of female-headed households in district  $d$  in region  $r$ ;  $X_r$  is region  $r$  socio-economic status;  $Z_{sd}$  are school  $s$

specific characteristics in district  $d$ ;  $FH_{dr} \cdot U_{dr}$  is the interaction between the percentage of FHHs and and Urbanity to account for the heterogeneity effect or rurality and urbanity;  $\varepsilon_{rt}$  is an idiosyncratic error term,  $\beta$ ,  $\gamma$ , and  $\delta$  are coefficients,  $\square$  and  $\alpha$  is the overall intercept.

### **Robustness Checks**

The study used robust OLS to account for issues related to the adoption of cross-sectional data. Consideration of this model is based on both intuition and quantitative assessment methods for model fitting of educational data, as suggested in Theobald (2018) and Rockwood and Hayes (2022). Thus, the authors performed several robustness checks, including homoscedasticity, to account for the variability of the dependent variable as well as linearity, multicollinearity, and normality tests.

## **RESULTS AND DISCUSSION OF FINDINGS**

### **The impact of FHHs on learning achievement**

The study examined the impact of FHHs on learning achievement in Tanzanian secondary education, using the GPAs of 1,149 schools obtained from the results of students who sat for the CSEE in the 2023 academic year. The authors examined whether the prevalence of FHHs across 26 mainland Tanzanian regions affects learning achievement (Table 2).

**Table 2**  
*The Impact of FHH on Learning Achievement*

Variables	1	2
Female-Headed Households (FHH)	0.069** (0.0203) CI[0.03-0.11]	0.068** (0.0213) CI[0.03-0.11]
FHH x Urbanisation	0.050 (0.0709) CI[-0.09-0.18]	
Urbanisation (Baseline)	-2.218 (2.703) CI[-7.52-3.08]	
N	1,149	1,149
R <sup>2</sup>	0.05	0.05
F-Statistics	8.02**(df = 6, 1142)	8.02**(df = 6, 1142)
RMSE	2.86	2.86

Note: N = Number of observations, FHHs = Female-Headed Households, R<sup>2</sup> = R-squared, CI = Confidence Interval, df = degrees of freedom, RMSE = Root Mean Square Error. Robust standard errors are reported in parentheses

\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

The increasing prevalence of FHHs influences learning achievements in secondary education. As shown in Table 2 (column 1), an increase in FHH prevalence raises school GPAs by 0.07 points. These results suggest that the presence of FHHs does not negatively impact students' learning, implying that FHHs successfully sustain students' education despite facing challenges such as a lack of support from a second parent. These findings align with Bammeke (2010). Interestingly, this result is somewhat unexpected, as one might anticipate a decline in learning achievement due to the challenges typically caused by single parenthood (Heyes et al., 2023; Sharma, 2023). However, this relationship may be driven by the economic stability of FHHs, as women's participation in productive sectors in Tanzania has been increasing in recent years. This trend is common among both married and unmarried women, who engage in productive activities to boost their family's income. The effects of FHHs' prevalence are particularly notable between 34 and 36 per cent, as shown in Figure 1a. Beyond this threshold, further increases in FHHs' prevalence may become detrimental to students' learning achievements. This is likely due to the greater number of children affected by issues associated with single parenthood, such as absenteeism and limited access to educational resources (Nonoyama-Tarumi, 2017; Solehudin et al., 2023). While the findings indicate a positive influence of FHH prevalence on learning achievements, they also highlight the potential risks of higher FHH rates. Despite initial gains in learning, higher levels of FHHs' prevalence introduce uncertainties regarding effective learning, as students from these household's face challenges that can hinder their educational progress.

The impact of FHHs on learning achievements differs between the rural and urban areas. As indicated in Table 2 (column 2), an increase in FHHs prevalence has ambiguous effects on learning achievements of urban schools, even though the results show that school GPAs rose at similar rates in both rural and urban schools, as depicted by the slopes in Figure 1a. In contrast, the results demonstrate a positive impact of FHHs on learning achievements in rural schools, where a higher prevalence of FHHs increases GPAs by 0.07 points. These findings are consistent with Chudgar's (2011) assertion that regional development disparities account for differences in the impact of FHHs on learning achievements. It is important to note that the time mothers spend on family responsibilities is critical to children's development in all aspects of life. The rural-urban differences in the caregiving roles of women in Tanzania partly explain

the impacts observed in this study. In rural areas, where women's participation in agriculture and small businesses has grown, they can balance their work with family responsibilities, including taking care of their children. However, in urban areas, women are more often involved in business-oriented production activities, which limit their time for childcare. Additionally, FHHs in urban areas are often affected by low-income statuses, and the higher costs of education further limit their ability to adequately support their children (Almeida et al., 2020; Sharma, 2023). In this context, the effects of FHHs are shaped by local factors that constrain their ability to support their children's schooling. The study finds that the impact of FHHs' prevalence, both in urban and rural areas, is most pronounced when prevalence rates are between 36 and 38 per cent (Figure 1c). Therefore, the findings suggest that FHHs' prevalence should not exceed this threshold in either rural or urban areas, as doing so may result in more detrimental effects on learning achievements.

***The impact of FHHs' educational attainment on learning achievement***  
 The analysis considered the secondary education attainment index of the FHHs as a factor to account for learning achievements. The authors hypothesised that the higher the attainment index of the FHHs, the greater the impact on students' learning achievement. Furthermore, the study accounted for urbanisation heterogeneity to determine whether contextual attributes moderate the effects of FHHs on learning achievements (Table 3).

**Table 3**  
*The Effect of FHHs' Educational Attainment on Learning Achievement*

Variables	1	2
Educational Attainment of FHHs	0.077** (0.033) CI[0.01-0.14]	0.074** (0.0329) CI[0.01-0.14]
Educational Attainment of FHHs x Urbanisation		0.064 (0.059) CI[-0.05-0.18]
Urbanisation (Baseline)		-0.770 (0.467) CI[-1.69-0.15]
N	1,149	1,149
R2	0.05	0.05
F-Statistic	8.02**(df = 6, 1142)	8.02** (df = 8, 1140)
RMSE	2.86	2.86

Note: N = Number of observations, FHHs = Female-Headed Households, R2 = R-squared, CI = Confidence Interval, df = degrees of freedom, RMSE = Root Mean Square Error. Robust standard errors are reported in parentheses  
\* p<0.10, \*\* p<0.05, \*\*\* p<0.01

Table 3 presents the results on the impact of FHHs' secondary education attainment on learning achievements in Tanzanian schools. The results show that a rise in the prevalence of FHHs with at least secondary education leads to an increase in school GPAs by 0.08 points. The results are consistent with Bammeke (2010), suggesting that females' formal education influences the learning outcomes of secondary school students. This implies that educated mothers are likely to prioritise the education of their children even in the absence of the second parent. According to Becker et al. (2013), educated mothers tend to have stronger preferences for the education of their children, hence, support for their learning in schools. Mothers play a role in supporting their children's education through maintenance costs, including transportation, study materials, and school uniforms, which enhances learning achievement in schools.

The moderating effect of urbanisation on the impact of FHHs is improbable, but positive effects are evident in rural schools. As indicated in Table 3 (column 2), the prevalence of FHHs in the rural areas increases school GPAs by 0.07 per cent. The improbability of the effect of FHHs on learning achievement in urban schools may result from several factors, including lack of engagement in their children's schooling, partly due to prioritising financial stability to meet household needs, as also suggested by Almeida et al. (2020). This may be possible in the Tanzanian context, particularly for FHHs, where women's engagement in both family responsibilities and economic activities aimed at boosting household income may reduce their ability to support their children's education. The positive effects of educational attainment of the FHHs in rural areas are attributed to active participation of parents and communities in schools discussing their children's schooling with schools (European Commission, 2023). However, the moderating role of rural schools in the effect of FHHs' secondary education attainment on learning achievement appears plausible at prevalence rates below 32 per cent and becomes unlikely above this threshold (Figure 1d). Therefore, increasing FHHs with secondary education poses a threat to higher learning achievements in secondary schools both in urban and rural areas, partly due to the lack of financial and social capital for their education, as also noted by

Solehudin et al. (2023) and Wendt et al. (2021). Therefore, the educational attainment of FHHs exerts diverse influences on learning outcomes, particularly when considering the contextual disparities between urban and rural schools. This suggests that additional social stability mechanisms may be required. Support for dual-parent households could prove vital, as the increasing prevalence of FHHs may jeopardise students' academic achievements regardless of parental education.

## **CONCLUSION**

Increases in FHH prevalence contribute to improved GPAs, particularly in rural areas. However, the positive impact of FHHs on learning achievements is most substantial when prevalence rates are minimal. The rural-urban disparities matter in the impact of FHHs on influencing learning achievements in secondary schools, with the rural areas being more advantageous than the urban areas. This is partly due to factors related to differences in caregiving roles, economic opportunities, and the cost of living that affect a mother's ability to support their children's education. The study emphasises that women, especially FHHs, are taking on a greater role in productive sectors, which has likely helped FHHs maintain or even improve students' academic performance, particularly in rural areas. Educated female heads of households significantly support student outcomes by prioritising and investing in education, especially in rural areas where community involvement and work-life balance foster a supportive environment. Urban-educated FHHs face greater challenges due to economic pressures, time limitations, and higher living costs, which hinder their children's support for education. The increase in the number of FHHs is significant for improved learning achievements, but could be offset by reduced financial and social support resources. Factors like community engagement, resources, and living costs influence educational results. Parental education is valuable but requires broader support systems to sustain its positive impact, particularly in disadvantaged areas.

## **RECOMMENDATIONS**

Maintaining the positive effects of FHHs on learning outcomes, particularly in rural areas, requires support networks that empower women both economically and socially. Policies should expand access to income opportunities, childcare, and education programmes for FHHs. Urban areas need targeted interventions such as community education to

address the challenges of parental involvement due to economic pressures. Promoting community engagement and school-parent partnerships can strengthen educational outcomes. FHHs should be matched with sufficient financial and social support to prevent adverse effects on student achievement in both rural and urban areas.

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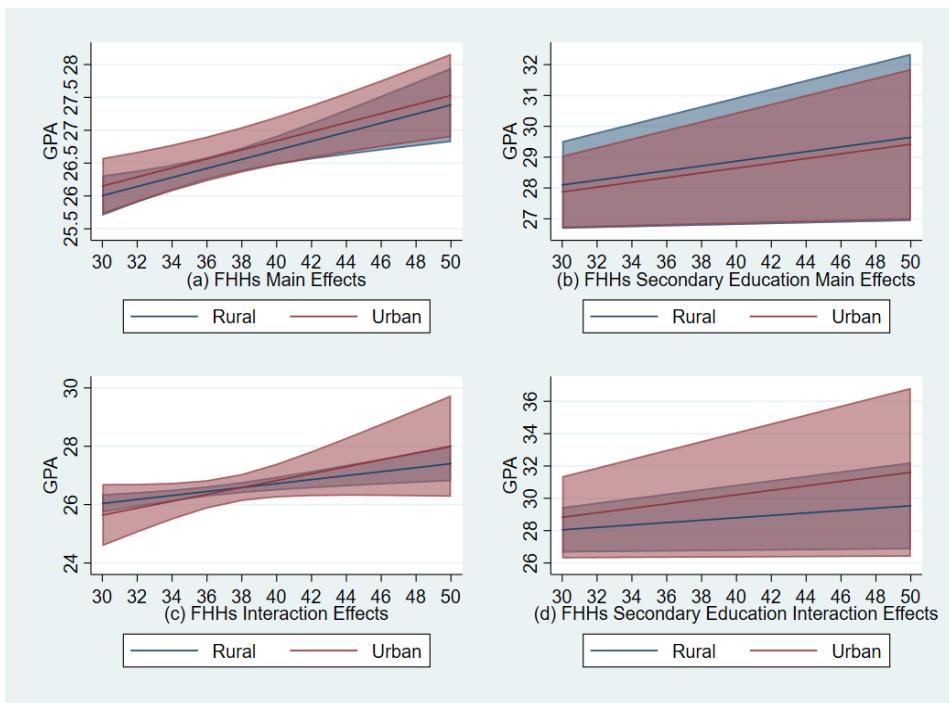
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## Appendix I: Main and Interaction Effects of FHH and SEAFHs on learning achievement

**Figure 1:**

*Main and Interaction Effects of FHH and SEAFHs on learning achievement*



**Note:** FHH = Female Headed Households, Predictive Margins with 95% Confidence Interval

## **Endurance and Change: The Historical Trajectory of Agricultural Marketing Cooperatives Under Four Decades of Economic Reforms in Tanzania (1984 – 2024)**

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### **Abstract**

*This study critically examines the long-term development trajectory of Agricultural Marketing Cooperative Societies (AMCOS) in Tanzania across four decades of economic reforms (1984–2024). Although several studies have documented discrete phases of cooperative change, there remains a limited longitudinal, integrated analysis that systematically traces patterns of endurance, adaptation, and institutional transformation over extended reform periods. The study was motivated by persistent policy uncertainty on whether economic reforms have strengthened or undermined the sustainability of AMCOS, and what lessons can be drawn to inform contemporary cooperative policy and practice. Using a systematic documentary review of policy frameworks, academic literature, and institutional reports, the study analyses AMCOS performance across four reform phases: Structural Adjustment Programmes of the 1980s; market liberalisation and cooperative autonomy in the 1990s; renewed cooperative reforms in the early 2000s; and contemporary reforms of the 2010s–2020s. The findings reveal a cyclical pattern of institutional weakening and renewal. The SAPs period reduced state support and weakened organisational capacity; liberalisation enhanced autonomy but exposed governance and financial management deficiencies; early 2000s reforms improved performance through renewed state support, but reinforced dependency risks; and recent reforms introduced digital governance innovations and expanded market access but revealed persistent regulatory and digital adoption gaps. The study contributes new knowledge by providing a consolidated longitudinal framework that connects policy shifts with institutional responses and organisational outcomes of AMCOS over time. It offers evidence-based insights for designing balanced cooperative policies that combine institutional autonomy, governance strengthening, sustainable financing, and digital transformation to enhance the long-term resilience of agricultural cooperatives in Tanzania.*

**Keywords:** *Endurance and Change, Agricultural Marketing Cooperatives, four decades of economic reforms, Tanzania.*

## INTRODUCTION

The history of cooperatives in Tanzania dates back to 1932 with the founding of the Kilimanjaro Native Planters' Association (KNPA), marking the inception of organised agricultural groups within the nation. The primary objective of the KNPA was to bolster farmers' bargaining power within the coffee industry, facilitating collective negotiations for more favourable prices and improved livelihoods for local farmers (Seimu, 2015). This cooperative movement gradually expanded, culminating in the enactment of the Cooperative Societies Ordinance in 1932, which established the legal framework for cooperative activities during the colonial period of Tanganyika. Following independence in 1961, the government endorsed the role of cooperatives as a means for rural development and economic self-sufficiency, encouraging their proliferation across various sectors including agriculture, finance, and marketing (Mruma, 2014). Nevertheless, by the late 1970s, Tanzanian cooperatives encountered significant challenges such as bureaucratic impediments and constrained financial resources, which compromised their operational efficacy and necessitated reforms (Maghimbi, 2010).

In response to the economic crisis of the late 1970s and early 1980s, Tanzania implemented Structural Adjustment Programs (SAPs) as part of conditional loans provided by the International Monetary Fund (IMF) and the World Bank. These reforms concentrated on liberalising the economy, decreasing government expenditure, and fostering private-sector-led growth. With regard to cooperatives, the SAPs stipulated reduced government support and deregulation, thereby compelling cooperatives to operate independently in a competitive market (Lofchie, 2014).

Although these reforms aimed to enhance the efficiency and sustainability of cooperatives, their outcomes have been mixed. For some AMCOS, reforms facilitated expanded market access, improved operational independence, and empowered members by strengthening their bargaining power (Puttermann, 1995). Conversely, many AMCOS encountered significant obstacles, including financial instability, governance challenges, and limited capacity to compete effectively within a liberalised market environment (Birchall & Simon, 2010; Maghimbi,

2010). Accordingly, there is a need to comprehensively analyse the full spectrum of AMCOS experiences throughout the reform period, including both successes and ongoing challenges. This research endeavours to fill this gap by exploring how AMCOS have adapted, thrived, or struggled under Tanzania's economic reforms, thereby providing a holistic understanding of their trajectory.

The principal aim of this study is to evaluate the development of AMCOS in Tanzania over a span of four decades (1984 to 2024) of economic reform. Specifically, this investigation seeks to identify the key successes of AMCOS in adapting to policy shifts and market dynamics, examine the challenges of sustaining operations and supporting members amid these reforms, and derive lessons from the cooperative sector's experiences that may inform future policy formulation and cooperative development. By analysing these aspects, the study aims to offer a comprehensive perspective on how AMCOS have navigated the intricate economic landscape over the past four decades.

The following research questions guided this study:

- i) What successes has AMCOS experienced over four decades of economic reforms in Tanzania?
- ii) What challenges and failures have AMCOS encountered during the four decades of economic reforms?
- iii) What lessons can be learned regarding AMCOS development in four decades of economic reforms that inform future cooperative policies and practices?

This study makes an original contribution by moving beyond fragmented historical accounts to provide a systematic, longitudinal synthesis of how Agricultural Marketing Cooperative Societies (AMCOS) in Tanzania have responded to four distinct waves of economic and institutional reforms between 1984 and 2024. Unlike earlier studies that examine isolated reform periods or single organisational challenges, this research integrates evidence across multiple decades to identify patterns of institutional endurance, cycles of decline and renewal, and the cumulative effects of policy shifts on cooperative sustainability. The study generates new knowledge by developing an integrated reform–response framework that links specific policy reforms to organisational adaptations,

governance changes, and performance outcomes within AMCOS. Through this approach, it reveals previously underexplored dynamics, including how repeated policy reversals shaped dependency, how digital reforms reconfigured accountability structures, and how institutional pressures influenced cooperative legitimacy over time. Practically, the findings provide evidence-based guidance for policymakers, cooperative regulators, and development practitioners by identifying which policy mixes have strengthened cooperative resilience and which have unintentionally weakened institutional capacity. The study, therefore, offers a transferable analytical model that can inform the design of more balanced, sustainable cooperative policies not only in Tanzania but also in comparable Sub-Saharan African contexts.

## **LITERATURE REVIEW**

Institutional Theory guided this study. It originated in the social sciences and has become a foundational framework for examining organisations and their behaviour within specific contexts (DiMaggio & Powell, 1983). Rooted in the work of early sociologists like Max Weber, who examined bureaucracy and the role of institutions in structuring societies, the theory evolved with contributions from Meyer and Rowan (1977), who introduced the concept of institutional isomorphism. This concept explains how organisations within similar environments often adopt comparable structures and practices to gain legitimacy. Institutional Theory has grown over the decades, particularly in fields such as sociology, organisational studies, and political science, as it provides a lens for understanding how external environments, norms, and pressures shape organisational structures and behaviours (Berthod, 2016).

In examining the development of AMCOS in Tanzania, the theory is particularly relevant as it helps explain how these cooperatives have responded to changing economic policies and external pressures over the past four decades. The theory offers insights into how AMCOS adapted to SAPs and subsequent policy reforms aimed at liberalising the agricultural sector (Berthod, 2016). The theory can shed light on how AMCOS conformed to new regulations and market norms, attempting to gain legitimacy and support in a competitive environment. By applying this framework, the study can analyse both the successes and challenges AMCOS experienced, considering not only its economic strategies but also its responses to institutional pressures and policy shifts in Tanzania.

Empirical studies on agricultural cooperatives, particularly in Tanzania's context, have highlighted a range of outcomes regarding the development and performance of AMCOS. Studies, such as those by Maghimbi (2010) and Cooksey (2003), examine the impact of economic liberalisation policies on cooperatives, noting mixed outcomes in terms of organisational sustainability and effectiveness. Maghimbi (2010) found that liberalisation efforts enabled AMCOS to access broader markets, thereby improving their financial performance in some cases. However, the same studies indicate that market liberalisation also introduced competitive pressures that many cooperatives struggled to manage, leading to operational challenges and, in some cases, dissolution.

Further research by Birchall & Simmon (2010) explores how SAPs transformed the cooperative landscape, with many cooperatives experiencing financial strain due to the reduced state support they had previously relied on. Their study indicates that while some AMCOS managed to adapt to the new policies through diversification and improved management practices, others faced considerable challenges, including reduced access to credit and limited capacity to compete in a liberalised economy. Similarly, Mruma (2014) highlights that AMCOS' resilience to market fluctuations and policy changes varied widely depending on internal governance, leadership, and member commitment, suggesting that these factors played a crucial role in determining cooperative success or failure.

In the context of cooperative effectiveness and governance, some studies (Kweka et al., 2024; Msuya, 2024; Anania et al., 2020) provide insights into the internal challenges faced by AMCOS, including leadership issues, transparency problems, and member disengagement. Their findings underscore the need for AMCOS to strengthen internal governance mechanisms to enhance resilience and maintain member trust. This study complements Chambo's (1991) findings on the role of government regulations in shaping cooperative practices, showing that while regulatory oversight can help ensure compliance and accountability, excessive control can limit cooperative autonomy and adaptability.

Despite a substantial body of literature on agricultural cooperatives and economic reforms in Tanzania, existing studies remain fragmented,

period-specific, and largely descriptive. Most prior research, including that by Msuya (2024), Mruma (2014), Birchall & Simmon (2010), Maghimbiri (2010), and Sizya (2001), focused on isolated reform phases, such as the immediate effects of Structural Adjustment Programmes, market liberalisation, or governance challenges within specific cooperatives. While these studies have generated valuable insights, they have not systematically traced how AMCOS have evolved across multiple, sequential waves of reforms as an interconnected historical and institutional process. Moreover, these studies tend to document events rather than analyse patterns of institutional endurance, adaptive capacity, and cumulative organisational transformation over time. Little attention has been paid to how repeated policy reversals, shifts in state–market relations, and changing regulatory regimes have jointly shaped the long-term sustainability trajectories of AMCOS. As a result, there is limited empirical understanding of why some AMCOS have demonstrated resilience while others have stagnated, collapsed, or become dependent on external support across different reform periods.

This study addresses this gap by developing a longitudinal, reform-linked analytical framework that connects specific policy reforms with organisational responses and outcomes of AMCOS between 1984 and 2024. Rather than reproducing historical narratives, it synthesises evidence from policy documents, institutional reports, and academic studies to identify recurrent patterns of success, failure, and adaptation. The study introduces a cumulative reform–response model that demonstrates how institutional pressures under successive reforms reshaped governance structures, market strategies, and organisational legitimacy within AMCOS. By doing so, the study contributes new knowledge in three key ways: first, it provides a structured, comparative understanding of AMCOS performance across four decades rather than within isolated timeframes; second, it empirically links policy shifts to organisational behaviour using an institutional theory lens; and third, it generates transferable lessons that can inform the design of more balanced cooperative policy frameworks in Tanzania and similar Sub-Saharan African contexts.

## **METHODOLOGY**

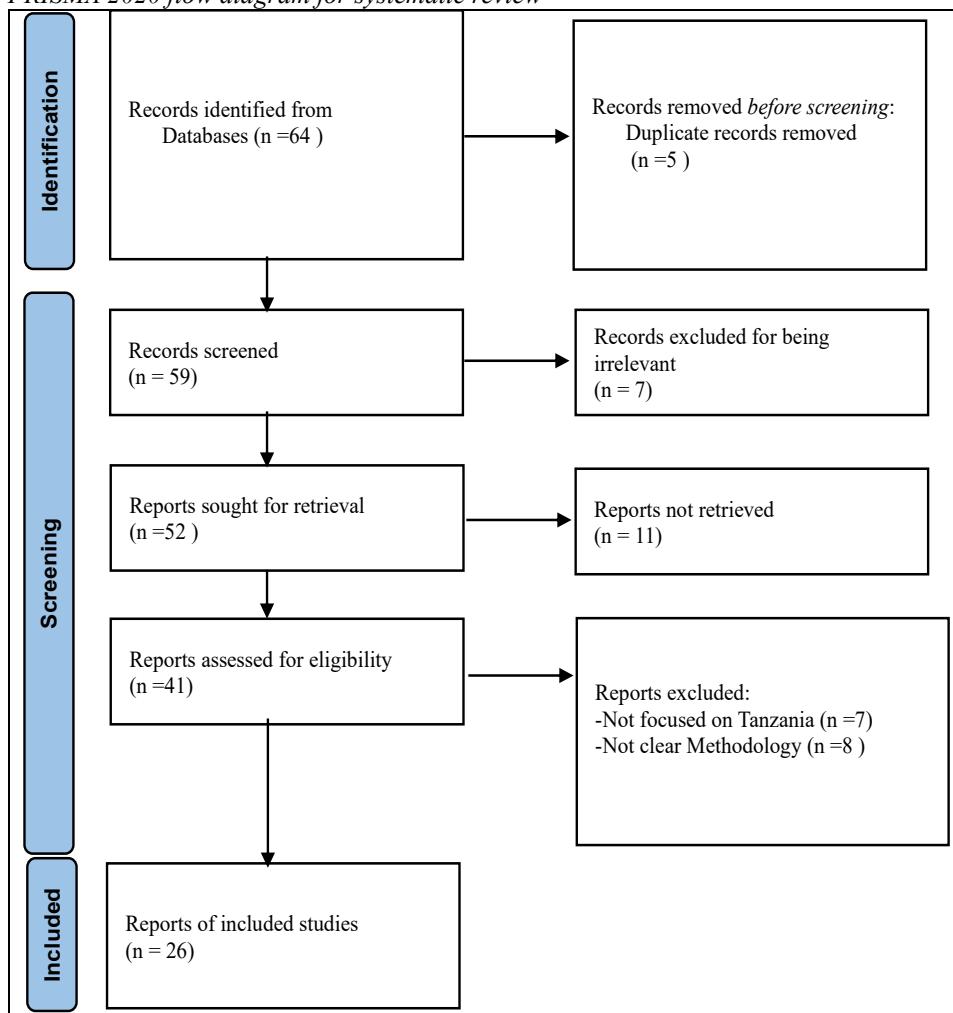
The Systematic Literature Review (SLR) method was used to analyse the successes, failures, and lessons learned in the development of AMCOS

over four decades of economic reforms in Tanzania. A systematic literature review is a rigorous approach that involves clearly defined processes for locating, evaluating, and synthesising existing research on a particular topic. By applying this methodology, the study aims to identify, evaluate, and synthesise findings from a wide range of sources, providing a comprehensive understanding of the factors influencing AMCOS development from 1984 to 2024.

The SLR process used in this study included steps for defining the review scope, selecting relevant studies, assessing the quality of the sources, and synthesising the results. A comprehensive search strategy was employed to identify relevant studies, using a combination of keywords and Boolean operators. Primary search terms included “Agricultural Marketing Cooperatives,” “economic reforms in Tanzania,” “AMCOS development,” “cooperative successes,” “cooperative challenges,” and “Tanzania.” Boolean operators such as “AND” and “OR” were used to refine searches further. The search spanned multiple academic databases, including Emerald, Moshi Cooperative Repository, Tanzania Cooperative Development Commission Website, Google Scholar, AJOL, Taylor & Francis Online, and ScienceDirect, ensuring a robust collection of relevant articles and reports from scholarly journals, government publications, and reputable organisational reports. Search strings were continuously refined to ensure relevance and focus on AMCOS development under Tanzania’s economic reforms.

The inclusion and exclusion criteria were applied to narrow down the initial 64 documents to a final set of 26 articles and reports that were both highly relevant and methodologically sound. The inclusion criteria were established to ensure that selected studies provided relevant insights into AMCOS development within the context of economic reforms. Criteria included: studies published from 1984 to 2024 to capture four decades of reforms; those focused on Tanzania to maintain contextual relevance; and peer-reviewed journal articles, government reports, and credible organisational studies.

**Figure 1**  
 PRISMA 2020 flow diagram for systematic review



Exclusion criteria included studies focusing on non-Tanzanian cooperatives, publications outside the specified time frame, and studies lacking a clear focus on agricultural cooperatives. These criteria helped to filter out irrelevant or low-quality sources and maintain the review's coherence. To evaluate the quality of the selected studies, each article was assessed based on methodological rigour, clarity of findings, relevance to the research questions, and credibility of the sources. Studies were included based on their alignment with the review's objectives, ensuring that the final pool of literature comprised high-quality, reliable sources.

A structured data extraction form was used to gather relevant information from each selected study. Extracted data included study objectives, methods, main findings, limitations, and conclusions regarding AMCOS' successes, challenges, and lessons learned. The extracted data were then organised into thematic categories aligned with the research questions. The synthesis process followed a thematic analysis approach, wherein common themes and patterns were identified and grouped into categories such as "success factors," "challenges," and "lessons learned".

The analysis synthesised findings from the 26 selected studies, with themes including "success factors," "challenges," and "lessons learned," offering a structured comparison of study findings. The thematic categorisation enhanced understanding of the successes and constraints AMCOS faced over the period, addressing both convergent and divergent findings in the literature.

## **FINDINGS AND DISCUSSION**

The study findings are organised in four categories: SAPs and AMCOS in the 1980s; liberalisation and cooperative autonomy in the 1990s; renewed cooperative reforms in the early 2000s; and contemporary reforms (2010s-2020s). Successes, challenges, and lessons learned are presented in each category.

### **SAPs and AMCOS Development in the 1980s**

This section examines the successes, challenges, and lessons derived from the experiences of AMCOS during the implementation of Structural Adjustment Programmes (SAPs) in Tanzania in the 1980s. The findings are drawn from a systematic analysis of policy documents, government reports, and peer-reviewed studies identified through the systematic literature review process.

#### ***Successes of AMCOS in the 1980s***

The study revealed that, despite the disruptions caused by SAPs, some cooperatives successfully facilitated farmers' access to local and regional markets, thereby sustaining agricultural livelihoods. Cooperatives in cash crop sectors such as coffee and cotton continued to provide essential market linkages, although their resources were significantly constrained (Maghimbhi, 2010). The removal of cooperatives' monopoly in agricultural

marketing further opened the sector to private traders, creating opportunities for smallholder farmers to sell their produce to buyers offering competitive prices. This market diversification enabled farmers to benefit from better pricing mechanisms and fostered a more dynamic agricultural market (Sizya, 2001).

### ***Challenges faced by AMCOS in the 1980s***

The removal of subsidies under SAPs deprived cooperatives of essential funding, severely affecting their ability to procure critical inputs such as fertilisers and seeds. This loss of support significantly reduced agricultural productivity and placed cooperatives in a precarious financial position (Birchall & Simmon, 2010).

Liberalisation policies introduced under SAPs encouraged private sector entry, forcing AMCOS to compete with financially robust private traders. These traders, who offered faster payments to farmers, captured significant market share, leading to a decline in membership among many cooperatives (Sumelius et al., 2013). Furthermore, the elimination of subsidies and fixed pricing structures increased AMCOS's operating expenses, rendering many cooperatives financially unsustainable and leading to closures across the sector (Maghimbiri, 2010).

The shift to self-governance exposed weaknesses in management, as reduced external oversight led to widespread mismanagement in some cooperatives. Deficiencies in record-keeping and financial administration eroded member trust, undermining cooperative functionality (Birchall, 2003). Concurrently, state-controlled marketing systems persisted, demoralising small-scale farmers who perceived that cooperatives were still under significant state influence, limiting their autonomy and growth potential (Chambo, 2016).

Farmers also faced significant knowledge gaps, lacking access to market information, education, and entrepreneurial training. Although limited training was provided to board members, most farmers remained confined to subsistence farming without exposure to innovative practices or modern market dynamics (Hyden, 1980).

Political interference further exacerbated governance issues. The 1985 CCM directive automatically enrolled all party members into

cooperatives regardless of their commitment or contributions. This approach undermined governance by diluting member ownership and accountability (Chambo, 1991). These challenges collectively illustrate the difficulties AMCOS faced during the SAP era and highlight the need for balanced policies and capacity-building initiatives to ensure cooperative sustainability.

### ***Lessons Learned from AMCOS' Successes and Challenges in the 1980s***

AMCOS's experience during the 1980s underscores the vital importance of establishing resilient market linkages. Despite a decline in government support under SAPs, certain cooperatives succeeded in facilitating access to local and regional markets, thereby exemplifying the value of diversified and adaptive market strategies. This highlights the necessity for cooperatives to invest in enhancing their capacity to secure and maintain market access amidst fluctuating economic conditions. The role of cooperatives as community support networks during periods of crisis demonstrates the significance of fostering strong local collaborations. By pooling resources, cooperatives mitigated the effects of subsidy withdrawal, enabling agricultural production to persist in many regions. This indicates that strengthening cooperative structures as safety nets can be crucial during economic transitions.

Nonetheless, governance and financial mismanagement emerged as notable challenges, particularly as external oversight diminished. The inability of some cooperatives to adapt to self-governance underscores the imperative to equip cooperative leaders with skills in financial management and accountability. Implementing structured training programs and establishing robust governance frameworks are essential for ensuring the sustainability of cooperatives and maintaining member trust.

An additional lesson pertains to the critical importance of access to information. The deficiency of market and price data limited farmers' capacity to make informed decisions, rendering them susceptible to exploitation. This underscores the need for cooperatives to develop systems that provide timely and accurate market intelligence to their members. Furthermore, while autonomy enables cooperatives to operate independently, it must be complemented by capacity-building initiatives for leaders and members to enhance competitiveness and operational efficiency.

The period also revealed the delicate balance required between government support and cooperative independence. While excessive state control hindered innovation and decision-making, a complete withdrawal of support rendered cooperatives vulnerable to market shocks. A balanced approach combining strategic government assistance with policies that promote self-reliance is vital for the development of cooperatives.

Finally, political interference, such as the automatic enrollment of CCM members into cooperatives, weakened member commitment and undermined governance integrity. This highlights the importance of maintaining political neutrality to foster a sense of ownership and accountability among members. Future reforms should delineate clear boundaries between cooperative governance and political agendas to enhance operational independence and sustainability.

### **Liberalisation and Cooperative Autonomy in the 1990s**

Additionally, the study examined the successes, challenges, and lessons learned from AMCOS experiences in the 1990s. The results are based on a thorough analysis of policy documents, government reports, and peer-reviewed studies identified through a systematic literature review.

#### *Successes of AMCOS in the 1990s*

The study delineated several notable successes attained by AMCOS throughout the 1990s, underscoring their adaptability and expansion amidst a period of economic transition. A principal achievement was the augmentation of decision-making autonomy conferred upon cooperatives as a consequence of diminished government intervention. This autonomy empowered cooperatives to independently establish pricing, marketing strategies, and membership policies, thereby facilitating better alignment with market dynamics and enhancing member engagement (Sizya, 2001).

Another salient accomplishment was the enhancement of access to export markets. With increased independence, certain cooperatives commenced negotiations directly with international buyers, particularly within sectors such as coffee and tea. This direct access enabled cooperatives to secure competitive prices, subsequently elevating member incomes and augmenting their overall economic influence (Maghimbiri, 2010).

The period also witnessed successful innovation in cooperative management practices. Some AMCOS adopted alternative governance models inspired by private- sector managerial practices, which improved operational efficiency and fostered trust among members. These innovations contributed to increased productivity and the sustained viability of the cooperatives (Chambo, 2016).

Furthermore, the legislative and policy framework supporting cooperatives was substantially reinforced during the 1990 s. The enactment of the Cooperative Societies Act Number 15 of 1991 and the Cooperative Development Policy of 1997 reemphasised the principle of voluntary membership, representing a pivotal step in empowering cooperatives as autonomous, member- driven organisations (Chambo, 2016).

The study additionally documented significant growth within the cooperative movement during this era. The number of cooperative unions rose from 27 in 1990 to 45 in 1994, concomitant with the registration of four crop- based apex organisations. Other non- crop agricultural cooperatives, such as those operating within fisheries and livestock sectors, were also established. Moreover, the Tanzania Federation of Cooperatives (TFC) was officially registered as an umbrella organisation, to which the crop- based apex bodies, the Savings and Credit Cooperative Union League of Tanzania (SCCULT), and the Tanzania Industrial Cooperative Union (TICU) were affiliated (Sizya, 2001).

### ***Challenges faced by AMCOS in the 1990s***

The study identified challenges encountered by AMCOS during the 1990s, emphasising the difficulties of operating within a liberalised economic environment. A principal issue was the inadequacy of management skills among cooperative members. With diminished oversight from the state, many AMCOS lacked the capacity to manage finances and operations independently. Poor financial management practices, coupled with instances of embezzlement, eroded member confidence and compromised the sustainability of these cooperatives (Anania et al., 2020). Leadership and governance issues also emerged as significant impediments. The newfound autonomy often precipitated internal conflicts among members and leadership disputes within cooperatives. These challenges were exacerbated by the absence of well-

defined governance structures, resulting in operational inefficiencies and further disruptions to cooperative activities (Kweka et al., 2024).

The limited regulatory oversight permitted under the liberalized framework facilitated the proliferation of corruption in certain cooperatives, thereby diminishing transparency and eroding trust. The lack of comprehensive mechanisms for accountability and supervision rendered AMCOS vulnerable to malpractice and governance failures. Additionally, many cooperatives faced difficulties in adjusting to the demands of liberalised markets due to inadequate marketing expertise and weak leadership capacities. The persistent reliance on government support continued to hinder their ability to operate competitively (Mruma, 2014). Furthermore, the liberalised environment resulted in substantial structural and operational setbacks. Competition from private traders and firms led to the demise of many crop-based apex organisations and cooperative unions, with some ginneries in the Lake Zone ceasing operations entirely (Chambo, 1991). By 1994, the number of primary agricultural marketing societies had declined from 8,978 in 1990 to 4,316. Cooperatives experienced a significant loss of market share, with the Kilimanjaro Native Cooperative Union (KNCU) losing approximately 20% of its coffee purchases to private traders by the 1996/97 crop season (Sizya, 2001).

Economic pressures further exacerbated these challenges. The failure of cooperatives to provide price incentives, alongside rising costs of agricultural inputs, demoralised members and led to decreased participation. Farmers in regions such as Kilimanjaro shifted from traditional cash crops, like coffee, to alternative crops such as beans and tomatoes, due to declining prices (Omari, 1993). Moreover, government-imposed debts totalling 44 billion Tanzanian shillings were ultimately forgiven, reflecting the severe financial difficulties faced by cooperatives during this period (Birchang & Simmon, 2010). The reintroduction of government control through the 1991 Cooperative Act further impeded cooperative independence. This legislation reinstated significant decision-making authority to the Registrar of Cooperatives, undermining the autonomy previously granted to AMCOS. Political patronage and state intervention contributed to demoralising members, negatively influencing their attitudes towards cooperative participation and governance (Maghimbiri, 2010).

## ***Lessons Learned from the Successes and Challenges of AMCOS in the 1990s***

The successes and challenges experienced by AMCOS in Tanzania during the 1990s provide valuable insights for cooperative development. Primarily, the significance of establishing strong management capacity is apparent. The transition toward greater autonomy revealed that many cooperatives lacked essential management skills, especially in financial oversight and operational governance. The resultant mismanagement, including cases of embezzlement, highlights the importance of continuous investment in managerial training and the implementation of effective financial control mechanisms to ensure long- term viability.

An additional crucial lesson pertains to the necessity of clear and effective governance structures. Although autonomy permitted certain cooperatives to better respond to market demands, it also precipitated internal conflicts and leadership disputes due to the absence of well- defined governance frameworks. The importance of transparent decision- making processes and the role of strong leadership in mitigating internal disagreements became evident, emphasising the need for cooperatives to adopt well- designed governance models to maintain operational stability and foster member trust.

The experience of AMCOS further illustrates the importance of maintaining a balanced approach between autonomy and regulatory oversight. While increased independence has facilitated innovation and access to new markets, it has also exposed vulnerabilities such as corruption and a lack of accountability. This underscores the imperative of establishing a regulatory framework that ensures cooperatives remain accountable without compromising their autonomy. Appropriate oversight is essential to prevent resource misuse and to uphold the cooperative' s commitments to its members.

Finally, the challenges faced by AMCOS in adapting to a liberalized market environment underscore the importance of developing marketing and business competencies necessary for effective competition. Cooperatives are advised to invest in market training, financial literacy, and business development initiatives to sustain competitiveness and meet the ongoing needs of smallholder farmers. These lessons demonstrate that achieving enduring cooperative success requires a combination of strong

management, transparent governance, regulatory support, and adaptability to dynamic market conditions.

### **Renewed Cooperative Reforms in the Early 2000s**

Furthermore, the study examined the successes, challenges, and lessons learned from AMCOS experiences in the early 2000s. The findings are derived from a comprehensive review of policy documents, government reports, and peer-reviewed research identified through a systematic literature review.

### **Successes of AMCOS in the Early 2000s**

The renewed cooperative reforms in Tanzania during the early 2000s marked a significant period of success for AMCOS. One of the key achievements during this time was increased government support, which helped enhance cooperatives' internal management capacity. Training programmes introduced as part of the reforms enabled AMCOS to add value, which in turn improved their bargaining power and contributed to increased profits. These programmes helped cooperatives diversify their operations, particularly through value-added activities such as coffee and cashew processing (Maghimbhi, 2010).

Furthermore, the reforms improved AMCOS' financial access by providing provisions for cooperative financial support. This access to credit allowed cooperatives to invest in value addition and expand their operations. Studies have shown that this credit access enabled significant investment in processing activities, particularly in key agricultural sectors such as coffee and cashews, thereby improving the economic viability of cooperatives and enhancing their ability to support farmers (Birchall & Simmon, 2010). The government concurrently promoted an increase in cooperative membership during this period. Through augmented financial assistance and improved access to markets, farmers recognised the tangible advantages of cooperative support, thereby leading to a rise in membership. This growth in membership subsequently contributed to the strengthening of AMCOS, empowering them to serve the agricultural community more effectively (Sizya, 2001).

In accordance with these initiatives, the development of the Cooperative Policy in 2002 and the subsequent enactment of the Cooperative Societies Act of 2003 established a foundation for a more organised and

economically sustainable cooperative sector. The policy was aligned with the 1995 ICA Statement of Cooperative Identity and Principles, highlighting the necessity for financial sustainability and economic viability within cooperatives. Notably, the 2003 Act introduced a code of conduct dedicated to upholding the integrity of cooperative leadership and the qualifications of executive personnel, thereby ensuring that cooperatives operated with enhanced accountability. Furthermore, the establishment of the Cooperative Reform and Modernization Program (CRMP) between 2005 and 2015 provided additional momentum to the development of the cooperative sector, delivering supplementary support to reinforce cooperative practices across diverse sectors (Maghimbiri, 2010).

### ***Challenges faced by AMCOS in the Early 2000s***

The study identified several key challenges encountered by AMCOS in Tanzania during the early 2000s. One principal challenge was their persistent reliance on government subsidies, which obstructed the development of self-sufficiency within the cooperatives. Despite renewed governmental support, many AMCOS continued to face difficulties in operating profitably without such subsidies, thereby restricting their ability to attain financial independence and sustainability (Chambo, 2016).

Another significant challenge highlighted in the study was the sluggish rate of adoption of modern technologies among AMCOS. Numerous cooperatives were hesitant to integrate contemporary production and management technologies, which hampered their capacity to compete effectively with private traders who had adopted digital tools and technological innovations. This reluctance to embrace technological advancements contributed to operational inefficiencies, further disadvantaging AMCOS in a liberalised market environment (Anania et al., 2020).

The research also revealed disparities in support across various agricultural sectors, with some cooperatives, particularly those engaged in cash crop cultivation, receiving more substantial benefits from the reforms than those in non-cash crop sectors. This resulted in inequalities in cooperative development, leaving certain agricultural subsectors

underdeveloped and struggling to derive benefits from the reforms (Mruma, 2014).

Furthermore, the financial stability of numerous cooperatives was found to be precarious, as evidenced by their considerable debt loads. By 2001, AMCOS in mainland Tanzania was recorded to owe a total of TZS 17. 8 billion to financial institutions. Despite governmental initiatives aimed at supporting cooperatives, a prevailing perception among cooperative specialists was that the government continued to exert control over cooperatives, thereby diminishing their autonomy and hindering their capacity for optimal growth (Maghimbiri, 2010).

### ***Lesson Learned in the Early 2000s***

The study highlights several key lessons from the successes and challenges of AMCOS in the early 2000s. Firstly, it emphasises the importance of balancing external support with self-sufficiency. While government aid helped AMCOS improve their internal management and expand operations, it also created dependency. The main lesson is that, although financial aid and capacity-building are vital, cooperatives must develop sustainable, self-reliant business models to succeed in the long run. Secondly, adopting technology proved to be essential for competitiveness. AMCOS that were slow to adopt technological advancements faced operational inefficiencies and struggled to compete with private sector counterparts. This underscores the need for targeted investment in digital tools and technical training as crucial parts of cooperative development, ensuring that cooperatives remain relevant in a rapidly changing market. Moreover, the study shows that sector-specific support should be a priority.

The uneven distribution of reform benefits across agricultural sectors resulted in disparities among cooperatives, especially between cash crop and non-cash crop sectors. This stresses the necessity for tailored support that recognises the unique needs and potential of different agricultural subsectors, fostering balanced growth and development. Lastly, the issues of high debt levels and government control highlight the need for improved financial management and greater autonomy. AMCOS should focus on financial stability and independence, decreasing reliance on external funding and adopting sound financial practices to secure their

sustainability. Additionally, a clearer regulatory framework is needed to promote cooperative autonomy while ensuring accountability.

### **Contemporary Reforms (2010s – 2020s)**

Finally, the study determined the successes, challenges, and lessons learned from AMCOS experiences in the early 2000s. The findings were derived from a comprehensive review of policy documents, government reports, and peer-reviewed research identified through a systematic literature review.

#### ***Successes of AMCOS in the 2010s to 2020s***

A notable achievement from the study is the digital transformation of AMCOS. Implementing digital platforms like the Electronic Management Information System for Cooperative Societies, MUVU (*Mfumo wa kielektroniki wa Usimamizi wa Vyama vya Ushirika*), greatly enhanced financial transparency and operational efficiency in cooperatives. These tools allowed for more precise financial tracking and reporting, reducing mismanagement risks and boosting accountability. Beyond streamlining daily activities, digital adoption also increased trust among members by offering real-time access to financial data (TCDC, 2023).

The study further determined that sustainability initiatives contributed significantly to the growth of AMCOS during this period. Through participation in sustainability programs such as fair trade and organic certification, cooperatives were able to access niche markets characterised by higher profit margins. These initiatives facilitated an increase in the revenue of participating AMCOS and enhanced their visibility within both local and international markets. The integration of sustainable practices into cooperative operations proved to be a strategic approach for ensuring long-term financial viability (Kweka et al., 2024).

An additional notable accomplishment of this period was the policy support for market access. The reforms implemented by the government established opportunities for AMCOS to penetrate both local and international markets, thereby directly benefiting cooperative members. Evidence suggests that this improved market access resulted in increased incomes for members and higher agricultural productivity, as AMCOS were able to negotiate better prices and broaden their market reach (Rwekaza & Anania, 2021; Mruma, 2014).

Furthermore, the Cooperative Act of 2013 and the subsequent Cooperative Regulations of 2015 played a crucial role in shaping the cooperative landscape. These reforms facilitated the establishment of member-based cooperatives and enabled the creation of integrated cooperatives and joint enterprises. This legal framework also supported the revitalisation of cooperative industries, particularly in the Lake Zone, where cooperative activities had previously been dormant. The reforms underscored member empowerment through training and capacity-building initiatives, ensuring that cooperatives could operate effectively within a modernised economy (TCDC, 2024; TCDC, 2023; URT, 2015; URT, 2014).

### ***Challenges of AMCOS in the 2010s to 2020s***

The study delineates various critical challenges encountered by AMCOS during the period from 2010 to 2020, which impeded their capacity to fully capitalise on reforms and technological progress. A predominant challenge identified was the digital divide. Despite the deployment of digital solutions such as MUVU, numerous rural cooperatives continue to confront infrastructural and connectivity deficiencies that constrain their ability to utilise these technologies effectively. Research underscores that limited digital access in rural regions hampers the scalability of digital platforms, thereby preventing some cooperatives from fully realising the operational efficiencies and financial transparency afforded by such technologies (Anania et al., 2020).

Additionally, the deregistration of more than 300 inactive AMCOS has been a growing concern, with some cooperatives being removed from the official register. This deregistration undermines the legitimacy and operational capacity of affected cooperatives, leaving them vulnerable to reduced support and resources (TCDC, 2024). Finally, the continued weakness of primary societies, particularly the lack of strong foundational cooperative structures, has made it difficult for many AMCOS to function effectively and achieve sustainable growth (CRMP, 2005).

### ***Lessons Learned in the 2010s to 2020s***

The successes and challenges encountered by AMCOS during the period from the 2010s to the 2020s offer several significant lessons for their future development. One principal lesson identified is the critical importance of bridging the digital divide. The implementation of digital

platforms such as MUVU has demonstrated improvements in operational efficiency and financial transparency within AMCOS. Nevertheless, persistent challenges related to limited digital access in rural areas emphasise the necessity for targeted infrastructure investments. It is essential that all cooperatives, especially those in remote regions, gain access to reliable internet and digital tools to ensure the scalability and sustainability of technological solutions. This situation underscores the need for both government and private sector initiatives to address the digital disparity and foster inclusive technological adoption.

Another lesson is the necessity of diversified access to finance. While some cooperatives have benefited from access to credit, many still struggle to secure financing due to a lack of collateral. This situation points to the need for more innovative financing mechanisms, such as government-backed loans or cooperative-specific financial products that do not rely solely on traditional collateral. Encouraging financial institutions to develop tailored credit products for cooperatives could significantly enhance their ability to invest in growth and innovation.

Finally, the fortification of primary societies emerges as a crucial lesson. Fragile organisational frameworks continue to compromise the sustainability and effectiveness of numerous AMCOS. It is imperative to allocate resources towards capacity-building initiatives for grassroots cooperative structures to ensure sustainable development. Providing training in cooperative management, leadership, and governance at the primary society level will empower cooperatives to become more resilient and autonomous, thereby enhancing their capacity to address local and global market challenges.

## **CONCLUSION AND RECOMMENDATIONS**

This study provides a thorough analysis of the successes, challenges, and lessons learned from the development of AMCOS in Tanzania over four decades of economic reforms. It highlights the crucial role that AMCOS have played in supporting agricultural livelihoods, improving market access, and fostering rural economic stability, despite various obstacles. The successes recorded across each period, from the 1980s to the 2020s, show how AMCOS have adapted to changing policy environments, technological advancements, and market conditions. However, these successes have often been hindered by issues such as inadequate

management skills, dependence on government support, regulatory uncertainties, and limited access to financial resources.

The study emphasises the importance of ongoing policy support, capacity building, and infrastructure development to ensure AMCOS's sustainability. The findings indicate that for AMCOS to succeed in a competitive, globalised marketplace, it must adopt technological innovations, strengthen its internal governance structures, and expand its financial access. Furthermore, a stable regulatory framework and increased investment in rural infrastructure are essential for overcoming obstacles related to digital transformation and credit accessibility.

Based on the findings of this study, several key recommendations are proposed to enhance the effectiveness and sustainability of AMCOS in Tanzania. Firstly, capacity building and management training are crucial for the continued growth of AMCOS. Leadership and membership training programmes should concentrate on improving governance, financial management, and operational efficiency. These programmes should highlight modern cooperative management techniques, financial literacy, and the use of digital tools to support better decision-making and operational transparency. A well-trained leadership team can help AMCOS to make informed decisions and prevent financial mismanagement, which has been a challenge in the past.

Secondly, improving access to credit and financial resources is essential for the development of AMCOS. Many cooperatives face difficulties in securing loans due to a lack of collateral, which limits their ability to invest in growth opportunities. To tackle this, the government and financial institutions should collaborate to develop financial products tailored to the specific needs of cooperatives, such as low-interest loans or grants for infrastructure development, value addition, and expanding markets. This would help strengthen the financial viability of AMCOS and enable them to compete more effectively in both local and international markets.

Thirdly, it is essential to strengthen infrastructure for digital transformation. Although some AMCOS have adopted digital solutions such as MUVU, many rural cooperatives still encounter infrastructural and connectivity issues. To close this digital gap, efforts should focus on

improving internet connectivity, offering digital literacy training, and subsidising access to digital tools. By enabling AMCOS to use digital platforms for financial management, market access, and member administration, cooperatives can boost their operational efficiency and transparency, ultimately lowering the risks of mismanagement.

Furthermore, maintaining a consistent and transparent regulatory framework is vital for the stability of AMCOS. The government should establish and uphold policies that provide clear guidance on the formation, operation, and governance of cooperatives. This regulatory consistency will help cooperatives address challenges posed by a liberalised market and protect their interests as they enter global markets. Clear policy frameworks will also foster an environment of trust, transparency, and accountability within the cooperative sector.

Another recommendation is to promote diversification and market access. AMCOS should be encouraged to diversify their activities and products, especially in non-crop sectors such as livestock and fisheries. The government can play a key role in supporting this diversification by facilitating access to both local and international markets through trade facilitation programmes, market information platforms, and participation in international certification schemes such as fair trade and organic certifications. In this way, cooperatives can enhance their market visibility, increase revenue, and improve member incomes.

Furthermore, fostering public-private partnerships can provide essential support to AMCOS. Collaborations between the government, private sector, and development partners could help strengthen the cooperative movement. These partnerships might concentrate on joint ventures, value chain development, and providing technical support and resources that cooperatives need to succeed. Public-private partnerships can also create platforms for AMCOS to access market information and financial resources.

Finally, it is crucial to carry out regular monitoring and evaluation of cooperative performance. A comprehensive framework should be established to measure progress and identify challenges faced by AMCOS. Periodic assessments will help pinpoint areas in need of improvement and ensure policies and interventions effectively support the

cooperative sector. By systematically monitoring performance, the government and stakeholders can make informed, data-driven decisions to revise policies and provide timely assistance to AMCOS.

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# **Impact of Local Government Authorities' Development Budget on Project Performance in Tanzania: A Case of Muheza District Council**

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## **Abstract**

*The study examined the impact of Local Government Authorities' (LGAs) development budgets on project performance in Tanzania, with a specific focus on Muheza District Council. A descriptive research design was employed, and 64 respondents were selected through purposive sampling. Quantitative data were analysed using descriptive statistics and multiple linear regression in SPSS Version 27.0 to determine the effects of project planning, project management, budget allocation, and budget utilisation on project performance. The findings revealed that project planning, project management, and budget allocation each had a significant positive effect on project performance, contributing to improvements of 75%, 55%, and 65% respectively. Conversely, budget utilisation was found to have an insignificant influence on project performance. These results underscore the importance of comprehensive planning, effective managerial practices, and timely budget allocation in enhancing the performance of development projects, while inefficiencies in budget utilization continue to present challenges. The study contributes to the literature on public administration and development planning by providing insights that can assist policymakers in strengthening resource allocation, project planning, and management within LGAs to improve project outcomes.*

**Keywords:** Local Government Authorities, Development Budget and Project Performance.

## **INTRODUCTION**

### **Background of the study**

Development budgets have played a significant role in shaping project performance and implementation practices across local government authorities globally. In Africa, the influence of development budgets has produced mixed outcomes. While increased financial support from international aid and development agencies has enabled the

implementation of vital infrastructure and social projects, challenges such as corruption, weak institutional capacity, inadequate planning, insufficient budget allocation, inefficient budget utilisation, and political instability have frequently undermined project effectiveness (African Development Bank, 2021).

In Tanzania, project performance trends reveal both progress and persistent constraints. Major emphasis has been placed on infrastructure development in sectors such as transportation, education, health, water, and energy. These investments reflect the government's commitment to stimulating economic growth and improving public service delivery (World Bank, 2021). However, despite these efforts, issues including poor project planning, delays, inadequate budget allocation, cost overruns, and ineffective budget utilisation continue to impede project outcomes. Such challenges are often linked to logistical barriers and limited institutional capacity (Smith, 2023).

This study offers meaningful contributions to the fields of public administration and development planning. The findings provide valuable insight into the effectiveness of local government authorities' budgeting practices and their influence on project performance. These insights can support policymakers in strengthening resource allocation, enhancing budget utilisation, and improving project implementation processes. Furthermore, the study enriches the existing literature on budgeting and project management within the context of Tanzania's local government authorities.

The purpose of this paper was to evaluate the impact of development budgets on project performance in Tanzania, with a particular focus on Muheza District Council.

### **Statement of the Problem**

Local Government Authorities (LGAs) play a critical role in driving socio-economic development in Tanzania, with development budgets serving as the primary mechanism for financing local projects and improving service delivery. These funds are intended to enhance project performance, strengthen infrastructure, and support community welfare (Collin, 2020). However, despite these expectations, many LGAs, including Muheza District Council, continue to experience persistent challenges such as poor project outcomes, financial mismanagement, and limited utilisation of allocated resources. Such challenges weaken the

capacity of LGAs to implement development projects effectively and contribute to delays in improving essential public services (Bakker, 2019).

Although the Government of Tanzania has introduced several budgeting and financial accountability reforms aimed at improving planning and promoting effective use of development funds, performance gaps remain evident at the council level. Current evidence (Mnyawi & Kessy, 2021; Mrope, 2020) indicates that limited clarity regarding budget allocation processes, inefficiencies in budget utilisation, and weaknesses in project planning and management practices continue to hinder the successful implementation of development initiatives. These shortcomings highlight the need for systematic evaluation of whether development budgets result in improved project performance, as well as an assessment of how allocation, utilisation, planning, and management practices specifically contribute to project outcomes.

This study therefore seeks to address these gaps by examining the impact of development budgets on project performance in Muheza District Council. Specifically, the study aims to assess how budget allocation affects project performance, determine the contribution of budget utilisation to project outcomes, examine the role of project planning in shaping project performance, and analyse how project management practices influence the overall achievement of project goals.

## **Research Objectives**

### ***General Objective***

The main objective of this study is to evaluate the impact of Local Government Authorities' development budgets on project performance in Tanzania, with a specific focus on Muheza District Council.

### ***Specific Objectives***

The study was guided by the following specific objectives:

- i) To assess the effect of budget allocation on project performance in Muheza District Council.
- ii) To determine the effect of budget utilization on project performance in Muheza District Council.
- iii) To examine the role of project planning in influencing project performance in Muheza District Council.
- iv) To analyse the effect of project management practices on project performance in Muheza District Council.

## **LITERATURE REVIEW**

### **Theoretical Literature Review**

Public Finance Theory, developed by Simon Kuznets in the 1960s, explains how governments allocate and manage public funds to promote economic and social development. The theory emphasises efficient resource allocation, financial accountability, and budgetary discipline, enabling governments to determine appropriate ways to finance and implement development projects that yield the greatest social benefit. It underscores the value of cost-benefit analysis and transparent budgeting processes to ensure that limited public resources are directed towards high-impact initiatives. Despite its strengths, the theory has limitations, as it focuses primarily on financial efficiency and may overlook long-term sustainability considerations such as institutional capacity, stakeholder engagement, social equity, and environmental protection. These dimensions are essential for achieving durable and inclusive development outcomes.

### **Empirical Literature Review**

Project planning has consistently been identified as a key determinant of successful project outcomes. Ocharo and Kimutai (2018) describe planning as a systematic process involving the definition of objectives, identification of activities, resource estimation, and establishment of monitoring frameworks, all of which reduce uncertainties and strengthen coordination. Empirical evidence confirms that robust planning improves implementation outcomes by enabling strategic resource allocation and effective responses to emerging constraints (Ocharo et al., 2018; Hyera & Tonya, 2022). Scholars further argue that performance-based budgeting depends heavily on well-structured planning to enhance accountability and execution, demonstrating that comprehensive planning directly influences the pace and quality of development results (Mutinda & Wanyoike, 2021).

Evidence from project management literature also underscores the importance of managerial effectiveness in shaping project performance. Studies from Kenya's power sector show that planning, monitoring, evaluation, and stakeholder engagement significantly enhance implementation outcomes (Ocharo et al., 2018; Muturi & Ngari, 2020). Additional research grounded in institutional and resource-based perspectives highlights that strong leadership, efficient communication, and adaptive management contribute to timely and cost-effective project delivery (Karanja & Wanyoike, 2021; Mugo & Njenga, 2022). However,

many of these studies give limited attention to the financial dimension of project execution, overlooking how allocation and utilisation influence development outcomes within Local Government Authorities budget.

Budget allocation has also received considerable empirical attention as a key driver of project performance. Arzanlou and Sardroud (2024) define allocation as the process through which public funds are distributed and expenditure limits are established. Evidence shows that adequate, timely, and predictable budget allocations are essential for ensuring project continuity and quality, while delayed or insufficient allocations often lead to implementation setbacks and reduced outputs (Lima et al., 2021; Kabiru & Ndiritu, 2020). Nonetheless, studies conducted in business settings frequently fail to account for the governance, institutional, and political complexities inherent in public-sector budgeting, limiting their relevance to Local Government Authorities (Lima et al., 2021; Mtey & Simba, 2023).

Budget utilisation is similarly recognised as a critical factor influencing project outcomes, particularly in public-sector development contexts. The National Audit Office (NAO, 2023) defines utilisation as the extent to which allocated resources are spent efficiently and in alignment with planned activities. Empirical studies indicate that efficient utilisation enhances implementation quality through stronger accountability, timely execution, and adaptive management (Molaei, Bosch-Rekveldt & Bakker, 2019; Chepkemboi & Nyang'au, 2021). Research on infrastructure and construction projects further demonstrates that project performance improves when funds are transparently managed and directed towards intended purposes (Ong'ondo, Gwaya & Masu, 2019; Chirchir & Bwisa, 2020). However, several studies overlook challenges such as under-utilisation, misallocation, and delays in expenditure, revealing gaps in understanding how weak execution of budgets affects project performance in Local Government Authorities. This gap underscores the need for focused research on utilisation patterns within decentralised government systems.

## **Research Gap**

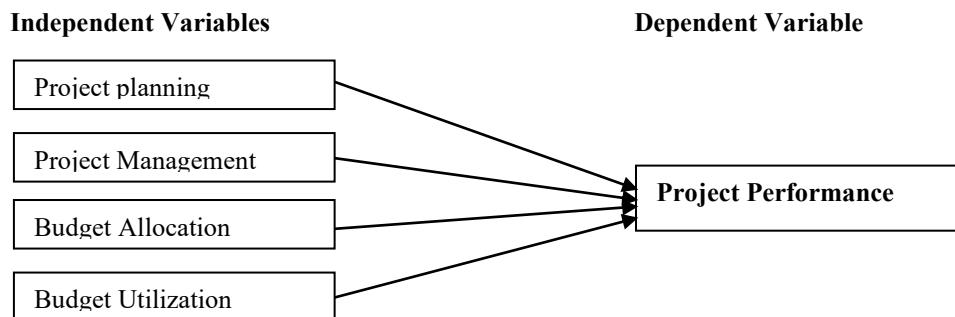
Despite the existing studies, there is a research gap that still need to be addressed, which is the lack of comprehensive studies that comprehensively examine the impact local government authority's development budgets on project performance in Tanzania. Moreover, the limited empirical evidence on specific challenges during budget

implementation, monitoring, and evaluation mechanisms restricts policymakers and practitioners from making informed decisions to enhance the effectiveness of budgeting practices and improve project outcomes. Closing the research gap, the study intended to contribute significantly to the knowledge base on local government authority development budgets in Tanzania. It also provides insights into effective budget allocation, implementation, and monitoring practices to improve project performance.

### **Conceptual Framework**

The conceptual framework illustrates how project planning, project management, budget allocation, and budget utilization collectively influence project performance in Local Government Authorities. Effective project planning provides clear objectives and structured implementation pathways, while strong project management ensures coordination, supervision, and timely decision-making throughout the project cycle. Adequate and transparent budget allocation supplies the necessary financial resources for activities, and efficient budget utilization ensures those resources are used appropriately and economically to achieve intended results. When these four factors function effectively, they enhance the overall performance of development projects in terms of timeliness, quality, efficiency, and sustainability (World Bank, 2020).

**Figure1**  
*Conceptual framework*



## **RESEARCH METHODOLOGY**

The study was guided by a post-positivist research philosophy, which promotes objective inquiry while recognising the possibility of researcher bias (Creswell & J. David, 2023). A quantitative descriptive approach was adopted to examine the relationship between development budgets and

project performance (Creswell et al., 2023). The descriptive research design was appropriate for assessing variables such as project planning, project management, budget allocation, and budget utilisation. The study was conducted in Muheza District Council, selected due to recurring challenges of unutilised and incomplete development projects highlighted in recent CAG reports (NAO, 2023; 2024). The target population comprised 2,242 public employees, and a sample size of 64 respondents was determined using Yamane's (1967) formula. Purposive and simple random sampling techniques were used to select key officials involved in budgeting and project implementation (Nyimbili & Nyimbili, 2024). Data were collected using structured questionnaires administered through Kobo Toolbox, targeting heads of departments, planning and budgeting officers, project supervisors, engineers, and accountants (Taherdoost, 2021). Completed questionnaires were coded and analysed in SPSS Version 27 using descriptive statistics and multiple linear regression to assess the influence of the independent variables on project performance (Alita, Putra & Darwis, 2021). Validity was enhanced through triangulation, while reliability was tested using Cronbach's alpha, applying a threshold of 0.7 for acceptable internal consistency (Creswell & J. David, 2023). Ethical procedures—including informed consent, confidentiality, and adherence to institutional guidelines—were strictly observed throughout the study.

## Multiple linear regression model

To examine the strength and direction of the relationship between development budget components and project performance, the study employed an econometric model estimated using multiple linear regression. The model allows for inexact relationships between variables by incorporating an error term ( $\epsilon$ ), which captures all unobserved factors that may influence project performance but are not included explicitly in the model.

The general form of the regression model used in this study is expressed as:

$$y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \dots + \beta_n X_n + \varepsilon \quad (1)$$

Applied to this study, the model specified as:

$$y = \beta_0 + \beta_1 \text{PPlan} + \beta_2 \text{BUTi} + \beta_3 \text{Pman} + \beta_4 \text{BALlo} \dots \beta_n X_n + \varepsilon \quad (2)$$

## Where

where,  
y = project performance

y = project performance  
PPlan = Project planning

Pman = Project management

BAllo =Budget allocation

BUti =Budget utilization

$\epsilon$  = Residual ("error term").

## FINDINGS AND DISCUSSION

### Demographic information of the respondents

This section presents an analysis of the demographic characteristics of the respondents who participated in the study. These characteristics are crucial for assessing the validity and reliability of the data collected. The information includes Age, gender, educational level, working experience in project planning and implementation, and designation position of respondents.

**Table 2**

*Demographic information of the respondents*

Variable	Category	Frequency	Percent (%)
Sex	Male	38	59.4
	Female	26	40.6
	<b>Total</b>	<b>64</b>	<b>100.0</b>
Age	18–25 Years	1	1.6
	26–35 Years	21	32.8
	36–45 Years	27	42.2
	Above 45 Years	15	23.4
	<b>Total</b>	<b>64</b>	<b>100.0</b>
Education Level	Diploma	9	14.1
	Degree	44	68.8
	Masters	11	17.2
	<b>Total</b>	<b>64</b>	<b>100.0</b>
Working Experience	1–5 Years	8	12.5
	6–10 Years	26	40.6
	11–15 Years	10	15.6
	16–20 Years	12	18.8
	Above 21 Years	8	12.5
	<b>Total</b>	<b>64</b>	<b>100.0</b>
Designation / Position	Head of Department/Unit	8	12.5
	Planning & Budgeting Officer	16	25.0
	Accountant	2	3.1
	Project Supervisor	33	51.6
	Engineer	5	7.8
	<b>Total</b>	<b>64</b>	<b>100.0</b>

Source: Research field Data (2024)

## **Age of Respondents**

The results indicate that the majority of respondents were aged between 36 and 45 years (42.2 percent), followed by those aged 26 to 35 years (32.8 percent) and those above 45 years (23.4 percent). Only 1.6 percent were between 18 and 25 years. This distribution suggests that project planning and management roles within Muheza District Council are predominantly occupied by mature professionals who are likely to possess substantial technical and managerial experience. This finding aligns with Anderson and Brown (2021), who observed that individuals within this age range often demonstrate strong leadership and sound decision-making abilities. The limited participation of younger respondents reflects institutional constraints that restrict youth involvement in strategic functions, as highlighted by Taylor et al. (2023).

## **Gender of Respondents**

The analysis shows that 59.4 percent of respondents were male, whereas 40.6 percent were female. This gender imbalance corresponds with findings by Mwangi and Omondi (2021) and Ahmed et al. (2023), who noted that structural and cultural dynamics continue to influence gender representation in public sector project environments. Although female participation remains comparatively lower, their involvement indicates progressive movement towards more inclusive engagement. Kabeer and Ngozi (2022) emphasised that balanced gender participation enhances decision-making and strengthens accountability within project settings.

## **Education Level of Respondents**

The findings reveal that most respondents held a bachelor's degree (68.8 percent), followed by those with master's qualifications (17.2 percent) and diplomas (14.1 percent). This suggests that the personnel involved in planning and budgeting processes are academically well prepared. Okeke and Eze (2021) observed that higher levels of education enhance analytical capability and improve contributions to technical tasks. Adeyemi and Oluwaseun (2020) further emphasised that well-qualified individuals significantly reinforce the credibility and robustness of research outputs.

## **Working Experience of Respondents**

A total of 40.6 percent of respondents reported having 6 to 10 years of working experience, while 34.4 percent had between 11 and 20 years. This reflects a strong representation of mid-career and experienced professionals who are well positioned to provide informed insights into

project management practices. Smith et al. (2022) underscored the role of experienced personnel in ensuring effective project delivery. The presence of both early-career and highly experienced respondents enriches the diversity of perspectives, consistent with observations by Martinez et al. (2023).

### **Designation of Respondents**

The results show that Project Supervisors constituted the largest proportion of respondents (51.6 percent), followed by Planning and Budgeting Officers (25 percent). This highlights the central role of operational and financial personnel in influencing project performance. Carter and Evans (2021) noted that supervisors are essential in ensuring timely and efficient implementation of project activities, while Thompson and Patel (2022) emphasised the importance of budgeting officers in guiding resource allocation. The smaller proportions of Heads of Departments, Engineers, and Accountants suggest that specialist contributions complement broader project management functions.

### **Results and discussion on key components of the budget performance process**

The discussion focused on the independent variables (project planning, project management, budget allocation, and budget utilization) in relationship to the independent variable (project performance) as discussed below.

**Table**  
*Effect of project planning on project performance*

Responses	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Effective project planning contributes to improved project performance	16 (25%)	31 (48%)	7 (11%)	0 (0%)	10 (16%)
Project planning has a significant effect on project performance	31 (48%)	24 (38%)	0 (0%)	0 (0%)	9 (14%)
Proper project planning affects the overall success of a project	15 (23%)	37 (58%)	12 (19%)	0 (0%)	0 (0%)

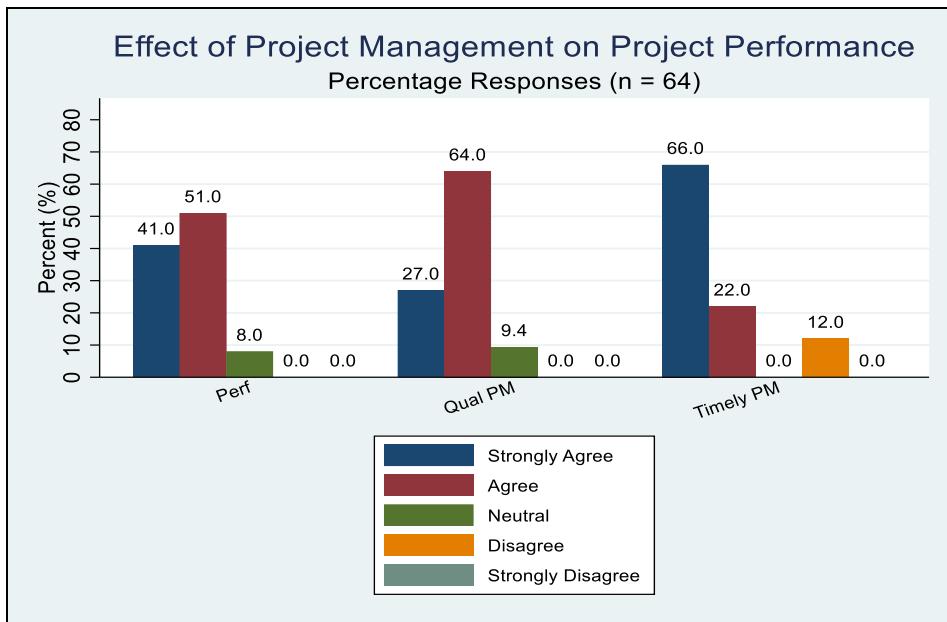
**Source:** Research field Data (2024)

Results from Table 4.5 indicate that respondents consistently view project planning as a central determinant of project performance. A large proportion agreed that effective planning enhances implementation, reduces uncertainty, and supports coordination, reflecting views similar to Anderson and Brown (2021) and Taylor et al. (2023), who highlight planning as essential for efficient project execution. The majority also affirmed that planning significantly influences project outcomes, a finding that aligns with Lee and Smith (2022) and PMI (2021), who emphasize that planning strengthens resource allocation and risk management. Furthermore, respondents largely agreed that proper planning contributes to overall project success, supporting the arguments of Johnson and Lee (2021) and Anderson et al. (2021), who note that structured planning improves predictability and increases the likelihood of achieving intended results.

### **Effect of Project Management on Project Performance**

Results presented in Figure 2 indicate a strong recognition among respondents that project management practices play a central role in achieving successful project outcomes within Local Government Authorities. The distribution of responses across the three indicators demonstrates a consistent pattern of agreement on the importance of management quality, timeliness, and efficiency. With respect to the significance of quality project management, Figure 2 shows that most respondents agreed or strongly agreed that high-quality management improves project performance, suggesting that effective coordination and decision-making are crucial for project success. This finding aligns with Carter and Evans (2021), who emphasized the role of competent managerial practices in strengthening project execution. With respect to the timeliness of management activities, Figure 2 further illustrates that a substantial majority affirmed the importance of timely project management in improving performance, although a small proportion disagreed. This pattern reflects the observations of Thompson and Patel (2022), who argued that schedule adherence enhances efficiency but must be supported by adequate resources and operational capacity. With respect to the dependence of project performance on efficient and effective management, Figure 2 shows strong agreement that management efficiency is closely linked to project outcomes. This consensus supports the views of Smith et al. (2022) and Taylor (2023), who found that efficient resource use, clear communication, and oversight significantly enhance the likelihood of successful project performance in public sector settings.

**Figure 2**  
*Effect of Project Management on Project Performance*



Source: Research field data (2024).

### **Effect of Project Management on Project Performance**

Results from Table 4 show that respondents strongly acknowledge the importance of project management practices in influencing project performance within Local Government Authorities, with consistently high levels of agreement across all three indicators. Regarding the significance of quality project management, 41 respondents (64 percent) agreed and 17 respondents (27 percent) strongly agreed that high-quality management improves project performance, while only 6 respondents (9.4 percent) were neutral, indicating widespread recognition that coordination, supervision, and informed decision-making are essential drivers of project success, consistent with Carter and Evans (2021). Similarly, 42 respondents (66 percent) strongly agreed and 14 respondents (22 percent) agreed that timely project management enhances performance, although 8 respondents (12 percent) disagreed, suggesting that while timeliness is broadly valued, some respondents believe additional factors influence outcomes, a perspective supported by Thompson and Patel (2022), who noted that schedule adherence improves efficiency but relies on adequate resources and institutional capacity. With respect to the dependence of project performance on efficient and effective management, 33 respondents (51 percent) agreed and 26 respondents (41 percent) strongly

agreed that project outcomes rely on efficient resource use and effective oversight, with only 5 respondents (8 percent) remaining neutral; this strong consensus reinforces the view presented by Smith et al. (2022) and Taylor (2023) that efficient process management and clear communication are fundamental to achieving positive project results.

**Table 4**  
*Effect of Project Management on Project Performance*

Responses	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Quality project management has a significant impact on project performance	17 (27%)	41 (64%)	6 (9.4%)	0 (0%)	0 (0%)
Timely project management contributes to improved project performance	42 (66%)	14 (22%)	0 (0%)	8 (12%)	0 (0%)
Project performance depends on efficiency and effective project management	26 (41%)	33 (51%)	5 (8%)	0 (0%)	0 (0%)

Source: Research field Data (2024)

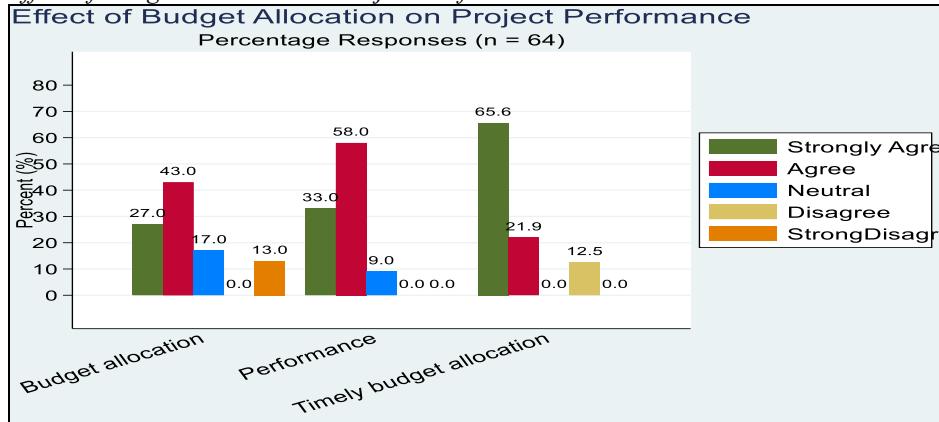
### **Effect of Budget Allocation on Project Performance**

Results from Figure 3 show that respondents strongly acknowledge budget allocation as an important factor influencing project performance in Local Government Authorities, with consistently high levels of agreement across all indicators. With respect to the timeliness of budget allocation, 42 respondents (65.6 percent) strongly agreed and 14 respondents (21.9 percent) agreed that timely disbursement of funds improves project performance, while 8 respondents (12.5 percent) disagreed; this suggests that delays in funding disrupt activities and reduce efficiency, a pattern consistent with Banda and Chirwa (2022), who found that timely funding enhances implementation speed and output quality. With respect to whether budget allocation significantly affects project performance, 28 respondents (43 percent) agreed and 17 respondents (27 percent) strongly agreed, whereas 11 respondents (17 percent) remained neutral and 8 respondents (13 percent) disagreed, indicating broad recognition that allocation processes shape outcomes but that some respondents believe other factors may contribute; this aligns with Muthoni and Kariuki (2021), who emphasized that effective allocation mechanisms support adequate resource distribution and improved project results. Finally, with respect to the dependence of project performance on budget allocation, 37 respondents (58 percent) agreed and 21 respondents (33 percent) strongly agreed that performance

relies heavily on how budgets are allocated, with only 6 respondents (9 percent) neutral, demonstrating strong consensus that well-planned allocations are central to successful implementation; these findings correspond with Nkrumah and Boateng (2020), who highlighted that appropriate financial resource distribution strengthens implementation capacity and supports the achievement of intended results.

**Figure 3**

*Effect of Budget Allocation on Project Performance*



Source: Research field data (2024).

### **Effect of Budget Utilization on Project Performance**

Results from Table 5 show that respondents strongly recognize budget utilization as a key factor influencing project performance in Local Government Authorities, with consistently high agreement across all indicators. With respect to whether project performance depends on efficient and effective utilization of materials and financial resources, 40 respondents (63 percent) agreed and 15 respondents (23 percent) strongly agreed, suggesting a strong belief that proper resource use is essential for achieving project goals; this aligns with Mwangi and Opiyo (2022), who found that efficient resource utilization improves implementation quality and strengthens project success. With respect to insufficient budget utilization as a hindrance to project outcomes, 28 respondents (43 percent) agreed and 17 respondents (27 percent) strongly agreed, indicating that most respondents view underutilization as a barrier to effective project delivery, consistent with Chikonde and Banda (2021), who observed that unspent or poorly allocated funds often lead to delays and reduced performance. With respect to the overall effect of budget utilization on project performance, 32 respondents (50 percent) agreed and 20 respondents (31.3 percent) strongly agreed that utilization patterns

significantly influence project outcomes, underscoring the belief that effective use of allocated funds enhances performance; this corresponds with Osei and Boateng (2020), who emphasized that transparent and efficient utilization mechanisms increase efficiency, accountability, and the overall success of development projects.

**Table 5:**  
*Effect of Budget Utilization on Project Performance*

Responses	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
Project performance depends on efficient and effective utilization of materials and financial resources	15 (23%)	40 (63%)	3 (5%)	6 (9%)	0 (0%)
Insufficient budget utilization is a major hindrance to project outcomes	17 (27%)	28 (43%)	8 (13%)	0 (0%)	11 (17%)
Budget utilization affects the overall performance of a project	20 (31.3%)	32 (50%)	0 (0%)	12 (18.8%)	0 (0%)

Source: Research field data (2024).

## Results and discussion on multiple linear regression outputs

**Table 6**  
*Descriptive Statistics Results*

Variables	Mean	Std. Deviation	N
Project planning	4.56	.534	64
Project management	4.70	.441	64
Budget allocation	4.70	.393	64
Budget utilization	4.72	.390	64
Project performance	4.33	.730	64

Source: Research field data (2024).

The findings from the descriptive statistics indicate that independent variables project planning, project management, budget allocation, and budget utilization exhibit relatively high average scores, with means ranging from 4.33 to 4.72 on the scale. This suggests that these factors are perceived positively in relation to project performance. Also, the dependent variable, project performance, has a mean score of 4.33, indicating a generally favorable perception of project performance across the sample. The standard deviations for all variables are relatively low,

indicating that the responses are tightly clustered around the mean, suggesting consistency in how participants evaluated these factors.

**Table 7**  
*Model Summary*

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.584	0.75	0.743	0.321

**Source:** Research field data (2024).

Table 7, indicates that, the R-value is 0.584 indicates a moderate positive correlation between the dependent variable (project performance) and the independent variables (budget utilization, budget allocation, project planning, and project management). Since it is greater than 0.4, it is acceptable for further analysis. The R-square of 0.75 suggests that 75% of the variation in project performance can be explained by the independent variables, indicating that the model is effective in establishing the relationship. The Adjusted R-square is 0.743, which is close to the R-square value of 0.75, meaning the results generalize well from the sample to the population, further strengthening the model's explanatory power. The model demonstrates a significant relationship between project performance and the key predictors.

**Table 8**  
*ANOVA<sup>a</sup>*

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.436	4	2.859	7.626	.000 <sup>b</sup>
Residual	22.120	59	.375		
Total	33.556	63			

b. Predictors: (Constant), project planning project management, budget allocation, budget utilization.

The ANOVA table above determines whether the model is significant enough to explain the outcome. In this case, the significance value (p-value) is .000, which is less than the chosen significance level of 0.05, indicating that the result is statistically significant. The F-ratio is 7.626, which is greater than 1, signifying that the model efficiently improves the prediction of project performance after accounting for the inaccuracy in the model. Since the p-value is below the acceptable threshold, we can consider the study for further analysis. This implies that the independent variables (project planning, project management, budget allocation, and budget utilization) significantly predict project performance.

**Table 9**

*Coefficients<sup>a</sup>*

Model	Unstandardized Coefficients		Standardized Coefficients Beta	t	P value	Sig.
	B	Std. Error				
(Constant)	0.783	1.203		0.651	0.001	***
Project planning	0.68	0.145	0.75	1.250	0.001	***
Project management	2.27	0.276	0.55	1.420	0.000	***
Budget allocation	0.45	0.288	0.65	1.033	0.000	***
Budget utilization	-1.38	0.339	-0.11	3.138	0.25	-

Statistically significant \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

In the analysis of the coefficients, the relationship between project planning, project management, budget allocation, and budget utilization on project performance is evaluated. The results indicate that project planning (Sig. = 0.001), project management (Sig. = 0.000), and budget allocation (Sig. = 0.000) have statistically significant effects on project performance, as their significance values are below the 0.05 threshold except for budget utilization which falls outside the probability value 95% interval since (sig=0.25) higher than 0.05 interval.

These significant variables imply that changes in these factors contribute significantly to variations in project performance. The results suggest that a 1% increase in project planning leads to a 75% improvement in project performance holding all other variables constant. Also, a 1% increase in project management effectiveness is associated with a 55% increase in project performance keeping all other variables constant, also findings suggest that a 1 % increase in budget allocation leads to an increase in project performance by 65% holding other variables constant. On the other hand, budget utilization, with a Sig. value of 0.25, does not exhibit a statistically significant effect on project performance indicating that for every 1% change in budget utilization decreases the project performance by 11%. Since this value exceeds the 0.05 significance level indicating that variations in budget utilization do not have a significant impact on project performance in this study.

## CONCLUSION AND RECOMMENDATIONS

### Conclusion

This study contributes to the understanding of how development budgeting practices influence project performance within Local Government Authorities in Tanzania. The findings indicate that effective project planning, sound management, and timely budget allocation play

important roles in strengthening project execution and improving performance outcomes. Although budget utilization did not show a significant statistical effect, its practical relevance remains important because the efficient use of financial resources underpins credible service delivery and implementation effectiveness. Overall, the study reinforces that project performance results from the interaction between financial inputs and the institutional, managerial, and governance systems that guide how those resources are planned and administered.

### **Policy Recommendations**

The study recommends that government authorities ensure timely and adequate budget allocations for development projects by improving transparency and strengthening accountability mechanisms. Diversifying funding sources, including public-private partnerships, may also enhance project financing capacity. Strengthening project planning processes is essential and should involve conducting needs assessments, feasibility studies, and risk analyses while ensuring stakeholder participation. Governments should also establish realistic timelines and measurable objectives to improve implementation consistency. In addition, investing in continuous capacity building for project managers and operational teams is crucial, alongside adopting modern project management tools and institutionalizing monitoring and evaluation practices that enable timely adjustments and support the attainment of project objectives.

### **Areas for Further Research**

Future research should explore the specific factors influencing budget utilization and its relationship with project performance, especially in other districts where contextual differences may exist. Since budget utilization was found to be statistically insignificant in this study, further investigations could examine challenges related to fund disbursement, expenditure tracking, and administrative or oversight constraints that may hinder efficient financial use. Such studies may reveal underlying barriers, including bureaucratic delays, weak financial management systems, or gaps in accountability, which could inform more targeted policy interventions aimed at improving budget efficiency and enhancing development project outcomes across local governments.

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## **A Framework for Assessing Adoption of Emerging Technologies in Oil Distribution Networks in Tanzania: The Case of TANOIL and PUMA Energy**

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### **Abstract**

*The adoption of emerging technologies is critical for enhancing operational efficiency, competitiveness, and sustainability in the oil distribution sector. In Tanzania, oil distribution companies face challenges related to technological readiness, organizational capacity, and environmental support, which affect their ability to integrate innovations. This study aimed to evaluate the technological, organizational, and environmental factors influencing the adoption of emerging technologies in Tanzania's oil distribution sector, and to develop an integrated framework to guide effective technology adoption. Data were collected from two major oil distribution companies, TANOIL and PUMA, using structured questionnaires. Data were analysed by using descriptive statistics, correlation and multiple regression. The results indicate that technological and organizational context have positive and significantly influence on adoption emerging technologies. Contrary, environmental factors showed a positive but insignificant influence on adoption emerging technologies. The study concludes that the adoption of emerging technologies in Tanzanian oil distribution sector is primarily driven by technological and organizational factors, while environmental does not motivate oil distribution companies to adopt new technologies. To enhance adoption, the study recommends that policymakers strengthen supportive regulations and industry incentives, while companies invest in internal capacity-building to fully leverage emerging technologies.*

**Keywords:** Emerging technologies, Oil Distribution Networks, Tanzania

### **INTRODUCTION**

The oil and gas industry is a cornerstone of the global economy, supporting energy supply chains and industrial development (Tang *et al.*, 2024). Within this sector, the efficiency and safety of oil distribution networks are critical, particularly in ensuring timely delivery, reducing

losses, and maintaining compliance with environmental and safety standards. Traditionally, oil distribution systems have relied on manual supervision, periodic inspections, and aging monitoring infrastructure practices that contribute to delays, inefficiencies, and increased risks of spillage or theft (Kang'ethe, 2021). However, rapid advancements in Emerging Technologies (ETs) have introduced digital solutions capable of significantly enhancing supply chain visibility, operational control, and decision-making. Technologies such as Supervisory Control and Data Acquisition (SCADA), Internet of Things (IoT) sensors, Geographic Information Systems (GIS), blockchain, and cloud computing now enable real-time fuel tracking, leak or theft detection, and optimized distribution routing (Aslam *et al.*, 2021; Rajput & Singh, 2021). These innovations offer enormous opportunities for improving operational efficiency, reducing human error, and strengthening compliance with environmental regulations.

Despite these benefits, the adoption of emerging technologies in oil distribution remains constrained by multiple technological, organizational, financial, and regulatory factors. High implementation costs, cybersecurity concerns, limited digital literacy among staff, and the need for specialized skills hinder effective technology integration (Nyaga & Mugambi, 2022; Malik *et al.*, 2022; Purohit, 2022). For developing economies such as Tanzania, these challenges are further exacerbated by infrastructure limitations and uncertainties within regulatory frameworks that have not fully evolved to accommodate digital transformation (El Tabsh, 2023; Peng *et al.*, 2024). Oil distribution companies including TANOIL and PUMA continue to experience supply chain bottlenecks, theft, and a lack of real-time operational visibility, which weaken efficiency and increase operational risks (Lawan, 2022).

Recent statistics highlight the urgency of technological transformation in Tanzania's downstream oil sector. The UN Technology Bank (2023) reports that only 27% of energy-related firms in Tanzania have adopted digital monitoring systems, compared to over 70% in developed economies. Similarly, EWURA (2024) estimates that leakage, theft, and distribution inefficiencies account for approximately 12% of annual operational losses (Said, 2022). The slow uptake of emerging technologies such as IoT and SCADA continues to undermine real-time data accuracy, operational transparency, and evidence-based decision-making (Lawan, 2022).

Although digital transformation trends have been widely researched, empirical studies focusing specifically on the oil distribution networks in Tanzania remain limited. Existing technology adoption studies have predominantly examined manufacturing, logistics, or upstream petroleum operations (Kamal & Ali, 2024; Chauhan *et al.*, 2021; Tang *et al.*, 2024), thereby overlooking the downstream distribution segment, which faces distinct infrastructural, regulatory, and operational challenges. Furthermore, previous studies rarely consider technological, organizational, and environmental determinants together, resulting in a fragmented understanding of adoption behaviour in the oil distribution sector. As a result, there is limited empirical evidence on how organizational readiness, leadership commitment, regulatory environments, and market conditions jointly influence the adoption of emerging technologies in Tanzanian oil distribution companies (Lawan, 2022).

This study addresses these gaps by examining the technological, organizational, and environmental factors influencing the adoption of emerging technologies in Tanzania's oil distribution networks, using TANOIL and PUMA as case studies. In doing so, the study makes three key contributions. Theoretically, it extends the traditional TOE framework by integrating downstream oil-sector, thereby proposing a context-responsive framework better suited to high-risk, infrastructure-intensive supply chains. Practically, the study provides oil distribution companies with evidence-based insights on how technological readiness, organizational capacity, leadership commitment, and environmental conditions jointly shape digital transformation outcomes, offering actionable guidance on investment priorities, capability development, and internal restructuring. Contextually, the research contributes new empirical evidence from Tanzania's downstream petroleum sector, an under-studied but economically critical segment, and demonstrates how local infrastructural constraints, regulatory dynamics, and market conditions influence the adoption of emerging technologies.

## **LITERATURE REVIEW**

### **Theoretical Review**

This study is grounded in the Technology–Organization–Environment (TOE) Framework developed by Tornatzky and Fleischer (1990), which offers a comprehensive structure for examining the determinants of

technology adoption at the organizational level. The TOE framework posits that the likelihood and success of adopting new technologies depend on three interrelated dimensions: technological readiness, organizational characteristics, and environmental pressures. Because emerging technologies such as IoT, SCADA, GIS, blockchain, and cloud-based monitoring systems involve complex technical, managerial, and regulatory considerations, the TOE framework provides an appropriate lens for examining their adoption within Tanzania's oil distribution networks (Lin & Chen, 2023).

Technological conditions, both internal and external, shape an organization's capacity and willingness to adopt new systems. In the context of oil distribution networks, these include the availability, compatibility, functionality, and perceived benefits of monitoring technologies such as IoT sensors, SCADA systems, and GIS platforms. These technologies offer significant potential to improve operational visibility, accuracy, and efficiency in fuel logistics. However, concerns regarding integration with existing systems, high implementation costs, cybersecurity vulnerabilities, and infrastructural limitations remain major barriers to adoption (Hasin & Nasir, 2021). For companies such as TANOIL and PUMA, the perceived relative advantage of these technologies such as enhanced real-time monitoring and reduced leakages or theft plays a critical role in shaping adoption decisions.

Organizational characteristics also strongly influence technology adoption. Factors such as company size, managerial support, financial capacity, organizational culture, and employees' digital skills determine a firm's readiness to embrace emerging technologies. Successful adoption of real-time monitoring systems requires strong top management commitment, adequate investment in digital infrastructure, and a supportive organizational climate that encourages innovation (Kamal & Ali, 2024). Access to skilled personnel with expertise in data analytics, IoT configuration, cybersecurity, and ICT maintenance is essential for effective integration. In the Tanzanian oil distribution sector, limited digital literacy and inadequate ICT capacity often hinder adoption and reduce organizational readiness for digital transformation.

External environmental pressures further shape adoption behaviour. Competitor actions, regulatory agencies, industry norms, and customer expectations exert influence on organizational decisions. In oil

distribution, compliance with safety standards, environmental regulations, and government monitoring requirements strongly motivates digital adoption. Regulatory bodies such as EWURA increasingly emphasize transparency, real-time reporting, and safety compliance, although digital regulatory frameworks remain underdeveloped (Peng et al., 2024; Kamal & Ali, 2024). Moreover, competitive pressures and rising customer expectations for accuracy, reliability, and timely delivery encourage firms to adopt sophisticated monitoring systems to maintain operational efficiency and market relevance. Thus, environmental forces act as both enablers and constraints within the technology adoption process.

The TOE framework's strength lies in its holistic approach, integrating technological, organizational, and environmental dimensions to provide a multidimensional understanding of technology adoption. Its flexibility allows application across industries and national contexts, making it particularly suitable for analysing digital adoption in developing economies such as Tanzania's oil sector. Additionally, its compatibility with other innovation diffusion theories, including the Diffusion of Innovation (DOI) theory, enhances its analytical depth and empirical utility (Hasin & Nasir, 2021). Nevertheless, the TOE framework has limitations. Critics argue that it offers limited guidance on how the three dimensions interact dynamically to shape adoption outcomes, which can oversimplify complex adoption processes (Kamal & Ali, 2024). The framework is also viewed as static, making it less responsive to rapidly evolving technological landscapes where technologies and regulatory requirements change quickly. Furthermore, variations in how TOE constructs are operationalized across studies may limit comparability and affect the generalizability of findings (Lin & Chen, 2023).

## **Empirical Review and Hypothesis Development**

### ***Technological Context and Adoption of Emerging Technologies***

Technological context plays a critical role in shaping the adoption of emerging technologies in oil distribution networks. Taifa (2025) found that IoT and real-time analytics in Tanzanian oil and gas sector had a positive and significant effect on adoption, as better technological readiness improved monitoring and operational efficiency. Tang *et al.*, (2024) reported that system compatibility and digital infrastructure positively influenced adoption, but the effect was insignificant due to persistent implementation barriers. Gill-Wiehl *et al.*, (2022) observed that accessible and reliable digital tools had a positive and significant impact

on technology uptake in the LPG sector. The UN Technology Bank (2023) highlighted that ICT gaps reduced adoption effectiveness, showing a positive but insignificant relationship in resource-constrained settings. Based on these insights, the study hypothesizes that:

*H<sub>1</sub>: Technological context positively influences the adoption of emerging technologies in oil distribution sector.*

### ***Organizational Context and Adoption of Emerging Technologies***

Organizational context, encompassing internal capabilities, managerial support, financial resources, and workforce digital skills, significantly affects technology adoption. Ali (2022) found that strong leadership commitment, IT governance, and absorptive capacity had a positive and significant effect on IT innovation adoption, enhancing organizational readiness. Changalima (2025) reported that firms with continuous learning programs, structured training, and collaboration with research institutions experienced a positive and significant influence on technology uptake. Maganga and Taifa (2023) observed that open organizational cultures, structured change management, and workforce reskilling positively facilitated adoption of technology. Similarly, Ishengoma (2024) and Hemed (2025) highlighted that managerial support and digital literacy positively influenced emerging technology adoption. Consequently, the study hypothesizes that:

*H<sub>2</sub>: Organizational context positively influences the adoption of emerging technologies in oil distribution sector.*

### ***Environmental Context and Adoption of Emerging Technologies***

Environmental context, including regulatory frameworks, policy incentives, market competition, and stakeholder pressures, also shapes adoption behaviour. Yhdego and Lema (2022) found that compliance with environmental regulations and community expectations had a positive and significant effect on the adoption of leak detection and low-emission technologies. Rweyendela (2023) reported that low-carbon development goals were inconsistently applied, resulting in a positive but insignificant influence on technology adoption. Gerutu (2025) observed that alignment between infrastructure development and environmental objectives positively facilitated adoption of alternative fuel technologies, with the effect being significant in well-supported contexts. The World Bank (2021) highlighted that national digital initiatives, including ICT

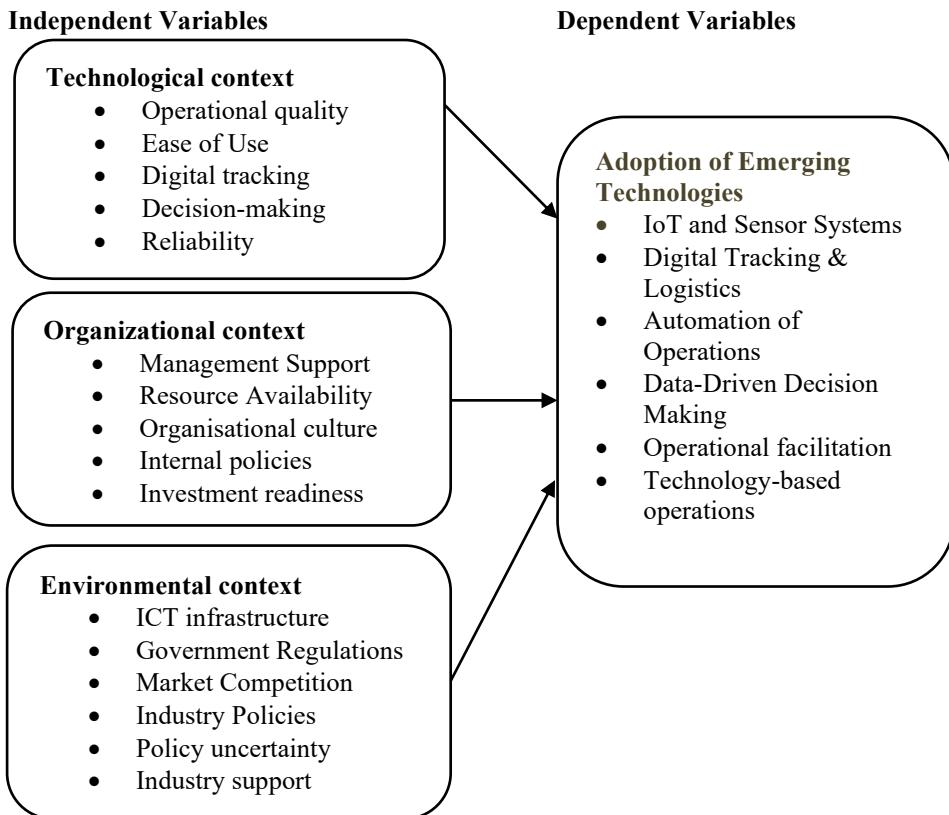
investments and e-service platforms, had a positive and significant impact on technology uptake, whereas Verma *et al.*, (2023) noted that insufficient sector-specific support limited the effectiveness of environmental factors, showing a positive but insignificant relationship in resource-constrained settings. These findings suggest that regulatory support, market demands, and broader policy environments are critical for successful integration of emerging technologies, leading to the hypothesis:

*H<sub>3</sub>: Environmental context positively influences the adoption of emerging technologies in oil distribution sector.*

### **Conceptual Framework**

The conceptual framework aligns with the main objective of developing a model to guide effective integration of emerging technologies in Tanzania's oil distribution sector. The framework thus provides a structured guide for integrating technology to achieve efficient and sustainable oil distribution in Tanzania. It focused on three key contexts technological, organizational, and environmental contexts which form predictor variables and adoption of emerging technologies which form dependent variables as shown in Figure 1 below.

**Figure 1**  
*Conceptual Framework for adoption of emerging Technologies*



Source: Modified from Tornatzky and Fleischman (1990)

## METHODOLOGY

### Research Philosophy, Research Approach and Research Design

This study was guided by a positivist research philosophy, which assumes that reality exists independently of human perceptions and can be objectively measured through observable and quantifiable data (Kothari, 2023; Saunders *et al.*, 2023). Positivism underpinned the use of empirical testing and statistical analysis, enabling the researcher to examine relationships among technological, organizational, and environmental factors in a structured and objective manner.

Accordingly, a quantitative research approach was adopted to systematically measure and analyse the influence of these factors on the adoption of emerging technologies in Tanzania, with a focus on TANOIL

and PUMA's oil distribution operations. The quantitative approach facilitated objective measurement of variables, statistical testing of hypothesized relationships, and generalization of findings to the population of interest, aligning with the study's goal of empirically testing theory (Creswell, 2023). To achieve this, the study employed an explanatory research design aimed at identifying causal relationships between technological, organizational, and environmental determinants and technology adoption outcomes. This design allowed for a detailed exploration of how and why these factors influence the integration of emerging technologies, supporting both contextual understanding and the development of a practical framework for technology adoption in the Tanzanian oil distribution sector.

### **Population, Sample Size and Sampling Techniques**

The target population comprised employees within Tanzania's oil distribution sector, specifically focusing on TANOIL and PUMA, given their central role as key petroleum distributors. As of 2024, the combined workforce of these companies totaled 216 individuals, with TANOIL employing 77 and PUMA Energy 139 employees. The population included operations staff, IT officers, engineers, administrative personnel, and management, all of whom are directly involved in day-to-day operations and decision-making processes. These employees were deemed suitable for providing insights into the adoption of emerging technologies, as they possess the necessary knowledge, experience, and exposure to ICT integration within operational workflows. Defining this population ensured that data were gathered from individuals directly relevant to the research objectives, enhancing the accuracy, reliability, and contextual relevance of the findings in line with the TOE framework (Kothari, 2023).

A sample size of 140 respondents was determined using the Yamane formula (1967) to ensure statistical representativeness while maintaining practical feasibility. The formula is expressed as:

$$n = \frac{N}{1 + N(e^2)}$$

Whereby;

n= sample size

N= total population

e= margin of error term

The given population of the study was 216, therefore, this gives N=216, and for social sciences,  $e= 5\% (0.05)$ , therefore  $n$  was determined as follow;

$$n = \frac{216}{1+216(0.05)^2} = 140.26 \approx 140$$

To ensure representative data collection, the study employed a combination of stratified and simple random sampling. Stratified sampling was first used to categorize employees based on their departmental roles, ensuring systematic representation of operations staff, IT officers, engineers, administrative personnel, and management. This approach reduced sampling bias and captured variations across organizational levels. Subsequently, simple random sampling was applied within each stratum to select respondents randomly, thereby minimizing selection bias and ensuring that each eligible employee had an equal chance of participation. This dual strategy enhanced the validity and reliability of the research findings by providing a comprehensive and representative understanding of the organizational, technological, and environmental factors influencing the adoption of emerging technologies in Tanzania's oil distribution sector (Zikmund *et al.*, 2022).

### **Methods of Data Collection**

Data for this study were collected using a structured questionnaire designed to capture quantitative insights on the technological, organizational, and environmental factors influencing the adoption of emerging technologies in Tanzania's oil distribution sector. The questionnaire employed a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to measure respondents' perceptions and attitudes regarding the extent to which these factors affect technology adoption. Questions were carefully developed to ensure clarity, relevance, and alignment with the study objectives, drawing on the TOE framework to provide a comprehensive assessment of internal and external determinants.

To maximize accessibility and response rates, the questionnaires were distributed through a dual-mode approach: physical copies were hand-delivered to employees present at company premises, while digital versions were sent via official email addresses to reach staff working in

different branches or remotely. This method facilitated inclusivity and minimized logistical constraints, while the standardized structure of the questionnaire ensured consistency in responses, reduced subjectivity, and enabled reliable statistical analysis (Akpe *et al.*, 2024). By employing this approach, the study was able to obtain robust, comparable, and empirically valid data, providing a strong foundation for examining the relationships among technological readiness, organizational capacity, environmental pressures, and the adoption of emerging technologies in oil distribution operations (Chauhan *et al.*, 2021).

Before administering the final questionnaire to the main sample, a pilot test was conducted to ensure clarity, reliability, and validity of the measurement items. The pilot involved 15 respondents drawn from operational and administrative staff within TANOIL and PUMA who were not part of the main study sample. Feedback from the pilot helped refine the wording, sequence, and relevance of items, ensuring that questions were easily understood and aligned with the study constructs. Reliability analysis using Cronbach's alpha revealed that all variable constructs exceeded the recommended threshold of 0.70, indicating strong internal consistency (Mmasi & Mwaifyusi, 2021).

### **Measurement of the Variables**

The study measured all key constructs using a structured 5-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), to capture respondents' perceptions on the influence of technological, organizational, and environmental factors on the adoption of emerging technologies in Tanzanian oil distribution networks. Technological Context was operationalized through items such as operational quality, ease of use, digital tracking, decision-making, and reliability, reflecting how internal and external technological readiness supports effective technology adoption (Taifa, 2025; Gill-Wiehl *et al.*, 2022). Organizational Context included management support, resource availability, organizational culture, internal policies, and investment readiness, indicating the firm's capacity, leadership commitment, and innovation-friendly environment to adopt emerging technologies (Ali, 2022; Ishengoma, 2024). Environmental Context comprised ICT infrastructure, government regulations, market competition, industry policies, policy uncertainty, and industry support, capturing external pressures and enablers that influence adoption decisions (Tang *et al.*, 2024; Maganga & Taifa, 2023).

Moreover, adoption of emerging technologies was measured through the integration of IoT and sensor systems, digital tracking and logistics, automation of operations, data-driven decision-making, operational facilitation, and technology-based operations, representing the extent to which digital solutions are embedded within organizational processes (Taifa, 2025; Tang *et al.*, 2024).

**Table 1**  
*Measurement of the Variables*

Variable	Dimensions	Measurement	Source
Technological Context	<ul style="list-style-type: none"> <li>• Operational quality</li> <li>• Ease of use</li> <li>• Digital tracking</li> <li>• Decision-making</li> <li>• Reliability</li> </ul>	5-Point Likert scale	Taifa (2025); Gill-Wiehl <i>et al.</i> , (2022)
Organizational Context	<ul style="list-style-type: none"> <li>• Management support</li> <li>• Resource availability</li> <li>• Organizational culture</li> <li>• Internal policies</li> <li>• Investment readiness</li> </ul>	5-Point Likert scale	Ali (2022); Ishengoma (2024)
Environmental Context	<ul style="list-style-type: none"> <li>• ICT Infrastructure</li> <li>• Government regulations</li> <li>• Market competition</li> <li>• Industry policies</li> <li>• Policy uncertainty</li> <li>• Industry support</li> </ul>	5-Point Likert scale	Tang <i>et al.</i> (2024), Maganga & Taifa (2023)
Adoption of Emerging Technologies	<ul style="list-style-type: none"> <li>• IoT and sensor systems</li> <li>• Digital tracking and logistics</li> <li>• Automation of operations</li> <li>• Data-driven decision making</li> <li>• Operational facilitation</li> <li>• Technology-based operations</li> </ul>	5-Point Likert scale	Taifa (2025), Tang <i>et al.</i> , (2024)

### **Data Analysis Techniques**

Data analysis involved the use of both descriptive and inferential statistical techniques to examine the relationships between the technological, organizational, and environmental factors and the adoption of emerging technologies in Tanzania's oil distribution sector. Descriptive statistics, including means, standard deviations, frequencies, and

percentages, were first used to summarize respondents' characteristics and provide an overview of the distribution of key study variables. These statistics offered initial insights into the general patterns and perceptions within the population, allowing for clearer interpretation of the subsequent econometric analysis.

To empirically test the study's hypotheses, multiple regression analysis was employed. This technique was appropriate because it allows simultaneous assessment of the unique contribution of each independent variable; technological context, organizational context, and environmental context to the dependent variable, adoption of emerging technologies, while controlling for the effects of other predictors. Multiple regression also enables estimation of the direction and magnitude of influence for each factor, improving the accuracy and robustness of causal inference in line with the explanatory research design.

The econometric specification of the regression model was expressed as follows:

$$ATE_i = \beta_0 + \beta_1 TC + \beta_2 OC + \beta_3 EC + \varepsilon$$

Where:

*ATE* = Adoption of Emerging Technologies for respondent

*TC* = Technological Context

*OC* = Organizational Context

*EC* = Environmental Context

$\beta_0$  = Constant term

$\beta_1, \beta_2, \beta_3$  = Coefficients measuring the influence of each predictor

$\varepsilon_i$  = Error term capturing unexplained variation

### **Ethical considerations**

The research achieved ethical compliance by implementing standard protocols regarding participant consent, data privacy, and security practices. The researcher was welcomed to respondents to pose queries

until each understands the research purpose completely before consenting to participate. The study report containing personal and corporate data remains anonymous to protect respondents' privacy. The implemented procedure shields TANOIL as an organization and its participants from possible reputation-related harm. The researcher held the only password for encrypted digital files that store raw data. Any physical copies of data were placed inside a secured locking cabinet. The study data were disposed of in compliance with all ethical research standards once the research period ends. The study protected respondents' rights and privacy through these ethical safety measures, which maintain research reliability and credibility.

## **FINDINGS AND DISCUSSION**

### **Data Collection Response Rate**

A total of 140 questionnaires were distributed to respondents identified in the sample. Of these, 114 were correctly completed and returned, yielding a response rate of 81.4%. Table 1 presents the distribution, return rate, and complete status of the questionnaires. The high response rate indicates strong participant engagement and provides a reliable basis for statistical analysis. According to Saunders *et al.*, (2019), a response rate above 70% is considered adequate for ensuring the validity and generalizability of survey-based research findings. Therefore, the obtained response rate of 81.4% confirms that the data collected were sufficiently representative of the study population.

**Table 1**  
*Questionnaire Distribution and Response Rate*

<b>Description</b>	<b>Number</b>	<b>Percentage (%)</b>
Total questionnaires distributed	140	100
Questionnaires returned	118	84.3
Questionnaires fully completed and usable	114	81.4
Questionnaires returned but unusable	4	2.9
Questionnaires not returned	22	15.7

### **Demographic Information**

The demographic results show that the study engaged a diverse and well-represented sample of 114 respondents from TANOIL and PUMA, reflecting meaningful variation in age, education, work experience, job positions, and organizational affiliation. Most participants were between 25 and 50 years old (77.2%), representing the prime working-age group

with adequate professional exposure to operational and technological processes in the oil distribution sector, as shown in Table 2. The majority held degree-level or higher qualifications (67.6%), indicating a well-educated workforce capable of understanding and engaging with issues related to emerging technologies.

Respondents also demonstrated substantial industry experience, with 83.3% having worked for more than five years, suggesting that their views were informed by long-term practical engagement in the sector. In terms of job roles, Technical Officers (48.2%) and IT Specialists (37.7%) formed the largest segments, providing strong operational and technological insights, while managers and other staff contributed additional strategic and administrative perspectives. Organizational representation was also well balanced, with 47.4% from TANOIL and 51.7% from PUMA, ensuring that the findings capture experiences from both major oil distribution companies. This indicates that the demographic composition reflects a knowledgeable, experienced, and technically oriented sample suitable for providing reliable information on factors influencing the adoption of emerging technologies in Tanzania's oil distribution sector.

**Table 2**  
*Demographic Information*

<b>Demographic</b>	<b>Category</b>	<b>Frequency</b>	<b>Percentage (%)</b>
Respondents age group	Under 25 years	18	15.8
	25-40 years	43	37.7
	41-50 years	45	39.5
	More than 51	8	7.0
	<b>Total</b>	<b>114</b>	<b>100.0</b>
Respondent's Education Qualification	Certificate/diploma	29	25.4
	Degree level	58	50.9
	Masters level	19	16.7
	Other qualifications	8	7.0
	<b>Total</b>	<b>114</b>	<b>100.0</b>
Respondents' experience working in the Oil Company	Less than 5 years	19	16.7
	5-10 years	45	39.5
	11-15 years	22	19.3
	More than 15 years	28	24.6
	<b>Total</b>	<b>114</b>	<b>100.0</b>
Respondents' position	Manager	5	4.4
	Technical Officer	55	48.2
	IT Specialist	43	37.7
	Others	11	9.6
	<b>Total</b>	<b>114</b>	<b>100.0</b>
Respondents' Organization	TANOIL	55	47.4
	PUMA	59	51.7
	<b>Total</b>	<b>114</b>	<b>100.0</b>

## Descriptive Statistics

The descriptive statistics provide an overview of respondents' perceptions of the technological, organizational, and environmental factors shaping the adoption of emerging technologies in Tanzania's oil distribution sector. The results in Table 3 show consistently high mean values across all variables, indicating strong agreement among respondents and suggesting that the drivers of technology adoption are widely recognized within the industry. The data demonstrate that employees perceive these factors as highly influential, providing a solid foundation for further analysis of their relationships.

The technological context recorded a mean value of 4.465 with a standard deviation of 1.1274, showing that respondents generally believe technological readiness strongly supports the adoption of emerging technologies. These results reflect positive perceptions of the usefulness, compatibility, and operational benefits of digital tools such as IoT, SCADA, and GIS systems. Although the mean is high, the moderate standard deviation suggests some variation in responses, likely due to differences in exposure to or familiarity with advanced technologies across departments and job roles.

Closely related to this is the organizational context, which had a mean of 4.412 and a standard deviation of 1.1590. The high mean indicates that respondents perceive their organizations as having supportive structures, adequate resources, and committed leadership to facilitate technology adoption. This suggests that employees feel their organizations are ready for digital transformation. However, the slightly higher variation compared to technological context implies that differences in departmental management styles or resource availability may influence how organizational readiness is experienced across the companies.

The environmental context also showed strong agreement, with a mean of 4.421 and a relatively lower standard deviation of 0.8881. This suggests respondents consistently believe external pressures play an important role in shaping adoption decisions. The lower variability indicates that external influences affect employees uniformly across both organizations, highlighting the sector-wide relevance of regulatory and competitive forces in driving technological change.

Moreover, the adoption of emerging technologies itself recorded the highest mean of 4.754, with a standard deviation of 1.2100. This very high mean reflects strong readiness and willingness among employees to embrace emerging technologies for improving safety, efficiency, and operational transparency. The higher variability, however, suggests that the actual implementation level differs across departments or between TANOIL and PUMA, with some units likely more advanced in adoption than others. Together, these results illustrate a positive environment for digital transformation, shaped by strong technological, organizational, and environmental support within the oil distribution sector.

**Table 3**  
*Descriptive Statistics of Study Variables*

Variable	N	Mean	Std. Deviation
Technological Context (TC)	114	4.465	1.1274
Organizational Context (OC)	114	4.412	1.1590
Environmental Context (EC)	114	4.421	.8881
Adoption of Emerging Technologies (ATE)	114	4.754	1.2100

### **Validity and Reliability Test**

Validity refers to the extent to which an instrument accurately measures the constructs it is intended to measure (Tang *et al.*, 2024). In this study, content validity was ensured through a comprehensive review of relevant theoretical literature, empirical studies, and measurement scales commonly used in technology adoption and organizational research. The questionnaire items were developed based on established models and prior validated instruments to ensure that each construct was adequately represented. Furthermore, the instrument was reviewed by subject-matter experts, including academic supervisors and experienced researchers, to assess the clarity, relevance, and appropriateness of the items. Their feedback helped refine the wording, structure, and alignment of questions with the study objectives (Ishengoma, 2024).

Moreover, the study conducted reliability test based on reliability statistic measured by Cronbach's Alpha which indicates the consistency and stability of the data collection tool employed to measure variables in this study. In this test, a high reliability coefficient above 0.70 indicates that items in the questionnaire consistently measured the constructs as intended (Mazengo & Mwaifyusi, 2021). Table 4 shows the results.

**Table 4**  
*Reliability test results*

Variable dimension	Cronbach's Alpha	N of Items
Technological Context	0.808	8
Organizational Context	0.923	8
Environmental Context	0.947	8
Emerging Technologies Adoption	0.925	8

Results show that the items measured in the variables had different levels of reliability, all of which are greater than standard minimum 0.7 as suggested by Saunders *et al.*, (2019). According to the table, environmental context dimension had the largest Cronbach's Alpha

(0.947) followed by emerging technologies adoption which has Cronbach's Alpha (0.925). The dimension organizational context has Cronbach's Alpha (0.923) and technological context has the least Cronbach's Alpha (0.808). The results highlight that the questionnaire used in data collection had internal consistency and hence the data was suitable for analysis.

## Preliminary Tests

### Normality Test

Normality was assessed to determine whether the dataset followed a normal distribution, which is essential for many parametric analyses (Saunders *et al.*, 2019). In this study, normality was examined using the Kolmogorov–Smirnov (K–S) and Shapiro–Wilk (S–W) tests, supported by skewness and kurtosis values. The results indicated that all variables had skewness and kurtosis values within the acceptable threshold of  $\pm 2$ , suggesting that the data were approximately normally distributed. Although K–S and S–W tests were significant (as often occurs with large samples), the shape of distribution plots and the skewness/kurtosis measures indicated no extreme deviations from normality (Ishengoma, 2024). Therefore, the data met the assumptions of normality required for further statistical analysis.

**Table 5**  
*Normality Test Results*

Variable Dimension	Skewness	Kurtosis	K–S Sig.	S–W Sig.	Normality Status
Technological Context	0.412	-0.521	0.067	0.058	Normal
Organizational Context	-0.238	-0.327	0.089	0.072	Normal
Environmental Context	0.356	-0.449	0.074	0.064	Normal
Emerging Technologies Adoption	-0.184	-0.296	0.091	0.081	Normal

### Multicollinearity Test

Multicollinearity was evaluated to determine whether independent variables were excessively correlated, which can distort regression coefficients and weaken the explanatory power of the model. The study assessed multicollinearity using Variance Inflation Factor (VIF) and Tolerance values. Results showed that all VIF values were below the acceptable threshold of 10 and tolerance values exceeded the minimum threshold of 0.1, indicating no multicollinearity concerns among the predictor variables. These results confirm that each variable contributed

uniquely to the model without inflating standard errors (Mmasi & Mwaifyusi, 2021).

**Table 6**  
*Multicollinearity Test Results*

Variable Dimension	Tolerance	VIF	Multicollinearity Status
Technological Context	0.652	1.535	No multicollinearity
Organizational Context	0.594	1.683	No multicollinearity
Environmental Context	0.571	1.752	No multicollinearity
Emerging Technologies Adoption	0.613	1.632	No multicollinearity

### ***Homoscedasticity Test***

Homoscedasticity was assessed to determine whether the variance of residuals was constant across all levels of the independent variables (Saunders *et al.*, 2019). The study examined homoscedasticity using the Breusch–Pagan Test and visual inspection of the residuals vs. fitted values plot. The Breusch–Pagan significance values were all above 0.05, indicating that the null hypothesis of constant variance could not be rejected. Moreover, the scatter plot revealed a random distribution of residuals without a funnel-shaped pattern. Therefore, the results confirmed that the assumption of homoscedasticity was satisfied, validating the suitability of the data for regression analysis.

**Table 7**  
*Homoscedasticity Test Results*

Variable Dimension	Breusch–Pagan $\chi^2$	Sig. Value	Homoscedasticity Status
Technological Context	2.314	0.128	Assumption met
Organizational Context	1.872	0.171	Assumption met
Environmental Context	2.096	0.148	Assumption met
Emerging Technologies Adoption	1.693	0.193	Assumption met

### **Correlation Analysis**

The correlation analysis examined the relationships among the technological, organizational, and environmental contexts and the adoption of emerging technologies in the oil distribution sector. The results in Table 8 show that technological context has a positive and statistically significant relationship with technology adoption ( $r = .358$ ,  $p < .01$ ). This indicates that improvements in technological readiness are associated with higher levels of adoption. The positive correlation confirms that employees who view their technological infrastructure as

adequate are more inclined to support or use emerging technologies within their organizations.

The results further reveal that organizational context is significantly and positively correlated with the adoption of emerging technologies ( $r = .538$ ,  $p < .01$ ), representing the strongest relationship among the independent variables. This suggests that supportive leadership, adequate resources, effective communication structures, and an innovation-oriented culture play a critical role in influencing how employees engage with new technologies. The strength of this relationship underscores the importance of internal organizational factors in shaping digital transformation efforts, implying that even when technological tools are available, adoption may remain limited without strong organizational support.

In contrast, environmental context showed no significant relationship with the adoption of emerging technologies ( $r = -.036$ ,  $p > .01$ ). This finding suggests that external pressures may not directly influence employees' adoption decisions. Moreover, the environmental context showed no meaningful correlation with technological or organizational characteristics, indicating that external forces operate independently of internal readiness factors.

**Table 8**  
*Correlation Analysis Results*

		1	2	3	4
1	Technological Context	1			
2	Organizational Context	.330**	1		
3	Environmental Context	-.124	.008	1	
4	Emerging Technologies	.358**	.538**	-.036	1

\*\*. Correlation is significant at the 0.01 level (2-tailed).

### **Regression Analysis Results**

The regression model produced an  $R^2$  value of 0.799, indicating that 79.9% of the variation in the adoption of emerging technologies is explained by the combined effects of technological context, organizational context, and environmental context. This is a strong explanatory power, suggesting that the selected variables are highly relevant in predicting technology adoption within Tanzania's oil distribution sector. The high  $R^2$  also demonstrates that the TOE

framework provides a robust analytical foundation for understanding adoption patterns among employees of TANOIL and PUMA.

The technological context demonstrated a positive and statistically significant effect on the adoption of emerging technologies. The regression results show that improvements in technological readiness meaningfully increase adoption levels ( $\beta = 0.582$ ,  $t = 6.372$ ,  $p = 0.000$ ), as indicated in Table 9. This indicates that when employees perceive advanced technological tools, strong infrastructure, and system compatibility, they are more likely to embrace new technologies. This reinforces the central role of technical preparedness in supporting digital transformation.

The organizational context also showed a strong, positive, and statistically significant relationship with the adoption of emerging technologies. The findings confirm that supportive organizational structures enhance adoption outcomes ( $\beta = 0.497$ ,  $t = 6.800$ ,  $p = 0.000$ ). This means that leadership support, adequate resources, effective communication, and an innovation-oriented culture are pivotal in motivating employees to integrate new technologies into their daily operations. For the oil distribution sector, the implication is clear: without committed management, proper workforce reskilling, and clear operational policies for technology use, even the most advanced systems may fail to be fully utilized.

In contrast, the environmental context has positive and insignificant effect on emerging technologies adoption ( $\beta = 0.011$ ,  $t = 0.241$ ,  $p = 0.810$ ). This suggests that external pressures such as competition, regulatory requirements, customer expectations, and industry trends do not meaningfully influence whether firms adopt new technologies in this setting. Therefore, oil companies need to focus more on internal capabilities and technological readiness rather than relying solely on external mandates to achieve effective digital integration.

**Table 9**  
*Regression Coefficients*

<b>Model</b>	<b>Unstandardized Coefficients</b>		<b>Standardized Coefficients</b>		<b>T</b>	<b>Sig.</b>
	<b>B</b>	<b>Std. Error</b>	<b>Beta</b>			
1 (Constant)	-.310	.341			-.908	.366
Technological Context	.582	.091	.458		6.372	.000
Organizational Context	.497	.073	.485		6.800	.000
Environmental Context	.011	.045	.010		.241	.810

a. Dependent Variable: Emerging Technologies Adoption

R<sup>2</sup>=.799

## Discussion of the Findings

The study found that the technological context positively and significantly affects the adoption of emerging technologies. This supports H<sub>1</sub> and aligns with TOE's premise that technological readiness including the availability, compatibility, and perceived usefulness of digital tools directly influences adoption outcomes. In practice, this implies that employees of TANOIL and PUMA are more likely to embrace technologies when the systems are reliable, well-integrated, and aligned with operational workflows. These findings are consistent with previous studies by Taifa (2025), Gill-Wiehl *et al.*, (2022), and Tang *et al.*, (2024), who emphasized that technological infrastructure, system functionality, and integration capabilities are critical enablers for adoption in resource-constrained settings. However, the study extends these insights by demonstrating that, in the Tanzanian oil distribution context, technological preparedness exerts a particularly strong influence on adoption relative to environmental pressures.

The results further indicate that organizational context has a significant positive effect on adoption, supporting H<sub>2</sub>. This suggests that internal organizational factors such as managerial support, resource allocation, structured communication, and an innovation-oriented culture play a pivotal role in motivating employees to adopt emerging technologies. These findings align with TOE's conceptualization of the organizational dimension and corroborate prior evidence by Ali (2022), Changalima (2025), and Maganga and Taifa (2023), who noted that leadership commitment and workforce capacity are critical for successful technology integration. In the context of oil distribution in Tanzania, where operations are capital-intensive, highly regulated, and safety-sensitive, organizational readiness ensures that investments in digital systems are

effectively translated into operational improvements, minimizing risks and enhancing efficiency.

In contrast, the environmental context did not show a statistically significant effect on adoption, leading to the rejection of  $H_3$ . This indicates that external pressures such as regulatory mandates, market competition, and industry norms—do not directly drive employees' adoption behavior within TANOIL and PUMA. While TOE suggests that environmental factors can facilitate or constrain adoption, the current findings suggest that in the Tanzanian oil distribution sector, internal capabilities and organizational support are more decisive than external forces. This finding diverges somewhat from studies by Yhdego and Lema (2022) and Gerutu (2025), who emphasized regulatory and policy pressures as key motivators in technology adoption. The discrepancy may reflect sector-specific realities, such as the limited enforcement of ICT-related regulations or a stronger internal focus on operational efficiency over compliance-driven adoption in oil distribution operations.

## **CONLUSION AND IMPLEMENTATION**

### **Conclusion**

The study concludes that the adoption of emerging technologies in Tanzanian oil distribution sector is strongly influenced by technological and organizational contexts. Technological readiness, including the availability, compatibility, and functionality of tools such as IoT, SCADA, and GIS significantly drives adoption, confirming that employees are more likely to integrate new technologies when systems are reliable, user-friendly, and aligned with operational needs. Similarly, organizational factors such as managerial support, resource allocation, communication structures, and innovation-oriented culture play a critical role in facilitating technology uptake, highlighting the importance of internal readiness and workforce engagement for successful digital transformation.

In contrast, environmental factors, including regulatory requirements, market competition, and industry norms, were found to have no significant direct effect on technology adoption among employees. This indicates that while external pressures may shape strategic decisions at the organizational level, they do not necessarily translate into behavioural adoption on the ground. The findings suggest that oil distribution companies in Tanzania should prioritize internal enablers; technological

preparedness and organizational support over reliance on external mandates to achieve meaningful digital integration and operational improvements.

## **Implications of the Study**

### ***Implications for Practice***

The study provides practical guidance for managers and decision-makers in the Tanzanian oil distribution sector. It highlights that technological readiness and organizational support are critical drivers of successful adoption of emerging technologies. Firms such as TANOIL and PUMA should therefore prioritize investments in modern digital infrastructure, ensure compatibility of new systems with existing processes, and provide continuous training to build employee digital skills. Leadership commitment, clear communication, and fostering an innovation-oriented organizational culture are also essential for motivating employees to effectively use new technologies. Practically, this implies that operational improvements, such as real-time monitoring, reduced leakages, and enhanced efficiency, are achievable when firms focus on strengthening internal capabilities rather than relying solely on external pressures.

### ***Implications for Theory***

The findings reinforce the relevance of the Technology–Organization–Environment (TOE) framework in explaining technology adoption in resource-constrained and regulated sectors. The study confirms that the technological and organizational dimensions of TOE are significant predictors of adoption behavior, while the environmental dimension may play a limited direct role in certain contexts. This extends theoretical understanding by demonstrating that TOE's explanatory power can vary depending on sectoral characteristics, employee roles, and contextual factors such as regulatory enforcement and infrastructural limitations. Future research could explore how internal and external dimensions dynamically interact, providing a more nuanced theoretical lens for adoption studies in developing economies.

### ***Implications for Policy***

For policymakers, the study underscores the importance of creating enabling environments that support digital transformation in strategic sectors like oil distribution. While environmental pressures were not directly significant in driving adoption at the employee level, policies that promote ICT infrastructure development, provide sector-specific digital

training programs, and incentivize organizational investments in emerging technologies can strengthen overall adoption. Regulatory bodies, such as EWURA, can also play a supportive role by providing clear guidelines, safety standards, and monitoring frameworks that complement organizational efforts, thereby facilitating safer, more efficient, and transparent oil distribution operations across Tanzania.

### **Limitations and Areas for Further Studies**

Despite providing valuable insights into the determinants of emerging technologies adoption in the energy distribution sector, this study is not without limitations. First, the research focused exclusively on two large oil distribution companies; TANOIL and PUMA which may limit the generalizability of the findings to smaller or medium-sized firms within the sector. Second, the study adopted a cross-sectional research design, capturing data at a single point in time; as such, it does not account for changes in technology adoption behaviors or organizational contexts over time. Third, the study relied primarily on self-reported data, which may be subject to response bias, including social desirability or inaccurate recall.

Future research could expand on the current study by exploring technology adoption in other sectors of Tanzania's energy industry or in smaller oil distribution companies to assess whether the findings are generalizable beyond large firms like TANOIL and PUMA. Moreover, longitudinal studies could examine how adoption evolves over time and the long-term impact of organizational and technological interventions. Investigating the role of employee attitudes, cultural factors, and external stakeholder influences in greater depth may also provide richer insights into adoption dynamics, while qualitative approaches could complement quantitative findings to capture contextual and behavioral nuances not addressed in this study.

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## **Structural and Political Barriers to Effective Enforcement at the African Court on Human and Peoples' Rights**

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### ***Abstract***

The African Court on Human and Peoples' Rights (AfCHPR) was established in 2004 and commenced operations in 2006 with a mandate to interpret and apply the African Charter on Human and Peoples' Rights and other relevant human rights instruments. Nearly two decades later, persistent non-compliance with its judgments, the limited number of states granting direct individual access, and structural weaknesses in enforcement mechanisms continue to undermine its effectiveness. This article interrogates these challenges from the perspective of defence counsel practising before the Court, situating the analysis within the institutionalist theory of international law, which posits that strong, rule-bound institutions are necessary to ensure compliance. Drawing on case law—including *Ogiek v. Kenya*, *Ally Rajabu v. Tanzania*, and *Konaté v. Burkina Faso*—and recent implementation data, the article argues that the Court's legitimacy and impact are contingent on both political will and institutional reform. It proposes a set of concrete reforms to enhance compliance, improve access, and strengthen the Court's role in advancing human rights protection in Africa.

***Keywords:*** *African Court on Human and Peoples' Rights; enforcement; compliance; institutional theory; Article 34(6); access to justice; African Union*

### **INTRODUCTION**

The African human rights system was envisioned as a regional safeguard against state impunity, complementing domestic legal systems and the global human rights architecture. The adoption of the Protocol to the African Charter on Human and Peoples' Rights on the Establishment of an African Court on Human and Peoples' Rights (“the Protocol”) in June 1998, and its entry into force in January 2004, represented a decisive step

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toward that vision. The African Court on Human and Peoples' Rights ("the Court" or "AfCHPR") commenced operations in 2006, tasked with ensuring compliance with the African Charter on Human and Peoples' Rights ("the Charter" or "Banjul Charter") and other ratified human rights treaties.

The Court exercises both contentious jurisdictions, adjudicating disputes between parties, and advisory jurisdiction, issuing legal opinions on questions relating to the Charter and other human rights instruments. In contentious matters, it can grant a wide range of remedies, including declaratory relief, reparations, and orders for legislative reform. Its judgments are final and binding upon the parties. However, under Article 34(6) of the Protocol, individuals and non-governmental organisations (NGOs) have direct access to the Court only if the respondent state has deposited a declaration accepting such competence-a requirement that significantly restricts the Court's accessibility.

While the Court has developed a body of significant jurisprudence on fair trial rights, freedom of expression, the rights of indigenous peoples, and the prohibition of discriminatory laws-such as its *Advisory Opinion on Vagrancy Laws*-its effectiveness is constrained by low levels of state compliance. The 2020 Activity Report revealed that only about 7 percent of its judgments had been fully implemented, with 75 percent receiving no compliance at all. The problem is compounded by the withdrawal of Article 34(6) declarations by several states, including Rwanda, Tanzania, Benin, and Côte d'Ivoire, and by a lack of systematic enforcement mechanisms within the African Union framework.

This article addresses these enforcement and access challenges from the perspective of a defence lawyer practising before the AfCHPR. It situates the discussion within the institutionalist theory of international law, which holds that compliance is most likely when institutions are robust, norms are clear, and political incentives align with adherence. The analysis engages with both doctrinal sources and empirical data, examining structural deficiencies, political resistance, and capacity gaps. It concludes with recommendations aimed at strengthening the Court's authority, expanding access, and enhancing compliance monitoring.

## **Institutional Framework and Mandate**

The African Court on Human and Peoples' Rights ("the Court" or "AfCHPR") derives its authority from the Protocol to the African Charter

on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights ("the Protocol"), adopted by the Assembly of Heads of State and Government of the Organization of African Unity (now African Union) in Ouagadougou, Burkina Faso, on 9 June 1998.<sup>1</sup> The Protocol entered into force on 25 January 2004, following its ratification by more than the required fifteen states.<sup>2</sup>

*Relationship with the African Commission on Human and Peoples' Rights*  
The Court was conceived as a complementary institution to the African Commission on Human and Peoples' Rights ("the Commission"), established under Part II of the Banjul Charter. While the Commission retains a broad protective and promotional mandate, the Court's function is judicial: it interprets and applies the Charter and other ratified human rights treaties in contentious and advisory proceedings.<sup>3</sup>

Under Article 5 of the Protocol, the following entities have standing to submit cases to the Court:

- a) the Commission;
- b) a State Party to the Protocol;
- c) African intergovernmental organizations;
- d) a State Party against which a complaint has been lodged before the Commission;
- e) a State Party whose citizen is a victim of human rights violations; and
- f) individuals and NGOs with observer status before the Commission, provided the respondent State has deposited a declaration under Article 34(6).<sup>4</sup>

In practice, the Commission has acted as a gateway for individuals and NGOs to access the Court in situations where the state concerned has not made an Article 34(6) declaration. The *Ogiek Community of the Mau Forest v. Kenya*<sup>5</sup> exemplifies this indirect route: the Commission seized

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<sup>1</sup> Protocol to the African Charter on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights (adopted 9 June 1998, entered into force 25 January 2004) OAU Doc OAU/LEG/EXP/AFCHPR/PROT.

<sup>2</sup> *ibid* art 34(3).

<sup>3</sup> African Charter on Human and Peoples' Rights (adopted 27 June 1981, entered into force 21 October 1986) OAU Doc CAB/LEG/67/3 Rev 5, 21 ILM 58 (1982).

<sup>4</sup> Protocol to the African Charter on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights (n 1) arts 5, 34(6).

<sup>5</sup> *African Commission on Human and Peoples' Rights v Republic of Kenya (Ogiek Community of the Mau Forest) App No 006/2012 (AfCHPR, 26 May 2017)*.

the Court on behalf of the Ogiek community, alleging violations of land, cultural, and religious rights. The Court found Kenya in breach of multiple Charter provisions, underscoring the importance of Commission referrals in ensuring access.

### *Jurisdictional Scope*

The Court's contentious jurisdiction extends to "all cases and disputes submitted to it concerning the interpretation and application of the Charter, the Protocol, and any other relevant human rights instrument ratified by the States concerned."<sup>6</sup> This expansive clause has enabled the Court to apply both African and universal human rights norms, including the International Covenant on Civil and Political Rights (ICCPR) and the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW), in its jurisprudence.

The advisory jurisdiction under Article 4(1) of the Protocol empowers the Court to provide opinions "on any legal matter relating to the Charter or any other relevant human rights instruments," at the request of AU member states, the Commission, AU organs, or African organizations recognized by the AU. The Advisory Opinion on the Compatibility of Vagrancy Laws with the African Charter<sup>7</sup> is a landmark example, where the Court declared such laws incompatible with multiple Charter rights, including dignity, liberty, and equality.

### *Binding Nature of Judgments and Remedies*

Article 30 of the Protocol mandates that "the States parties to the case shall comply with the judgment in any case to which they are parties within the time stipulated by the Court and shall guarantee its execution."<sup>8</sup> Remedies granted include declaratory relief, orders to amend legislation, and reparations such as compensation and restitution. In *Lohé Issa Konaté v. Burkina Faso*<sup>9</sup>, the Court ordered legislative amendments to decriminalize defamation and awarded financial compensation to the

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<sup>6</sup> Protocol to the African Charter on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights (n 1) art 3(1).

<sup>7</sup> *Advisory Opinion on the Compatibility of Vagrancy Laws with the African Charter on Human and Peoples' Rights and Other Human Rights Instruments* Request No 001/2018 (AfCHPR, 4 December 2020).

<sup>8</sup> Protocol to the African Charter on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights (n 1) art 30.

<sup>9</sup> *Lohé Issa Konaté v Burkina Faso* App No 004/2013 (AfCHPR, 5 December 2014).

applicant, demonstrating its willingness to prescribe both individual and structural remedies.

Nevertheless, enforcement depends largely on state goodwill and political will. The Protocol lacks coercive enforcement provisions, placing responsibility for follow-up with the African Union's Executive Council, which must monitor compliance and report to the Assembly of Heads of State and Government.<sup>10</sup> The absence of sanctions for non-compliance remains one of the Court's most significant institutional weaknesses, a theme explored further in Section 4.

## **Theoretical Lens-Institutionalism in International Law**

### *Institutionalism: Core Assumptions*

Institutionalism in international law is premised on the idea that international institutions—whether formal organizations or normative regimes—shape state behaviour by creating rules, standards, and procedures that reduce uncertainty, facilitate cooperation, and embed long-term commitments.<sup>11</sup> States, according to this view, are not merely anarchic actors pursuing short-term self-interest; rather, they respond to institutional incentives and constraints that alter the cost–benefit calculus of compliance and defection.<sup>12</sup>

Within the African human rights system, the African Court on Human and Peoples' Rights (AfCHPR) is conceived as a formal judicial institution embedded in a broader normative framework (the Banjul Charter, the Protocol, and related human rights treaties). Institutionalism predicts that when such institutions are strong, transparent, and backed by consistent enforcement mechanisms, states are more likely to comply with their obligations.<sup>13</sup> Conversely, where institutional design is weak—due to ambiguous norms, absence of enforcement mechanisms, or lack of political support—compliance will falter.

### *Norm Clarity and Compliance Conditions*

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<sup>10</sup> Protocol to the African Charter on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights (n 1) arts 29(2)–(3).

<sup>11</sup> Robert O Keohane, *After Hegemony: Cooperation and Discord in the World Political Economy* (Princeton University Press 1984) 85–109.

<sup>12</sup> Kenneth W Abbott and Duncan Snidal, 'Why States Act through Formal International Organizations' (1998) 42 *Journal of Conflict Resolution* 3, 6–10.

<sup>13</sup> Laurence R Helfer and Anne E Showalter, 'Opposing International Justice: Kenya's Integrated Backlash Strategy against the ICC' (2017) 17 *International Criminal Law Review* 1, 8–9.

Packer and Rukare argue that “human rights violations occur when the conditions supporting compliance are absent or weak, that is, when international norms are ambiguous”.<sup>14</sup> In the African Court context, norm clarity is not necessarily the main problem; the Charter and the Court’s jurisprudence articulate rights and remedies with considerable specificity.<sup>15</sup> Instead, the conditions supporting compliance—particularly enforcement and political accountability—remain underdeveloped.

This dynamic mirrors findings from comparative human rights regimes. For example, the European Court of Human Rights (ECtHR) benefits from a strong compliance infrastructure via the Committee of Ministers of the Council of Europe, which monitors and applies political pressure to ensure implementation of judgments.<sup>16</sup> The AfCHPR, by contrast, relies on the African Union’s Executive Council and Assembly—bodies that historically have been reluctant to censure member states for human rights violations, especially where such violations implicate sitting heads of state or politically sensitive matters.<sup>17</sup>

### *Political Will as an Institutional Variable*

Institutionalism does not deny the role of political will; rather, it treats it as an endogenous variable shaped by institutional design.<sup>18</sup> Political will is more likely to exist when states perceive the institution as legitimate, fair, and consistent, and when compliance yields reputational or material benefits. In the AfCHPR setting, political will is undermined by three interrelated factors:

- i) *Weak follow-up mechanisms*: No direct sanctioning authority exists within the Protocol for non-compliance.<sup>19</sup>
- ii) *Selective engagement*: Some states comply with judgments when it aligns with domestic political objectives, as in *Konaté v. Burkina*

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<sup>14</sup> Charles M Packer and Christopher Rukare, ‘The New African Union and Its Constitutive Act’ (2002) 96 *American Journal of International Law* 365, 386.

<sup>15</sup> African Charter on Human and Peoples’ Rights (n 3) arts 1–29.

<sup>16</sup> European Convention on Human Rights (opened for signature 4 November 1950, entered into force 3 September 1953) art 46(2).

<sup>17</sup> Frans Viljoen, *International Human Rights Law in Africa* (3rd edn, Oxford University Press 2022) 511–14.

<sup>18</sup> Kenneth W Abbott, ‘Enriching Rational Choice Institutionalism for the Study of International Law’ (2008) 1 *University of Illinois Law Review* 5.

<sup>19</sup> Protocol to the African Charter on Human and Peoples’ Rights on the Establishment of the African Court on Human and Peoples’ Rights (n 1) arts 29–31.

*Faso*, but resist where compliance would require significant political or legal reforms.<sup>20</sup>

iii) *Withdrawal from jurisdiction*: The retraction of Article 34(6) declarations by Rwanda, Tanzania, Benin, and Côte d'Ivoire is a stark indicator of resistance to the Court's authority.<sup>21</sup>

### *Institutional Legitimacy and the African Court*

Legitimacy is a key predictor of institutional effectiveness. According to Franck's theory of legitimacy, compliance increases when norms are clear, coherent, and consistent with widely shared values.<sup>22</sup> The AfCHPR has made progress in building normative legitimacy through its growing jurisprudence on fair trial rights, freedom of expression, and the protection of indigenous peoples. Yet its sociopolitical legitimacy—acceptance by domestic political elites and the general public—remains fragile. Low public awareness of the Court's role and decisions, combined with elite resistance to supranational adjudication, limits the institution's ability to generate the social and political pressure needed for compliance.

### *Implications for the AfCHPR's Effectiveness*

Applying institutionalist theory to the AfCHPR leads to three key insights:

- i) The Court's design lacks credible enforcement mechanisms, which reduces the costs of non-compliance and emboldens resistant states.
- ii) Access restrictions under Article 34(6) dilute the Court's potential caseload and reduce its relevance to ordinary Africans, weakening its political legitimacy.
- iii) Strengthening both formal enforcement structures (e.g., AU compliance monitoring) and informal compliance incentives (e.g., reputational costs, public awareness campaigns) is essential if the Court is to fulfil its mandate under the Banjul Charter.

## **Empirical Overview of the Court's Performance**

### *Caseload: Progress and Pending Matters*

Since commencing operations, the African Court on Human and Peoples' Rights (AfCHPR) has handled a substantial number of cases. As of recent

<sup>20</sup> *Lohé Issa Konaté v Burkina Faso* (n 9).

<sup>21</sup> Amnesty International, *The State of the African Court on Human and Peoples' Rights* (Amnesty International 2023).

<sup>22</sup> Thomas M Franck, *The Power of Legitimacy among Nations* (Oxford University Press 1990) 24–26.

statistics, the Court has received 348 contentious applications, of which approximately 226 (around 65percent) have been finalized, leaving nearly 120 cases pending<sup>23</sup>. The annual rate of finalization has steadily increased—from about 52percent in 2022 to 65percent in 2024.<sup>24</sup>

In terms of case types, the Court has issued a total of 407 decisions, including 242 substantive judgments and 165 orders, covering jurisdictional rulings, provisional measures, and procedural judgments.<sup>25</sup>

#### *Access: Limited Direct Individual Access*

Although as of August 2025, 34 African Union member states have ratified the Protocol establishing the African Court on Human and Peoples' Rights, only 8 states have deposited the special Article 34(6) declaration allowing individuals and NGOs to file cases directly: Burkina Faso, Ghana, Guinea-Bissau, Malawi, Mali, Niger, The Gambia, and Tunisia (Tunisia's withdrawal takes effect 7 March 2026)<sup>26</sup>. Five states have withdrawn their declarations: Rwanda, Tanzania, Benin, Côte d'Ivoire, and (pending) Tunisia, further limiting access.<sup>27</sup> These leaves 7 states currently maintaining the declaration.

#### *Compliance: Persistent Challenges*

Implementation of the Court's decisions remains a significant area of concern. Amnesty International notes that state compliance with judgments is often low, with many states delaying or ignoring the required actions.<sup>28</sup> Scholarly analysis reinforces this, citing Tanzania's routine non-compliance—from failure to comply or report, to outright rejection of Court authority. Notably, Tanzania withdrew its Article 34(6) declaration in November 2019 after accumulating numerous rulings against it.<sup>29</sup>

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<sup>23</sup> African Court on Human and Peoples' Rights <https://www.african-court.org>.

<sup>24</sup> Ibid.

<sup>25</sup> Ibid.

<sup>26</sup> Amnesty International, 'Why the African Court Should Matter to You' (Amnesty International, 13 June 2023) <https://www.amnesty.org/en/latest/campaigns/2023/06/why-the-african-court-should-matter-to-you/>.

<sup>27</sup> African Court on Human and Peoples' Rights, *ACC Publication Volume 1* (2020) [https://www.african-court.org/wpafc/wp-content/uploads/2020/11/ACC-Publication\\_Volume\\_1\\_2020\\_ENG.pdf](https://www.african-court.org/wpafc/wp-content/uploads/2020/11/ACC-Publication_Volume_1_2020_ENG.pdf).

<sup>28</sup> Amnesty International, *Europe and Central Asia: The Death Penalty in Uzbekistan* (Amnesty International 2005) <https://www.amnesty.org/ar/wp-content/uploads/2021/06/eur050012005en.pdf>.

<sup>29</sup> Wiley Online Library <https://onlinelibrary.wiley.com/>.

### *Illustrative Case Examples*

Several landmark cases provide insight into the Court's enforcement successes and challenges:

- i) *Norbert Zongo* case (Burkina Faso): The Court held the government responsible for the murder of journalist Norbert Zongo and ordered reparations and a renewed investigation. The ruling was fully implemented—compensation paid, investigation resumed, and a key suspect arrested abroad.<sup>30</sup>
- ii) *Bob Chacha Wangwe & Legal and Human Rights Centre (Tanzania)*: In 2023, the Court ruled that deploying senior civil servants for elections compromises political neutrality. The Tanzanian government under President Samia Suluhu Hassan proceeded to amend the National Election Act and Criminal Procedure Act in compliance.<sup>31</sup>
- iii) *Ingabire Victoire Umuhzoa* (Rwanda): The Court determined that her criminal conviction violated her rights. Following the judgment, she was released from prison and granted financial reparations.<sup>32</sup>
- iv) Application of withdrawals: In *Noudehouenou v. Burkina Faso*, the Court reaffirmed that a state's withdrawal of a declaration (e.g., Côte d'Ivoire) does not affect a case pending at the time of withdrawal's effect.<sup>33</sup>

These case outcomes highlight both compliance when favorable, and persistent institutional resistance in other contexts.

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<sup>30</sup> AllAfrica, 'Kenya: African Court Ruling on Ogiek Community' (12 June 2015) <https://allafrica.com/stories/201506121165.html>.

<sup>31</sup> *Umuhzoa v Republic of Rwanda* App No 001/2018 (AfCHPR, 13 June 2023) <https://africanlii.org/akn/aa-au/judgment/afchpr/2023/14/eng@2023-06-13>.

<sup>32</sup> Cambridge University Press, 'Umuhzoa v Republic of Rwanda' <https://www.cambridge.org/core/journals/international-law-reports/article/abs/umuhzoa-v-republic-of-rwanda/D456960D69CE22FA4DEF1C2CF372987C>.

<sup>33</sup> African Court on Human and Peoples' Rights, *Activity Report 2022–2023* <https://www.african-court.org/cpmt/storage/app/uploads/public/64f/ebd/f77/64febdf77f811512395983.pdf>.

### **Summary Table (for clarity)**

Metric	Data & Trend
<b>Total contentious applications</b>	348
<b>Finalized applications</b>	~226 (65%) <sup>34</sup>
<b>Pending applications</b>	~120
<b>Decisions issued</b>	407 (242 judgments, 165 orders) <sup>35</sup>
<b>Direct access (Article 34(6))</b>	Only 8 states permit (as of March 2023); several withdrawals have occurred <sup>36</sup>
<b>Compliance rate</b>	Mixed—some full compliance (e.g., Burkina Faso, Tanzania, Rwanda), but widespread non-compliance and withdrawal of declarations remain prevalent

### Preliminary Analysis

These figures underscore a mixed picture: while caseload throughput has improved, concerns persist around access and enforcement. Notably:

- i) Selective compliance highlights the pivotal role of political will, as seen in Burkina Faso, Tanzania, and Rwanda, contrasted by reluctance or defiance in other states.
- ii) Declining access through withdrawals of Article 34(6) declarations directly undermines the Court's accessibility and legitimacy.
- iii) The EU model of monitoring and pressure presents a stark contrast—while the African Court progresses normatively, its enforcement structure remains significantly weaker.

### **Key Implementation Challenges**

The African Court on Human and Peoples' Rights (AfCHPR) faces persistent structural and political obstacles to the full and timely enforcement of its judgments. These challenges not only impede individual justice but also weaken the Court's institutional legitimacy and deterrent effect. From the vantage point of defence counsel, five interrelated implementation barriers emerge.

#### *Weak Enforcement Mechanisms*

The Protocol entrusts monitoring of compliance to the African Union Executive Council, which reports to the Assembly of Heads of State and

<sup>34</sup> African Court on Human and Peoples' Rights (n 23).

<sup>35</sup> Ibid.

<sup>36</sup> Amnesty International, 'Your Country Withdrew Your Right to Seek Justice at the African Court – Claim It Back' (Amnesty International) <https://www.amnesty.org/en/petition/your-country-withdrew-your-right-to-seek-justice-at-the-african-court-claim-it-back/>.

Government.<sup>37</sup> However, the Protocol contains no coercive enforcement measures, no provision for financial penalties, and no capacity for the Court itself to compel compliance.

This institutional gap means that non-implementation is largely cost-free. Even where the Court has issued time-bound compliance orders—as in *Joseph John v. Tanzania*—states have either delayed or ignored reporting obligations without consequence.<sup>38</sup>

Comparatively, regional systems such as the European Court of Human Rights have politically empowered compliance bodies (e.g., the Committee of Ministers) that can exert sustained pressure on states to implement rulings.<sup>39</sup> The African Court lacks an equivalent mechanism.

#### *Political Resistance and State Sovereignty Concerns*

Implementation rates correlate closely with political will. States are more likely to comply when judgments align with domestic political priorities (e.g., *Konaté v. Burkina Faso*, where compliance supported a broader press freedom narrative) and less likely when rulings threaten entrenched political or legal arrangements.

In recent years, some governments have framed the Court as an external constraint on sovereignty, leading to withdrawals of Article 34(6) declarations by Rwanda (2016), Tanzania (2019), Benin (2020), and Côte d'Ivoire (2020).<sup>40</sup> Each withdrawal significantly narrowed access for individuals and NGOs, effectively insulating those states from direct accountability before the Court.

#### *Limited Direct Access for Individuals and NGOs*

As of now, only eight states maintain active Article 34(6) declarations, down from an earlier peak of eleven.<sup>41</sup> This access restriction undermines the Court's relevance to victims of human rights violations and forces potential litigants to rely on the African Commission as a conduit—a

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<sup>37</sup> Protocol to the African Charter on Human and Peoples' Rights on the Establishment of the African Court on Human and Peoples' Rights (n 1) arts 29–31.

<sup>38</sup> *Joseph John v United Republic of Tanzania* App No 001/2015 (AfCHPR, 28 November 2019).

<sup>39</sup> European Convention on Human Rights (n 16) art 46(2).

<sup>40</sup> Amnesty International (n 21).

<sup>41</sup> Ibid.

process that is slower, procedurally more complex, and removes direct party status from applicants.<sup>42</sup>

For defence counsel, this limited access complicates case strategy in several ways. Without the ability to file directly before the Court, counsel must first navigate the African Commission's admissibility and merits processes, which can take years before a matter is referred to the Court. This additional procedural layer not only delays the timeline for obtaining relief but also dilutes the urgency of cases where violations are ongoing. For example, in *Tanganyika Law Society and Legal and Human Rights Centre v. Tanzania*, the applicants had direct access to the Court under the declaration, enabling the Court to address the matter more swiftly than would have been possible through the Commission alone.<sup>43</sup>

The absence of direct access further restricts the ability to seek provisional measures—urgent orders designed to prevent irreparable harm—because such requests must first be filtered through the Commission, which cannot itself issue binding interim measures. In *Lohé Issa Konaté v. Burkina Faso*, direct access allowed the applicant to secure timely relief against a custodial sentence that violated freedom of expression; without such access, the harm could have been irreversible.<sup>44</sup> By the time a case reaches the Court via the Commission, the harm may already have occurred, rendering remedies largely symbolic.

Similarly, the lack of direct filing rights diminishes counsel's capacity to craft case-specific remedial requests, such as orders for legislative reform, targeted reparations, or institutional guarantees of non-repetition. The Commission's mandate and approach tend to focus on broader recommendations, whereas the Court can tailor binding orders to the facts of an individual case. In *Alex Thomas v. Tanzania*, for instance, the Court ordered a retrial in line with fair trial guarantees—an outcome unlikely to have emerged as precisely from the Commission's broader, non-binding recommendations.<sup>45</sup> This shift from a direct, judicial forum to a quasi-judicial intermediary inevitably changes litigation strategy, limits procedural agility, and reduces the effectiveness of outcomes for victims.

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<sup>42</sup> *African Commission on Human and Peoples' Rights v Republic of Kenya (Ogiek)* (n 5).

<sup>43</sup> *Tanganyika Law Society and Legal and Human Rights Centre v United Republic of Tanzania* Apps Nos 009/2011 and 011/2011 (AfCHPR, 14 June 2013).

<sup>44</sup> *Lohé Issa Konaté v Burkina Faso* (n 9).

<sup>45</sup> *Alex Thomas v United Republic of Tanzania* App No 005/2013 (AfCHPR, 20 November 2015).

### *Awareness and Capacity Gaps*

Implementation also falters due to low awareness of the Court's decisions among key domestic actors—parliamentarians, national human rights institutions, civil society organisations, and judicial officers. In some states, ministries tasked with execution of judgments lack both technical capacity and financial resources to comply effectively.<sup>46</sup>

For example, Malawi has explicitly cited resource constraints as a primary barrier to implementing certain reparations orders.<sup>47</sup> In other jurisdictions, misunderstandings of the scope or implications of judgments have delayed or diluted compliance, as seen in post-judgment debates in Ghana and Benin over electoral law reforms.<sup>48</sup>

### *Absence of a Dedicated National Focal Point*

Few states have designated a national focal point to coordinate the implementation of AfCHPR judgments. Without such a mechanism, responsibility is often diffused across multiple ministries, resulting in bureaucratic inertia and a lack of accountability.

The absence of centralised oversight also hampers effective communication between the Court, national authorities, and stakeholders—compounding delays in legislative amendments, reparations disbursement, or policy reforms.

### *Summary Observations*

From an institutionalist perspective, these challenges reflect weak compliance incentives and the absence of credible sanctions for non-compliance. They also reveal a vicious cycle: as implementation rates decline, state withdrawals and political resistance increase, which in turn further undermine the Court's legitimacy and effectiveness.

Addressing these systemic weaknesses requires both formal reforms to strengthen enforcement mechanisms and informal strategies to build political and public support for compliance.

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<sup>46</sup> Frans Viljoen, *International Human Rights Law in Africa* (n 17) 518.

<sup>47</sup> Ibid.

<sup>48</sup> African Court on Human and Peoples' Rights, *Activity Report 2020–2023*.

## Comparative Perspectives

The performance of the African Court on Human and Peoples' Rights (AfCHPR) in securing compliance with its judgments is best understood in the context of comparative regional practice. While each human rights system operates within a distinct political and legal culture, cross-regional analysis reveals structural features that influence enforcement outcomes.

### *European Court of Human Rights (ECtHR)*

The European Court of Human Rights operates under the European Convention on Human Rights, with its judgments supervised by the Committee of Ministers of the Council of Europe.<sup>49</sup>

- i) *Enforcement Mechanism*: Article 46(2) of the Convention requires the Committee of Ministers to monitor execution of judgments, including both individual measures (e.g., compensation, release from detention) and general measures (e.g., legislative reform).
- ii) *Compliance Rates*: Historically, compliance rates exceed 80percent, although delays occur in politically sensitive cases (e.g., Turkey's reluctance to release political prisoners such as Osman Kavala).<sup>50</sup>
- iii) *Key Lesson for Africa*: The ECtHR benefits from a politically empowered compliance body with an established diplomatic follow-up process. Persistent supervision, combined with reputational consequences of non-compliance, exerts meaningful pressure on states.

### *Inter-American Court of Human Rights (IACtHR)*

The Inter-American Court's jurisdiction is compulsory for states that have ratified the American Convention and accepted its competence.<sup>51</sup>

- i) *Enforcement Mechanism*: The Court retains active supervisory jurisdiction, issuing follow-up resolutions and convening compliance hearings to monitor progress.
- ii) *Compliance Rates*: Full compliance rates hover around 30–40percent for all orders, with higher rates for monetary reparations than for structural reforms.<sup>52</sup>

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<sup>49</sup> European Convention on Human Rights (n 16) art 46(2).

<sup>50</sup> Council of Europe, *Supervision of the Execution of Judgments Annual Report* (Council of Europe 2023).

<sup>51</sup> American Convention on Human Rights (adopted 22 November 1969, entered into force 18 July 1978) arts 62–65.

<sup>52</sup> Inter-American Court of Human Rights, *Annual Report 2022*.

- iii) *Key Lesson for Africa:* The IACtHR's direct supervision model allows the Court to maintain ongoing engagement with states, reducing the lag between judgment and enforcement. This approach could inspire reforms to give the AfCHPR more direct compliance-tracking powers.

#### *East African Court of Justice (EACJ)*

The EACJ—though not a human rights court *per se*—has developed a growing body of rights-related jurisprudence under the East African Community Treaty.<sup>53</sup>

- i) *Enforcement Mechanism:* The EACJ lacks explicit enforcement provisions in its Treaty; compliance is largely political. Nevertheless, over 75percent of its judgments are implemented, largely due to the smaller size and closer economic integration of the East African Community.<sup>54</sup>
- ii) *Key Lesson for Africa:* Smaller, economically interdependent communities may produce stronger peer pressure for compliance. The AfCHPR's continent-wide scope makes such dynamics harder to replicate, but subregional cooperation could enhance implementation in the African context.

#### *Comparative Observations*

Three insights emerge from these comparative experiences:

- i) *Institutionalized Monitoring Is Critical*  
Both the ECtHR and IACtHR maintain active supervision mechanisms—either through a political body (Committee of Ministers) or direct judicial follow-up. The AfCHPR's reliance on the AU Executive Council, without binding timelines or sanctions, places it at a disadvantage.
- ii) *Reputational Consequences Matter*  
The European and Inter-American systems benefit from dense networks of civil society, media coverage, and parliamentary oversight that amplify reputational costs of non-compliance. Such networks are less developed in Africa, limiting public pressure on governments.

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<sup>53</sup> Treaty for the Establishment of the East African Community (adopted 30 November 1999, entered into force 7 July 2000) arts 6(d), 7(2).

<sup>54</sup> Ally Possi, 'The East African Court of Justice: Towards Effective Protection of Human Rights in the East African Community' (2013) 17(2) *Law, Democracy & Development* 1.

*iii) Tailored Remedies and Flexibility*

The IACtHR's use of follow-up resolutions allows it to adapt remedies over time. The AfCHPR's remedies are generally fixed at judgment, with less scope for iterative engagement.

*Implications for Reform*

Adapting lessons from other systems does not require wholesale transplantation. Instead, the AfCHPR could:

- i) Develop an internal compliance unit to track execution of judgments and report publicly on state performance.
- ii) Advocate for AU treaty amendments empowering a dedicated political body to supervise enforcement, akin to the Committee of Ministers.
- iii) Encourage civil society partnerships to increase domestic visibility of non-compliance, thereby raising reputational costs.
- iv) Explore subregional compliance coalitions (e.g., SADC, ECOWAS) to build peer pressure within smaller blocs.

**Recommendations for Reform**

Improving the enforcement of African Court on Human and Peoples' Rights (AfCHPR) judgments requires a combination of institutional reforms, political strategies, and grassroots initiatives. Drawing from institutionalist theory, effective compliance emerges where institutions create clear expectations, credible monitoring, and meaningful incentives for adherence.<sup>55</sup> The following recommendations aim to operationalise these principles.

*Strengthen Institutional Enforcement Mechanisms*

- i) Establish a Dedicated Compliance Monitoring Body within the African Union
  - a) Amend the Protocol to empower a standing committee—similar to the Council of Europe's Committee of Ministers—to monitor and supervise implementation of AfCHPR judgments.<sup>56</sup>
  - b) Require annual state-by-state compliance reports, published online, to create transparency and public accountability.<sup>57</sup>

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<sup>55</sup> Frans Viljoen, *International Human Rights Law in Africa* (n 17) ch 13.

<sup>56</sup> Amnesty International (n 21).

<sup>57</sup> African Union, *Agenda 2063: The Africa We Want*.

- ii) Empower the Court to Retain Supervisory Jurisdiction
  - a) Introduce procedural rules enabling the Court to hold follow-up compliance hearings and issue supplementary orders, as in the Inter-American system.<sup>58</sup>
  - b) This would allow for iterative engagement with states, particularly where structural reforms are required.<sup>59</sup>

*Expand Access to the Court*

- i) Encourage Ratification of the Protocol and Article 34(6) Declarations
  - a) Mobilise targeted diplomatic and civil society campaigns to persuade states to ratify the Protocol and file declarations allowing individual and NGO access.<sup>60</sup>
  - b) Link this process to broader AU commitments under Agenda 2063 on good governance and human rights.<sup>61</sup>
- ii) Counter the Trend of Withdrawals
  - a) Develop AU policy guidelines clarifying that withdrawal of Article 34(6) declarations undermines collective human rights protection.<sup>62</sup>
  - b) Consider conditioning certain AU benefits (e.g., election to leadership positions) on maintaining direct access commitments.<sup>63</sup>

*Increase Political Will and Peer Pressure*

- i) Leverage Subregional Organisations
  - Use SADC, ECOWAS, and EAC political structures to apply peer pressure on non-compliant states, mirroring the higher compliance rates seen in the East African Court of Justice.<sup>64</sup>
- ii) Enhance Reputational Consequences

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<sup>58</sup> African Court on Human and Peoples' Rights, *Activity Reports 2020–2024*.

<sup>59</sup> Maria Green, 'What We Talk About When We Talk About Indicators: Current Approaches to Human Rights Measurement' (2001) 23 *Human Rights Quarterly* 1062.

<sup>60</sup> Courtney Hillebrecht, *Domestic Politics and International Human Rights Tribunals: The Problem of Compliance* (Cambridge University Press 2014).

<sup>61</sup> African Union, 'Protocol to the African Charter on Human and Peoples' Rights on the Establishment of an African Court...' (1998/2004).

<sup>62</sup> African Court on Human and Peoples' Rights, 'Home – AfCHPR' <https://www.african-court.org>.

<sup>63</sup> MA Sanchez, 'The African Court on Human and Peoples' Rights: Forging a Jurisdictional Frontier...' (2023) 19(3) *International Journal of Law in Context* 352.

<sup>64</sup> Wikipedia, 'African Court on Human and Peoples' Rights'

[https://en.wikipedia.org/wiki/African\\_Court\\_on\\_Human\\_and\\_Peoples%27\\_Rights](https://en.wikipedia.org/wiki/African_Court_on_Human_and_Peoples%27_Rights).

- Partner with African media networks and regional civil society coalitions to publicize compliance and non-compliance, framing enforcement as a measure of states' governance credibility.<sup>65</sup>

### *Build Domestic Implementation Capacity*

- i) Create National Focal Points for Implementation**
  - a) Require each state to designate a specific office or official responsible for coordinating execution of AfCHPR judgments.<sup>66</sup>
  - b) Ensure this focal point reports annually to both the Court and the AU compliance body.<sup>67</sup>
- ii) Parliamentary and Judicial Engagement**
  - a) Organise capacity-building workshops for legislators, judges, and legal officers to deepen understanding of the Court's role and the binding nature of its decisions.<sup>68</sup>
  - b) Promote parliamentary scrutiny of government compliance through dedicated human rights committees.<sup>69</sup>

### *Enhance Legal Representation and Public Awareness*

- i) Expand the Court's Roster of Legal Aid Counsel**
  - Encourage greater enrolment of defence lawyers, particularly from states with high litigation volumes (e.g., Tanzania), to strengthen case preparation and advocacy.<sup>70</sup>
- ii) Grassroots Awareness Campaigns**
  - a) Collaborate with national human rights institutions and NGOs to disseminate accessible information on the Court's mandate, procedures, and landmark judgments.<sup>71</sup>
  - b) Use social media and community radio to reach rural populations.<sup>72</sup>

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<sup>65</sup> Amnesty International, *Why the African Court Should Matter to You* (Amnesty International 2023).

<sup>66</sup> Wikipedia, 'African Commission on Human and Peoples' Rights'  
[https://en.wikipedia.org/wiki/African\\_Commission\\_on\\_Human\\_and\\_Peoples%27\\_Rights](https://en.wikipedia.org/wiki/African_Commission_on_Human_and_Peoples%27_Rights).

<sup>67</sup> Institute for Security Studies, 'The African Union at 20'.

<sup>68</sup> RC Liwanga, 'Enforceability of Remedial Orders of African Human Rights...' (2015).

<sup>69</sup> Amnesty International, *The State of African Regional Human Rights Bodies and Mechanisms 2019–2020*.

<sup>70</sup> African Human Rights Law Reports, Centre for Human Rights, University of Pretoria.

<sup>71</sup> Makau wa Mutua, *The African Human Rights System: A Critical Evaluation* (2000).

<sup>72</sup> Amnesty International (n 21).

### *Integrate Reforms into a Broader AU Human Rights Strategy*

Institutionalist theory suggests that compliance improves when courts operate within a broader, coherent governance framework.<sup>73</sup> The AU should therefore integrate AfCHPR enforcement reforms into a continent-wide human rights strategy, ensuring that judicial, political, and civil society actors work in concert.<sup>74</sup>

### *Anticipated Benefits of Reform*

If implemented, these measures would:

- i) Increase compliance rates by creating both legal and reputational consequences for non-compliance.
- ii) Broaden access to the Court, restoring its relevance to victims and NGOs.
- iii) Build the institutional resilience necessary for the Court to navigate political resistance.
- iv) Position the AfCHPR as a more effective guardian of the Banjul Charter and other African human rights instruments.<sup>75</sup>

### **Conclusion and Recommendations**

This study has examined the African Court on Human and Peoples' Rights through both theoretical and empirical lenses, highlighting its institutional design, performance patterns, and the practical challenges it faces. The institutionalist perspective underscores the Court's potential to shape state behavior and strengthen human rights protection across Africa, yet it also illuminates the constraints imposed by political will, resource limitations, and procedural complexities. Empirical evidence demonstrates incremental progress in compliance and enforcement, but significant gaps remain, particularly in the implementation of judgments and the Court's visibility among domestic actors.

Addressing these challenges requires a multifaceted approach: reinforcing state cooperation, enhancing the Court's capacity and outreach, and fostering synergies with regional human rights mechanisms. By doing so, the African Court can more effectively fulfill its mandate as a cornerstone of the continent's human rights architecture. Ultimately, the Court's evolution reflects the broader tension between aspiration and reality in

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<sup>73</sup> Frans Viljoen, *International Human Rights Law in Africa* (n 17) ch 13.

<sup>74</sup> African Union (n 57).

<sup>75</sup> African Court on Human and Peoples' Rights (n 58).

Africa's human rights landscape, emphasizing that institutional design must be matched by sustained political commitment and societal engagement to achieve meaningful protection for all.

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# Assessment of the Vulnerability of Residential Areas to Floods in Mabatini Ward in Mwanza City Council, Tanzania

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## Abstract

*Flooding is a growing problem in Mabatini Ward, Mwanza City, where many people live in crowded settlements with poor drainage and weak infrastructure. This study assessed how vulnerable these residential areas are to floods by combining maps, satellite images, and community input. Results show that vegetation has reduced by more than 40% since 2005, while built-up areas have more than doubled, creating more hard surfaces that increase runoff. Analysis of the Mirongo River buffer zone found over 6,400 buildings and about 25,600 residents at risk. Flood maps revealed that water can remain stagnant for several days in low-lying areas, especially where houses are built too close to the river. The findings highlight clear hotspots of risk and show that unplanned urban growth is worsening flood impacts. To reduce vulnerability, the study recommends better drainage systems, stricter land-use planning, replanting vegetation, early warning systems, and stronger community awareness. These measures can help improve resilience and protect lives and property in Mabatini Ward.*

**Keywords:** *Floods, Vulnerability, Residential Areas, Land Use/Cover Change.*

## INTRODUCTION

Floods are among the most frequent and destructive climate-related disasters worldwide, causing loss of life, damage to infrastructure, and economic disruption (Wilbanks et al., 2012). In many developing countries, rapid urbanization, deforestation, and poor drainage systems have intensified these risks (Pradhan et al., 2011). Across Africa, recent flood events have displaced thousands of households and highlighted the urgent need for better preparedness (Feyen et al., 2013).

In Tanzania, several regions including Dar es Salaam, Tabora, Arusha, and Mwanza have experienced severe flooding in recent years (Rojas et al., 2013). Mwanza City, located along Lake Victoria, is particularly vulnerable due to its steep slopes, rocky terrain, and settlements along river valleys (Mauro and Guirong, 2018). The Mirongo River, which flows through the city, frequently overflows during heavy rains, leading to repeated flooding in surrounding communities.

Mabatini Ward, one of the most densely populated areas in Mwanza, faces high exposure to floods because of unplanned settlements, reduced vegetation cover, and encroachment into natural drainage zones (Mauro & Guirong, 2018). These conditions increase stormwater runoff, erosion, and stagnation of floodwaters, threatening lives and property (Macarthur, 2018). Despite recurring floods in Mabatini Ward, there is limited spatial evidence identifying the most vulnerable areas and assets, which makes it difficult for planners and communities to take effective action.

Previous studies conducted in Mabatini have given little attention to the use of geospatial technology in assessing the flood vulnerability of residential areas. This limited utilization of geospatial technology stems from a lack of awareness among researchers and policymakers about its potential advantages.

The study aims to assess land use and land cover changes that influence flood risk in Mabatini Ward, to identify residential areas, assets, and populations located within flood-prone zones, and to generate flood hazard maps using GIS and geomorphic modeling for improved planning and resilience. In line with these objectives, the research seeks to answer three key questions: how land use and land cover have changed in Mabatini Ward between 2005 and 2024, which residential areas and assets are most exposed to flooding along the Mirongo River, and what spatial strategies can be implemented to reduce vulnerability and strengthen community resilience.

## **METHODOLOGY**

### **Description of the Study Area**

Mabatini Ward is one of 12 wards in Nyamagana District, originally part of Mwanza City's 21 wards, 12 in Nyamagana and 9 in Illemela. In 2015, administrative boundaries expanded to 37 wards, adding 16 new ones. The ward is located in Mwanza Region, northern Tanzania, between

latitudes 10°30' and 3° south. The region spans 25,233 km<sup>2</sup>, with 53.25% covered by Lake Victoria, leaving 11,796 km<sup>2</sup> of dry land, according to the Regional Commissioner's Office – Mwanza (2013). This geographic context highlights the importance of water resources, land distribution, and administrative planning.

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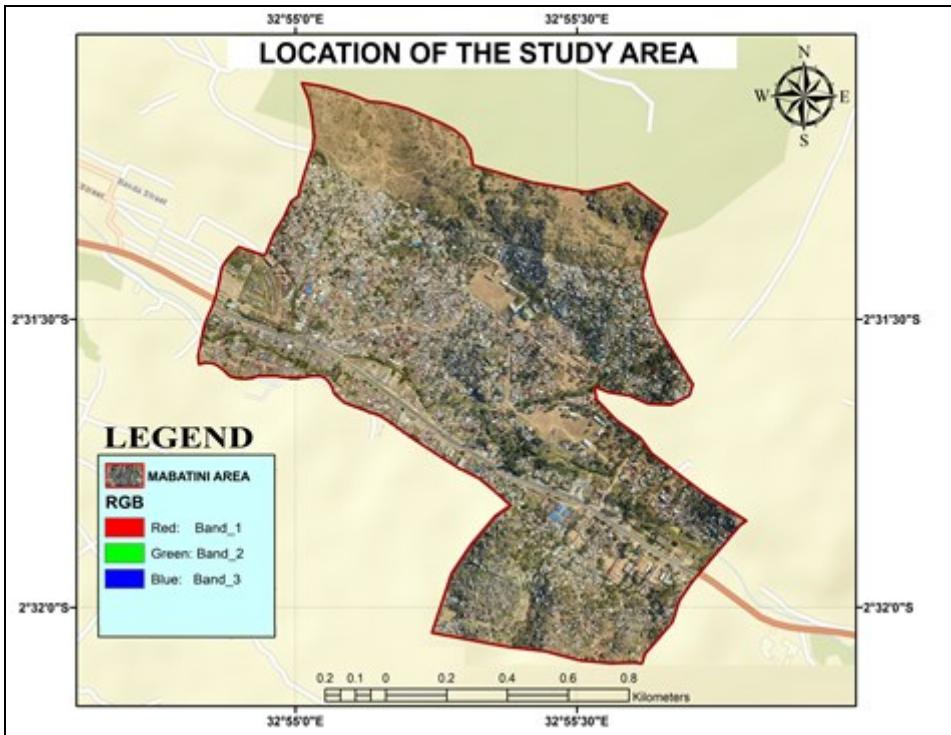
The city features hills, rock formations, and a natural drainage system that is part of the Lake Victoria watershed. These physical features influence flood patterns, erosion risks, and seasonal water flow dynamics across urban and peri-urban zones, while shaping ecological balance, community livelihoods, and environmental resilience. The terrain also creates challenges for infrastructure expansion, disaster preparedness, and climate adaptation, requiring integrated approaches to urban planning and hazard management. These directly determine how floods spread and which areas are most vulnerable.

The study area is bordered by Unguja and Mbugani 'B' Wards to the northwest, Nyashana to the northeast, Buzuruga and Nyakato to the east, Bugarika and Igogo to the west, and Mwananchi to the south. Nyamagana District, part of Mwanza's regional capital, attained city status in 2000, becoming Mwanza City Council. It is well-connected by major roads, residential routes, service roads, and transport links, connecting wards to Buzuruga and the Mara Region. These networks facilitate trade, mobility, and emergency response across diverse urban landscapes, supporting regional economic integration and sustainable development opportunities. Road and transport accessibility also influences emergency evacuation during floods.

Previously, Mabatini Ward was divided into villages, including Mabatini Kaskazini, Kusini, and Nyerere A, B, and C. A 1:7,500-scale map was created to represent the study area, ensuring visibility of details and supporting participatory mapping with the local community. This mapping exercise aids urban planning initiatives for future growth, disaster risk reduction, and sustainable infrastructure development through inclusive, climate-resilient, and data-driven decision-making strategies. It prioritizes equity, safety, adaptive environmental management, and long-term resilience, ensuring planning processes address both immediate risks and future generations' needs.

### Figure 1

This map shows the position of Mabatini Ward within Mwanza City. It shows surrounding wards and the Mirongo River, which is central to flood risk in the area. It provides geographic context for the study and helps readers understand the ward's boundaries and terrain features.



Source: URT, 2024)

### Data Collection

The study utilized spatial and non-spatial primary and secondary data to analyze environmental patterns and risks. Spatial data included Digital Elevation Models (DEMs), land use and cover maps, soil characteristics, drainage networks, remote sensing imagery, climate variables, settlement distribution, and catchment areas (Mukherjee et al., 2013).

These datasets provided insight into terrain, hydrology, and anthropogenic influences. Non-spatial data complemented the spatial analysis, with qualitative insights from literature and expert opinions, while quantitative climate data came from the Tanzania Meteorological Agency (TMA) and global databases like Open StreetMap (OSM) and the National Bureau of Statistics (NBS).

This combination enabled a strong environmental and socio-economic assessment, improving accuracy, reliability, and relevance. Participatory mapping showed frequently flooded areas. A high-resolution, 15-meter satellite image helped people mark flood-prone zones. To make the image clearer, techniques like contrast stretching, sharpening, and color mixing improved visibility. Other enhancements, including edge detection, histogram equalization, and vegetation indexing, further improved accuracy. These steps increased clarity, supported flood prevention, reduced risks, and guided future planning for community resilience and environmental management.

### **Data Processing and Analysis**

Field observation and ground truthing was done to validate information gathered from participatory mapping (Ojigi et al., 2013). This involved site visits utilizing a mobile Global Positioning System with 5-meter accuracy to verify flooded areas in the city and assess the location at-risk, including (Kursah, 2013). GPS data were overlaid with satellite imagery, to determine flood hazards and spatial distribution (Schowengerdt, 2012).

#### **Plate 1**

*Community members and researchers engaged in participatory mapping to identify flood-prone areas in Mabatini Ward. The exercise combined local knowledge with GPS data collection to validate hazard zones and improve the accuracy of spatial flood risk assessments.*



Source: Field survey, 2019

To identify potential flooding areas factors used in the analysis include DEM, rainfall, drainage systems, settlement patterns, and catchment

areas. DEMs were essential for assessing terrain characteristics such as elevation, slope, and drainage features. A series of assessments, including hydrological flood modeling and vulnerability evaluations of buildings based on land use and land cover, were done to determine the risk exposure of residential zones. The Department of Urban Planning and Development outlines that buildings near water sources must maintain a 60-meter distance from riverbanks to mitigate flood risks. A buffering analysis was conducted for the Mirongo River, utilizing geo-processing tools to establish a 60-meter buffer zone.

The analysis started by loading spatial data into ArcGIS, including the Mirongo River polyline and residential buildings layers in polygon features. Before spatial analysis, all layers shared were projected in coordinate system, UTM Zone 36S, to allow for accurate distance-based calculations. ArcGIS uses Euclidean geometry for spatial operations in projected systems, which enables precise measurements in meters rather than degrees, which are unsuitable for distance-based analysis and spatial flood risk assessments.

The 60-meter buffer along the Mirongo River was created. Using the Buffer tool, a 60-meter buffer was generated around the Mirongo River to represent a potential flood-prone zone. The buffer was constructed by expanding a polygon 60 meters outward in all directions from the river's channel. The "dissolve" option was applied to merge overlapping buffer zones, ensuring the output was a continuous, singular polygon. The buffer creation relies on Euclidean buffering, which calculates the radial expansion of each feature from its edge.

Buffer ( $x, y, d$ ) = Region within distance  $d$  of point  $(x, y)$   
 $(x, y) = (x - \text{coordinate}, y - \text{coordinate})$  or (Easting, Northing)  
 $d = 60 \text{ m} = \text{Buffer distance provided}$

Residential structures within the buffer zone were identified using a spatial relationship query which select layer by location. The condition used was "intersect", which identifies features that spatially overlap with the buffer polygon. In estimating building exposure, the exposure level was quantified using the Summary Statistics and Field Calculator tools. If a population attribute (e.g., residents per structure) was available, a sum was calculated to estimate total population at risk. Otherwise, the number of buildings was counted. ArcGIS also allows geometry-based

calculations (e.g., area or perimeter) using Calculate Geometry, applying basic geometric formulas depending on the feature type as area of polygons). For buildings only:

The final map was created, and the output layers were styled and laid out using ArcGIS Map Layout View, which includes standard cartographic elements such as legend, scale, and title, displayed in Figure 4, map A. No numerical algorithms are used here, but layout relies on best practices in visual design and cartographic symbology standards.

Boolean Overlay with Flood Susceptibility Indices was performed to enhance the accuracy of the buffer-based flood risk analysis; the 60-meter buffer layer was overlaid with geomorphic flood indices (GFI raster in Figure 4, map B), flood zones from remote sensing, or historical flood records. This step used Raster Calculator or Map Algebra to combine layers and extract intersecting zones.

In case of combining raster and vector data, zonal statistics were used to summarize raster values within the vector buffer zones, improving risk visualization, analytical precision, and flood mitigation planning for better decision-making in vulnerable regions. This analysis was intended to assess the proximity of residential structures to the river, as buildings within this buffer are deemed vulnerable to flooding. Structures located 60 meters or more from the river are considered safe, while those within this range pose a higher risk. The findings indicate that human settlements and constructions encroaching on this buffer heighten susceptibility to flood impacts, increasing damage potential and environmental degradation.

A DEM with a resolution of 30m×30m facilitated the creation of a simulation model to visualize drainage patterns and water runoff during heavy rainfall, processed using Arc Map version 10.3 (Mwanukuzi, 2008). High-resolution satellite imagery from an UAV, acquired from the Ministry of Land, Housing and Human Settlement, illustrated settlement patterns for participatory mapping and base map development.

Soil data from the FAO classified Mwanza Region's soils into three groups: sandy soils, red loams from limestone, and black clay soils, with information linked to textural classes and hydrologic groups. Climatic

data, including precipitation and temperature records from 1995 to 2024, collected from the TMA (Mukherjee et al., 2013).

### **Geomorphic Flood Assessment Model**

A Geomorphic Flood Assessment Model was used to simulate flood hazards. Model incorporated four spatial data layers essential for flood hazard simulations: Digital Elevation Model (DEM), filled DEM, flow direction, and flow accumulation. The primary data source is a raster DEM obtained from the United States Geological Survey, which has a spatial resolution of 30 meters. This model employs advanced algorithms to effectively partition landscapes into hydrologic units, facilitating hydrologic modeling and water resource assessment. The first step in geomorphic flood assessment modeling is to preprocess the DEM to ensure it accurately represents surface hydrology.

Natural terrain may contain imperfections or artificial depressions (sinks) that trap flow during hydrologic analysis. These must be removed using a sink-filling algorithm. This prepares the DEM for realistic flow routing in subsequent steps. After filling sinks, the flow direction was calculated. This determines the path water takes from each cell based on the direction of the steepest descent. The D8 algorithm is commonly used, where each cell flows into one of its 8 neighbors. This flow direction raster is essential for computing flow accumulation. With flow direction established, a flow accumulation raster is created.

This measures how many upstream cells drain into each cell. High values indicate areas where water converges, such as streams or valleys, and are key indicators of potential flood zones, influencing flood mitigation and disaster preparedness strategies. Then, Stream Network Extraction was done. The stream network is derived from the flow accumulation raster by setting a threshold. Cells with accumulation values above a certain threshold are considered part of a stream. This raster is used later in calculating HAND and proximity to water. Slope Calculation was performed to identify flat areas more likely to flood versus steep areas less likely to flood. This is typically derived using the elevation gradient in both the x and y directions.

Height Above Nearest Drainage (HAND) was identified as one of the most important indices in geomorphic flood modeling. It calculates the vertical distance from each cell to the nearest stream. Lower HAND

values suggest areas closer in elevation to drainage channels and therefore more flood-prone. Before combining terrain indices into the final GFI, each raster is normalized to a common 0–1 scale. This ensures that all variables contribute proportionally regardless of their original units or ranges.

The Geomorphic Flood Index (GFI) was computed by combining the normalized terrain variables into a single composite raster. This is typically done through a weighted sum. The weights can be adjusted depending on the importance of each factor or using data-driven methods. After calculating the GFI raster, a threshold is applied to classify areas as flood-prone or not. Cells with GFI values below a certain threshold are considered flood-susceptible. This final raster was validated using satellite imagery and historical flood maps.

### **Socio-economic Vulnerability Limitations**

This study primarily assessed physical exposure to floods using spatial data (DEM, LULC, building footprints, and buffer analysis). While these methods provide clear evidence of which areas and assets are at risk, socio-economic indicators such as household income, education level, housing quality, access to services, and coping capacity were not systematically integrated into the vulnerability assessment. Community inputs from participatory mapping and focus group discussions provided qualitative insights into residents' experiences, but these were not quantified into socio-economic indices. As a result, the analysis emphasizes where people are exposed rather than how their social and economic conditions may influence resilience or recovery.

The absence of detailed socio-economic data means that vulnerability is represented mainly in spatial terms. This may minimize differences between households for example, poorer families in informal housing may be less able to recover from flood impacts compared to wealthier households in more durable structures

## **FINDINGS AND DISCUSSION**

### **Land Use – Land Cover Change Detection**

Table 1 shows land cover changes between 2005 and 2024, measured in square meters. The classes include vegetation, bare land, roads, settlements, and water bodies. The percentage coverage for each class was calculated using the formula:

$$\text{Percentage Coverage (\%)} = \frac{\text{Area of Land class}}{\text{Total Study Area}} * 100\%$$

Vegetation categories include forests, grasslands, shrubs, and other green cover types. Vegetation cover has decreased sharply over time: in 2005 it was 1,217,180 m<sup>2</sup> (73.07%), dropping to 808,980.9 m<sup>2</sup> (48.56%) in 2018, and further to 484,494.28 m<sup>2</sup> (29.08%) in 2024. This decline is linked to urbanization, deforestation, cultivation, land degradation, and conversion for infrastructure projects.

Roads represent transportation networks such as trunk roads, service roads, paved surfaces, and bridges. They covered 58,277.2 m<sup>2</sup> (3.50%) in 2005, increased to 91,225.5 m<sup>2</sup> (5.48%) in 2018, but dropped to 48,474.6 m<sup>2</sup> (2.91%) in 2024. These fluctuations may reflect temporary construction, changes in road plans, or infrastructure upgrades.

Bare land, including exposed soil and rock outcrops, rose from 72,975.9 m<sup>2</sup> (4.38%) in 2005 to 382,685.6 m<sup>2</sup> (22.97%) in 2018, then slightly decreased to 352,278.07 m<sup>2</sup> (21.14%) in 2024. This trend is linked to deforestation, erosion, and land degradation.

Buildings and settlements expanded steadily, from 263,570.6 m<sup>2</sup> (15.82%) in 2005 to 382,861.7 m<sup>2</sup> (22.98%) in 2018, reaching 569,926.88 m<sup>2</sup> (34.21%) in 2024. Growth is driven by urbanization, population increase, and housing demand.

Water bodies covered 53,790.06 m<sup>2</sup> (3.23%) in 2005, dropped sharply to 40.06 m<sup>2</sup> (0.002%) in 2018, then rose to 210,691.26 m<sup>2</sup> (12.65%) in 2024. These fluctuations may reflect climate variability, seasonal rainfall, and inundation events.

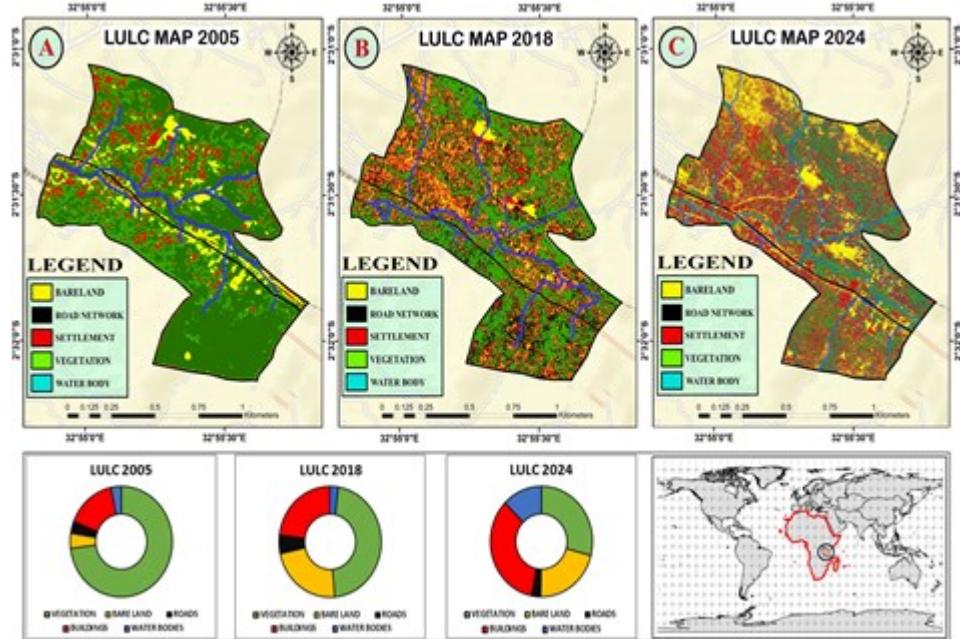
Overall, land cover change explains the area's growing flood risk. Vegetated areas reduce flooding, while settlements, roads, and bare land increase runoff and reduce natural infiltration, making Mabatini Ward more vulnerable to floods. These changes highlight the urgent need for effective land management strategies.

**Table 1**  
*Land Cover Changes*

LULC Type	2005 (m <sup>2</sup> Area)	2018 (m <sup>2</sup> Area)	2024 (m <sup>2</sup> Area)
Vegetation	1,217,180	808,980.9	484,494.28
Bare Land	72,975.9	382,685.6	352,278.07
Roads	58,277.2	91,225.5	48,474.60
Buildings	263,570.6	382,861.7	569,926.88
Water body	53,790.06	40.06	210,691.26
<b>TOTAL</b>	<b>1,665,793.76</b>	<b>1,665,793.76</b>	<b>1,665,793.76</b>

**Figure 2**

These maps illustrate how vegetation has declined while settlements have expanded over time. Between 2005 and 2024, green areas (vegetation) shrink significantly, while gray and brown areas (buildings and bare land) increase. This change explains why flood vulnerability has worsened, as natural infiltration is reduced and runoff is intensified.



Source: Survey Data, 2024

### Flood Vulnerability by Sub-Ward

The GFA model shows that flood coverage varies among sub wards in the study area. Table 2 indicates that Nyerere A sub ward is the most vulnerable, with 31.4% of assets located in the prone zone. Nyerere C has 19.3% of assets in the prone zone, while Mabatini Kusini has 18.3%. Mabatini Kaskazini records 16% of assets in the prone zone, and Nyerere

B has 15%. In total, 11,201 assets are found in flood prone areas, including residential buildings, infrastructure, and essential facilities, indicating significant exposure to potential flood damage.

These findings highlight critical hotspots where flooding can severely affect households, disrupt services, and cause economic losses across the sub wards, making urgent flood management and mitigation interventions necessary to protect both people, property, and community livelihoods effectively.

**Table 2**

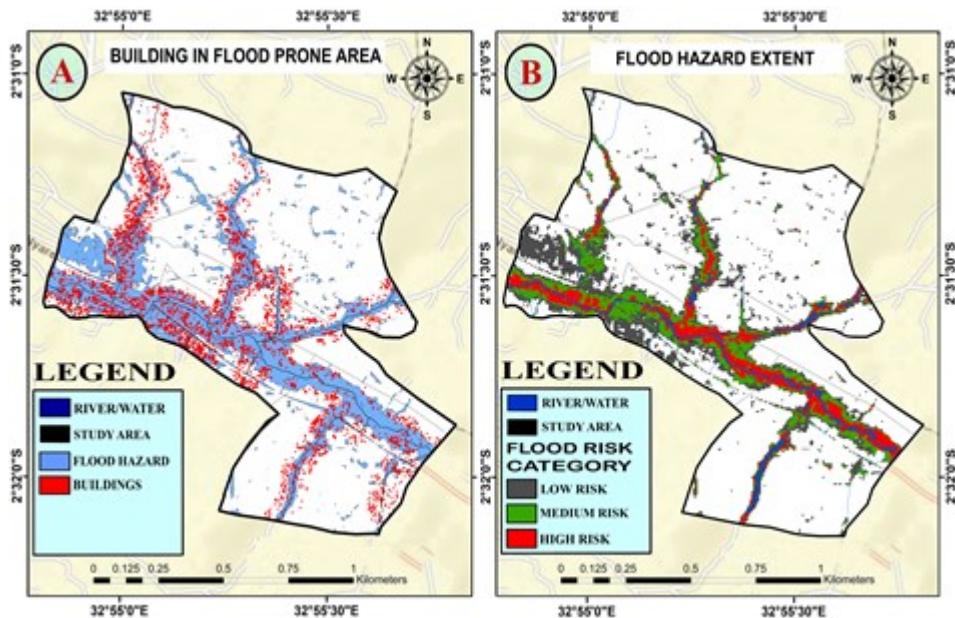
*Number of Assets in Flood Prone Area*

<b>SUB-Ward</b>	<b>Assets</b>	<b>Percentage</b>	<b>Area (m<sup>2</sup>)</b>
Mabatini Kusini	1851	16 %	6520
Mabatini Kaskazini	2048	18.3 %	7338
Nyerere - A	3516	31.4 %	12,822.8
Nyerere - B	1705	15 %	5801
Nyerere - C	2161	19.3 %	7467
<b>TOTAL</b>	<b>11,201</b>	<b>100</b>	<b>39,950</b>

The figure 3 shows a map to illustrate flood-prone zones across the study area. QGIS analysis of the 60-meter buffer revealed a 1,178,883.3 m<sup>2</sup> area containing 6,477 buildings in the most vulnerable zone, posing a threat to approximately 25,600 residents near the river path. The most affected buildings were informal establishments close to the Mirongo River, requiring urgent mitigation measures and community-driven resilience strategies such as improved drainage systems, land-use planning, and early warning mechanisms.

**Figure 3**

This map shows buildings located in high, medium, and low flood-risk zones along the Mirongo River. Red areas represent houses at highest risk, where floodwater can stagnate for more than five days. Green and gray areas show medium and lower risk zones. The figure emphasizes how unplanned settlements within 20–40 m of the river buffer is most exposed

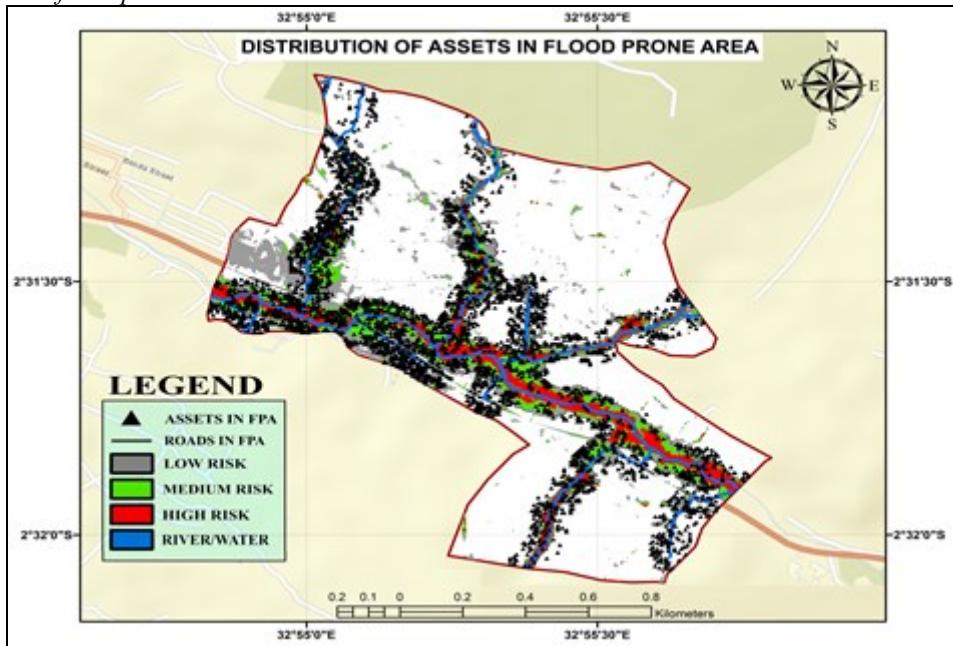


Source: Survey Data, 2024

Residential areas and infrastructure, including roads, are also located in flood-prone zones. The study area contains 46 roads with a total length of 9,177.7 meters. Of these, 43 roads, equal to 93% of the network, fall within flood-prone areas, with a combined length of 4,315.6 meters. The average road length is 100.4 meters, ranging from a minimum of 1.7 meters to a maximum of 447.5 meters. This high presence of roads within flood-prone zones indicates that transportation and mobility are at risk during floods, which could disrupt access to services and impede emergency response, especially during heavy rainfall. The findings highlight the need for improved urban planning and flood mitigation measures, as most roads are exposed due to settlement expansion into high-risk areas.

**Figure 4**

*This map shows the location of assets exposed to flooding across Mabatini. Sub-wards such as Nyerere A, Mabatini Kusini, and Nyerere C have the highest concentration of vulnerable buildings and infrastructure. The shaded buffer along the Mirongo River highlights areas most at risk, where informal settlements and essential services overlap with flood-prone zones*



Source: Survey Data, 2024

Assets were categorized according to the area they covered. Those with less than 5 m<sup>2</sup> accounted for 49,163 items, covering 57,145 m<sup>2</sup> with an average area of 1.2 m<sup>2</sup>. These included motor vehicles temporarily found in the study area and are highly susceptible to flood damage due to their limited resilience. Assets between 5 m<sup>2</sup> and 16 m<sup>2</sup> numbered 2,318, covering 19,981.5 m<sup>2</sup>, with minimum and maximum areas of 5 m<sup>2</sup> and 15.9 m<sup>2</sup> respectively.

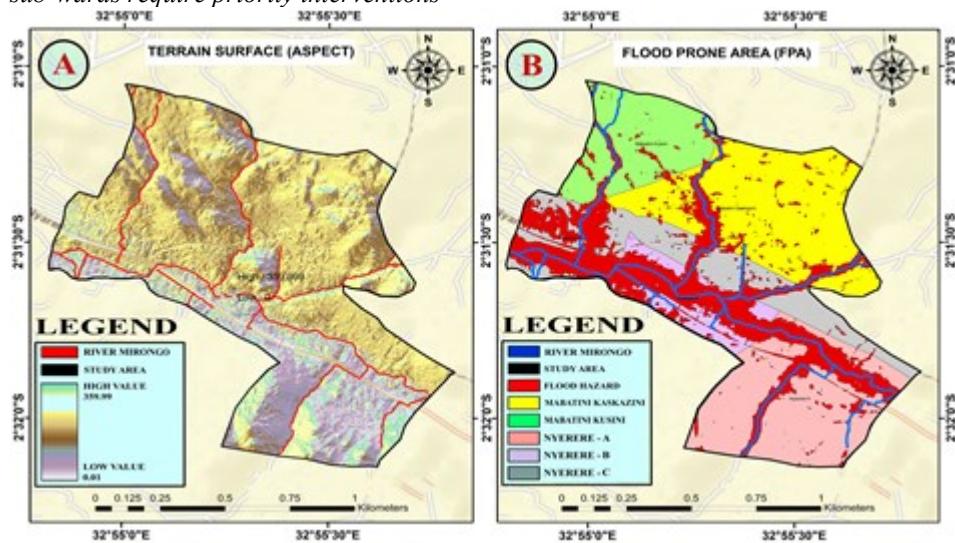
Water supply networks were also identified among vulnerable assets. A total of 41 networks with a combined length of 17,178.8 meters were recorded, with an average length of 418.9 meters. Of these, 33 networks (80.5%) are located in flood-prone zones, covering 7,894.6 meters. The minimum and maximum lengths were 0.9 meters and 1,600.7 meters respectively. These networks are critical for urban functionality, and their disruption during floods could lead to water shortages, sanitation crises,

health risks, and significant disruption to daily activities and essential community services. Other assets found in flood-risk zones include domestic animals, small businesses such as machingas, market commodities, bridges, and public service buildings. Schools, hospitals, offices, factories, and storage units are also at risk, alongside electricity and communication lines. The presence of these diverse and essential assets underscores the need for integrated flood management plans that prioritize human safety, economic resilience, and long-term sustainability.

The study reveals sub wards with varying flood coverage levels and extents. Nyerere 'A' sub ward has the highest flood coverage, covering 221 km<sup>2</sup>, followed by Mabatini Kaskazini with coverage of 138 km<sup>2</sup>, Mabatini Kusini with coverage 21 km<sup>2</sup>, and Nyerere 'B' sub ward with about 17 km<sup>2</sup>. The study suggests that residents near the river are at higher risk due to human activities as soil erosion, solid wastes deposition in river channel and gentle slopes.

**Figure 5**

*This figure compares terrain surface (Map A) with modeled flood-prone zones (Map B). Darker shading indicates higher flood hazard. Nyerere A sub-ward shows the largest flood area, confirming it as a hotspot of vulnerability. The map helps identify which sub-wards require priority interventions*



Source: Survey Data, 2024

### Variations in Rainfall and Temperature

The study area experienced varied rainfall, with three peaks from 1997 to 2015, indicating a fluctuating rainfall pattern. Temperature trends from

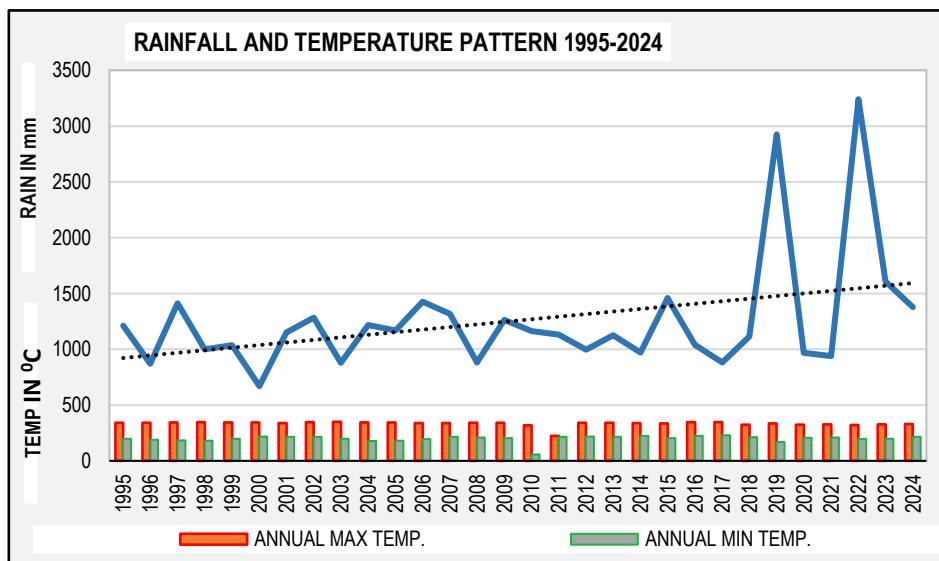
1995-2024 were determined using Time Series analysis and the Pearson correlation test, with the lowest average minimum temperature of 4.7°C in 2010 and the highest temperature of 29.10°C in 2003, providing insights into global warming occurrence.

Weather forecasting helps minimize flooding impacts by predicting storms, phenomena, and extreme precipitation events, improving disaster preparedness. The Masika rainfall season in the region is a major concern, with a slight increase in annual precipitation. Flood properties are influenced by precipitation characteristics, including amount, intensity, duration, and spatial distribution, and most research is conducted in small catchments in hyper-arid or high rainfall Mediterranean climates.

Results from statistical tests show no significant correlation between rainfall and average maximum temperature, implying each vulnerability factor plays an independent role in influencing vulnerability in the area. Results show temporal patterns intensify with temperature increases, leading to storms and flooding. Future planning should consider rainfall variability and increases in rainfall, as weather changes are key factors in floods.

**Figure 6**

*Temperature and rainfall trends of study area from 1995 to 2024. The blue line for rainfall and the bars indicate temperature.*



Source: Fieldwork, 2024

## **CONCLUSION AND RECOMMENDATION**

The findings of this study emphasize the severe vulnerability of residential areas in Mabatini Ward to flooding, primarily caused by poor drainage infrastructure, rapid urbanization, and environmental degradation. The study identified Nyerere A, Nyerere C, and Mabatini Kusini as the most flood-prone sub-wards, with 31.4%, 19.3%, and 18.3% of assets located in flood-prone areas, respectively.

These hotspots are concentrated along the Mirongo River, where informal settlements and high-density residential buildings encroach within the critical 60-meter buffer zone. The exposure of essential infrastructure, including roads and water supply networks, highlights significant vulnerability to flooding, which can disrupt household livelihoods, urban services, and emergency response. Informal settlements in these zones, encompassing over 738 buildings and approximately 3,468 households, are particularly susceptible, facing potential economic losses, displacement, and disruption of essential services.

Land use and land cover analysis indicates that vegetation cover has decreased by over 40% between 2005 and 2024, while built-up areas have more than doubled. This expansion of impervious surfaces has increased surface runoff and reduced natural infiltration, exacerbating flood impacts. The high density of roads, settlements, and essential services within flood-prone areas reflects gaps in urban planning and weak enforcement of land-use regulations.

To reduce flood vulnerability in Mabatini Ward, interventions should prioritize the most affected sub-wards. Nyerere A, being the most flood-prone area, requires strict enforcement of the 60-meter buffer zone along the Mirongo River. Strategic relocation of households and infrastructure in high-risk zones, supported by incentives, can significantly reduce exposure. Urban planning frameworks should integrate flood-resilient housing designs to protect residents and ensure that future settlements comply with land-use regulations.

Medium-risk sub-wards, including Mabatini Kusini and Nyerere C, require targeted infrastructure improvements. Upgrading drainage systems, constructing retention ponds, and introducing permeable surfaces will help manage runoff and reduce flood impacts. Complementary measures such as early warning systems and community

education campaigns will enhance preparedness and enable residents to respond effectively to seasonal flooding events.

Critical infrastructure, including roads and water supply networks, must be retrofitted or relocated using flood-resilient designs, as 93% of roads and 80.5% of water networks fall within flood-prone areas. Strong coordination between urban planning, transport, and water authorities is essential to minimize disruptions during floods and maintain essential urban services. Environmental management strategies, including reforestation, afforestation, and soil conservation initiatives, should also be prioritized to reduce surface runoff, improve water absorption, and mitigate long-term flood risks.

Community participation and integration of GIS-based flood modeling are essential for sustainable flood management. Residents should be actively involved in participatory mapping, awareness programs, and early warning system development to strengthen local governance and compliance with planning regulations. Investments in flood-resistant housing, improved waste management, and relocation incentives will protect vulnerable populations, while the use of GIS and real-time monitoring tools will support data-driven decision-making and long-term urban resilience in Mabatini Ward.

## **ACKNOWLEDGEMENT**

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## **Role of Technology Transfer Offices in Patenting and Commercialization of Research Results in Public Funded University: Case of South Africa**

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### **Abstract**

*This study investigates the role of Technology Transfer Offices (TTOs) in facilitating patenting, licensing, and commercialization within South Africa's publicly funded universities. As universities are increasingly expected to contribute to national innovation systems, TTOs have become central to translating academic research into marketable outputs. The study is guided by two specific objectives: to determine the role of TTOs in facilitating patenting, licensing, and commercialization for social and country's economic growth; and to identify the challenges facing TTOs in executing these functions. Using a quantitative research approach, data were collected from 49 respondents across several public universities, including TTO managers, and researchers who were working in TTOs in the selected public institutions. The findings reveal that while South Africa stands out as a regional leader in technology transfer and research commercialization their effectiveness is constrained by lack of buyers of new technology inventions, insufficient commercialization expertise in some institutions, lack of startup policy to effectively commercialize new technology and lack of enough funding to conduct researches. The study concludes that, the government should enact policies that support IP in public institutions and form the national IP management offices to support establishment of TTOs that guide the public universities in terms of recruitment of staffs, capacity building, and support research funding, patenting and commercialization.*

**Keywords:** *Technology Transfer Offices, Patenting, Commercialization*

### **INTRODUCTION**

In the 21st-century knowledge-based economy, universities are increasingly recognized not only as centers of learning and research but also as critical drivers of innovation and socio-economic development. Around the world, Technology Transfer Offices (TTOs) have emerged as

institutional mechanisms designed to bridge the gap between academic research and its application in the marketplace. These offices facilitate the identification, protection, and commercialization of intellectual property (IP), primarily through patents, licensing agreements, and the creation of spin-off companies. The growing pressure on universities to demonstrate real-world impact from publicly funded research has accelerated the development and institutionalization of TTOs across higher education systems globally (Etzkowitz & Leydesdorff, 2000).

Countries with advanced innovation ecosystems such as the United States, Germany, and the United Kingdom have long benefited from supportive policies and institutional arrangements that enable effective technology transfer. Notably, the Bayh-Dole Act of 1980 in the United States catalyzed university-based innovation by allowing universities to retain ownership of inventions developed through federal funding. This act led to an explosion in patenting and commercialization activities, positioning American universities as key players in technology-driven economic development. Similar models have been adopted or adapted by other countries seeking to strengthen their innovation capacity (Mowery, Nelson, Sampat & Ziedonis, 2001).

In contrast, developing and emerging economies continue to face significant barriers in leveraging university research for economic benefit. This line of thinking concurs with Chaminade & Vang (2008) hold that the challenges such as inadequate funding, limited infrastructure, fragmented innovation policies, and a lack of skilled personnel hinder the effectiveness of TTOs in these contexts. Nonetheless, many regions, particularly in the Global South, are making deliberate efforts to strengthen their national systems of innovation, with universities playing a more central role in knowledge transfer and enterprise development.

In Africa, the role of universities in technological innovation and economic transformation is increasingly acknowledged. However, the continent continues to grapple with systemic weaknesses, including limited public investment in research and development (R&D), weak intellectual property regimes, and a lack of industry-academia collaboration. A recent study published in *Springer Open Journal of Innovation and Entrepreneurship* (2024) highlights that only a minority of African universities have fully functional TTOs, and most lack sufficient capacity for effective patent management and

commercialization (Mensah & Owusu, 2024). Nevertheless, initiatives such as the Science, Technology and Innovation Strategy for Africa (STISA-2024) and regional training programs by organizations like WIPO signal growing political and institutional will to strengthen IP governance in African research institutions (African Union Commission, 2024).

Among African nations, South Africa stands out as a regional leader in technology transfer and research commercialization. The country has made significant strides in formalizing its innovation ecosystem, particularly through the enactment of the Intellectual Property Rights from Publicly Financed Research and Development Act (IPR Act) in 2008. This legislation mandates that public institutions protect and manage intellectual property resulting from publicly funded research. The Act also led to the creation of the National Intellectual Property Management Office (NIPMO), which oversees the implementation of the IPR Act, offers capacity-building support, and monitors IP outputs across the public research landscape (Department of Science and Innovation (DSI), South Africa, 2008).

Most public universities in South Africa such as the University of Pretoria, University of Cape Town, Nelson Mandela University, and University of South Africa (UNISA) have established Technology Transfer Offices in response to these policy directives. These offices are tasked with managing invention disclosures, securing IP rights, facilitating licensing deals, and, in some cases, supporting the creation of spin-off enterprises. For example, UNISA's Directorate of Innovation, Technology Transfer, and Commercialization (DITTC) has expanded its patent portfolio significantly, holding over 75 active patents across South Africa, the EU, and the US by the end of 2022 (University of South Africa (UNISA) 2022).

Despite this institutional progress, several challenges persist. Less majority of South African TTOs struggle with limited human and financial resources, a lack of commercialization expertise, and weak links to the private sector. Moreover, a performance gap exists between patent protection and actual commercialization outcomes, with relatively few inventions making it to the market. These challenges mirror broader issues seen across the continent but are particularly pressing given South

Africa's comparatively strong research base and policy infrastructure (Kruss & Visser, 2017).

Therefore, this study seeks to investigate the effectiveness of Technology Transfer Offices in South Africa's publicly funded universities, with a specific focus on patenting and commercialization activities. By situating South Africa within global and continental trends, the research aims to identify both enabling factors and bottlenecks in the country's technology transfer system. The study uses a combination of policy analysis, institutional case studies, and performance data to provide a comprehensive assessment of how TTOs are contributing to national innovation goals. The findings will offer insights for improving the effectiveness of TTOs not only in South Africa but also in other emerging economies striving to build robust research to market pipelines.

## **RESEARCH METHODOLOGY**

This study employed a quantitative research approach to investigate the role of Technology Transfer Offices (TTOs) in patenting and commercialization activities within publicly funded universities in South Africa. Data were collected through a structured survey questionnaire administered to 49 respondents across multiple public universities. The respondents included TTO managers, staff and researchers actively engaged in technology transfer activities within their respective institutions. A purposive sampling strategy was used to ensure representation from universities with established TTOs, focusing on individuals directly involved in patenting, licensing, and commercialization processes. The collected data were analyzed using descriptive statistics (percentages, frequencies). The quantitative design enabled a systematic assessment of the operational structures, challenges, and performance indicators associated with TTOs, contributing to a clearer understanding of their impact on innovation outputs in the higher education sector. However, ethical issues were observed as author managed to solicit clearance from relevant public universities authorities in South Africa. Data were collected from the University of Johannesburg (UJ), University of Cape Town (UCT), Northwest University (NWU), University of Pretoria (UP), Tshwane University of Technology (TUT), Cape Peninsula University of Technology (CPUT), Central University of Technology (CUT), Rhodes University (RU), Vaal University of Technology (VUT), University of Venda (UV), University of Zululand (UZL), Agriculture Research Council (ARC) and Human Sciences

Research Council (HSRC). These public universities were selected for the study following its only universities that funded by the government to implement IP policy in South Africa.

## **FINDINGS AND DISCUSSION**

The study aimed to investigate the role of Technology Transfer Offices (TTOs) in patenting and commercialization activities within publicly funded universities in South African. Specifically, it sought to determine how TTOs facilitate patenting, licensing, and commercialization processes, as well as to identify and quantify the number of invention disclosures submitted, patents filled, and patents granted.

### **The Role of TTOs in Facilitating Patenting, Licensing and Commercialization**

The first specific objective aimed to determine the role of Technology Transfer Offices (TTOs) in facilitating patenting, licensing, and commercialization. This objective was intended to provide a comprehensive understanding of how TTOs contribute to the innovation ecosystem in South African public universities. A structured questionnaire was used to collect quantitative data from 49 respondents. The questionnaire included four key items: the structural and functional setup of TTOs; the extent of TTO Involvement in the patenting process; strategies employed by TTOs for licensing university-developed technologies; and the role of TTOs in bridging academia and industry to support commercialization.

### **The Structural and Functional Setup of TTOs**

The respondents were requested to indicate what they knew regarding the organizational structure of Technology Transfer Offices (TTOs) within universities, specifically in terms of staffing adequacy, level of expertise, and the availability of resources dedicated to intellectual property (IP) management and commercialization. Questionnaires with a three-point Likert scale were applied to collect quantitative data. Individual TTO managers, staff and researchers were required to respond to a series of statement in the questionnaires by indicating whether they agreed (A), were neutral (N) or disagreed (D) as shown in Table 1 below.

**Table 1**  
*Perceptions on Organizational Structure of TTOs*

Perceptions on organizational structure of TTOs	Level of Agreement		
	Agree	Neutral	Disagree
The TTOs has adequate staffing to manage IP and commercialization activities	38 (77.55%)	3 (6.12%)	8 (16.32%)
TTOs staff possess sufficient expertise in IP management and commercialization	39 (79.59%)	1 (2.04%)	9 (18.36%)
There are sufficient resources financial, legal infrastructure dedicated to IP work	42 (85.71%)	3 (6.12%)	4 (8.16%)

Field data, 2022.

The survey results indicate a generally positive perception of Technology Transfer Offices TTOs among respondents regarding their capacity to manage intellectual property (IP) and commercialization. A significant majority 38 (77.55%) believe that TTOs have adequate staffing, while an even higher percentage 39 (79.59%) agree that the staff possess sufficient expertise in IP management. Furthermore, the higher agreement 42 (85.71%) was observed in relation to the availability of financial, legal and infrastructural resources dedicated to IP activities. Although a small portion of respondents remained neutral or disagreed across the items, the overall findings suggest strong confidence in the operational capacity and resources readiness of TTOs to effectively handle IP and commercialization tasks. This finding concurs with those of the study conducted by Uctu & Essop (2022), which stated that TTO staffing, expertise, and resources directly reflect the intended outcomes of the IPR-PFRD Act, as discussed by Uctu & Essop (*ibid*). The high level of agreement on these aspects suggests that the policy interventions implemented after 2008 have been effective in building institutional capacity for IP management and commercialization. Based on these insights, the findings provide empirical support for the paper's conclusion that the post-IPR-PFRD era has resulted in more structured and capable TTOs, better equipped to handle the demands of innovation commercialization in South Africa.

### **The Extent of TTO Involvement in the Patenting Process**

The second item under the first objective aimed to assess the extent of Technology Transfer Offices' (TTOs) involvement in the patenting process within selected public funded universities. The respondents were

asked to rate their perceptions of TTO involvement using three point-Likert scale. The results are displayed in Table 2.

**Table 2**  
*The Extent of TTO Involvement in Patenting Process*

TTO Involvement in Patenting Process	Level of Agreement		
	Agree	Neutral	Disagree
The TTO provides comprehensive support throughout the patent application process	30 (61.2%)	12 (24.5%)	7 (14.3%)
The TTO is actively involved in drafting and reviewing patent applications	27 (55.1%)	13 (26.5%)	9 (18.4%)
The TTO takes the lead in managing communication with patent offices.	33 (67.3%)	10 (20.4%)	6 (12.2%)

Field data, 2022

As shown in Table 2, great number 30 (61.2%) of TTOs managers, staff and researchers agreed that The TTO provides comprehensive support throughout the patent application process in public funded university. This implies a generally positive perception of TTO effectiveness in facilitating intellectual property activities. This suggests that a majority of stakeholders recognize the TTOs' active role in guiding and assisting researchers through complex patent procedures, reflecting a growing institutional capacity and commitment to supporting innovation. In the same vein, African Union Commission (2024) hold a national survey conducted by the National Intellectual Property Management Office (NIPMO) and the National Advisory Council on Innovation in South Africa found that a majority of higher education and research institutions reported their Technology Transfer Offices (TTOs) actively support researchers throughout the patent application process, a finding further corroborated by the detail that approximately 60% of universities felt empowered to commercialize

Moreover, Table 2 reveals that 27 respondents, representing 55.1% of the sample, agreed that the Technology Transfer Office (TTO) is actively involved in drafting and reviewing patent applications at publicly funded universities in South Africa. This level of engagement reflects a significant institutional commitment to supporting researchers through the technical and legal complexities of intellectual property protection. Active involvement by TTOs in patent drafting and review is a critical

component of effective technology transfer, as it helps ensure the quality and patentability of inventions before submission. The fact that over half of the respondents recognized this involvement suggests that many South Africa TTOs are not merely administrative bodies but are increasingly functioning as strategic partners in research commercialization. Is strongly supported, Cullen, Calitz & Chetty (2020) they affirm that active TTO involvement in patent drafting and review is central to enabling effective technology commercialization and researcher engagement in institutional IP processes.

In addition, Table 2 also, indicates that 33 of the respondents, representing 67.3% of the total sample, agreed that the Technology Transfer Office (TTO) takes the lead in managing communication with patent offices. This reflects a strong endorsement of the TTO's active role in overseeing the formal and often complex interactions required during the patenting process. Such communication includes responding to office actions, coordinating legal documentation, clarifying technical claims, and ensuring compliance with procedural timeline, all of which are essential for securing patent protection. It also indicates that many South African TTOs have developed the institutional expertise and administrative capacity necessary to handle these responsibilities effectively. In the same vein, Mokoena (2025) views this as a clear indication that TTOs are not only central to facilitating the often complex and technical interactions required during patent prosecution but have also built the necessary institutional expertise to do so effectively. Mokoena (*ibid.*) further notes that this level of agreement reflects the maturity and capacity of many South African TTOs to handle these responsibilities, highlighting their evolving role as key enablers in the commercialization of research and protection of intellectual property.

### **Strategies Employed by TTOs for Licensing University-Developed Technologies**

This item intended to depict the strategies employed by Technology Transfer Offices (TTOs) for licensing university-developed technologies, with a focus on understanding their approaches, challenges, and effectiveness in facilitating the commercialization of academic research outputs. Quantitative data were collected using questionnaires based on a three-point Likert scale. Respondents, were asked to respond to a series of statement by indicating their level of agreement: Agree (A), Neutral (N), or Disagree (D), as illustrated in Table 3 below.

**Table 3**  
**TTOs Licensing Strategies**

Strategies Employed by TTOs for Licensing University-Developed Technologies	Level of Agreement		
	Agree	Neutral	Disagree
TTO has clearly defined strategies for licensing university-developed technologies	39 (79.59%)	4 (8.16%)	6 (12.24%)
TTO faces significant challenges in the licensing of academic research outputs	28 (57.14%)	1 (2%)	20 (40.81%)
TTO has the necessary expertise and capacity to manage licensing processes effectively.	38 (77.55%)	2 (4.08%)	9 (18.36%)

Field data, 2022

The findings revealed that majority of Technology Transfer Offices (TTOs) 39 (79.59%) reported that they have clearly defined strategies for licensing university-developed technologies. This indicates a strong institutional focus on structured and strategic technology commercialization. Meanwhile, 4 (8.16) may have indicated that their strategies are either partially defined, informal, or still under development. This suggests that a small subset of institutions is in the process of formalizing their approach to licensing but may not yet have complete or documented strategies in place. Finally, 6 (12.24%) of the offices reportedly lack defined or evolving strategies altogether, potentially operating in a reactive, possibly due to resource constraints or lower institutions demonstrate strategic readiness, there remains a notable minority that may benefit from further support or guidance in developing formal licensing frameworks. This highlights the need for targeted support to help some institutions formalize and strengthen their licensing strategies (Bansi, 2016).

Also, Table 3 the data reveals that the Technology Transfer Offices (TTO) is encountering notable difficulties in the process of licensing academic research outputs. A majority of respondents 28 individuals, accounting for 57.14%, expressed agreement with this assessment, indicating a shared perception that licensing challenges are a significant barrier within the TTO's operations. This majority suggests that more than half of the stakeholders, lack of industry partnerships, insufficient market readiness of research. In contrast, 20 respondents 40.81%

disagreed, implying that a substantial portion of participants either do not perceive licensing as a major challenge or believe that the TTO is performing adequately in this area. This divergence in views may reflect variability in experiences across departments or disciplines, differences in awareness of licensing procedures. Only 1 (2.04%) respondent remained neutral, suggesting that most individuals had a clear stance on the issue, which further reinforces the importance and relevance of licensing challenges as a topic of concern. In the same vein, Stofberg (2019) noted there is the need for a deeper investigation into the factors contributing to licensing difficulties and potentially signals an opportunity for institutional reforms or capacity building within TTO.

The, Table 3 also indicates that a significant majority of respondents, 38 individuals 77.55%, believe that the Technology Transfer Office (TTO) possesses the necessary expertise and capacity to manage licensing processes effectively. Additionally, 9 respondents, accounting for 18.36%, seem to express a more neutral or uncertain stance, possibly indicating partial agreement or a recognition of some limitations in the TTO's capabilities. Meanwhile, only 2 respondents, equal 4.08%, disagreed with the statement, implying minimal concern regarding the TTO's competence in handling licensing matters. Overall, the figures indicate strong confidence in the TTO's proficiency, with limited reservations among stakeholders. The ideas supported by Mustapha et al., (2021) critically review national indicators for university technology transfer in South Africa. They underscore that while the system has institutional support under the IPR-PFRD Act of 2008, measurable performance remains uneven, suggesting that strong confidence in TTO capacity depends heavily on monitoring, resources, and aligned objectives.

### **Role of TTOs in Bridging Academia Industry and to Support Commercialization.**

This item is focused on understanding and evaluating how TTOs function as crucial bridging agents between academic research and the private sector in South Africa, with the goal of stimulating innovation-led economic growth through effective commercialization. Quantitative data were gathered through questionnaires utilizing a four-point Likert scale. Participants were asked to indicate their level of agreement with a series of statements by selecting one of the following options: Agree (A), Neutral (N), or Disagree (D), as shown in Table 4 below.

**Table 4**  
*TTOs in Bridging Academia and Industry to Support Commercialization.*

<b>Role of TTOs in Bridging Academia and Industry to Support Commercialization.</b>	<b>Level of Agreement</b>		
	<b>Agree</b>	<b>Neutral</b>	<b>Disagree</b>
TTOs actively support the protection and commercialization of research outputs	30 (61.2%)	10 (20.4%)	9 (18.4%)
TTOs effectively facilitate collaboration between academia and industry	36 (73.5%)	7 (14.3%)	6 (12.2%)
TTO-led commercialization initiatives contribute to economic development	45 (91.8%)	1 (2.04%)	3 (6.1%)
There is ongoing training and support for TTO personnel	24 (49%)	8 (16.3%)	17 (35%)

Field data, 2022

The findings revealed that a majority of respondents 30 (61.2%) agreed that TTOs actively support the protection and commercialization research outputs. While 10 (20.4%) held a neutral stance, indicating some uncertainty or lack of direct experience with TTO activities. And, a smaller portion of respondents 9 (18.4%) disagreed, suggesting that there is still doubt or dissatisfaction regarding the effectiveness or visibility of TTO support. These ideas supported by Myeki and Temesco (2019) who suggest that while TTOs are largely seen as supportive, there remains room for improvement in visibility, accessibility, or consistency of their services across institutions.

In addition, majority of respondents 36 ((73.5%) agreed that TTOs play an effective role in bridging the gap between these sectors, indicating recognition of their importance in promoting innovation and knowledge exchange. However, a notable proportion of respondents 7 (14.3%) selected neutral on the statement. And respondents 6 (12.2%) disagreed and highlighting ongoing challenges such as limited resources, bureaucratic barriers, inconsistent engagement practices. Generally, while the data reflect a generally favorable view, it also points to areas for improvement to enhance TTOs impact and efficiency in fostering meaningful partnership.

The findings also, indicate a generally positive perception of the contribution of TTO-led commercialization initiatives to economic development in South Africa. A significant portion of respondents 45 (91.8%) agreed that these initiatives support economic growth by promoting innovation, creating job opportunities, and enabling the

commercialization of academic research. However, a smaller yet notable group of respondents expressed neutral or disagreed responses, suggesting some skepticism regarding the measurable impact of such initiatives or concerns about their scalability and effectiveness. Overall, the data suggest that while TTO-led commercialization is viewed as beneficial to economic development, its full potential may not be consistently realized across the sector.

Also, in Table 4 indicates that 24 (49%) of respondents agreed that there is ongoing training and support, while 8 (16.3%) remained neutral, possibly reflecting uncertainty or inconsistency in training availability. And 17 (35%) of respondents disagreed that there is ongoing training and support. Therefore, although there is a positive indication that some training and support mechanisms are in place, the notable proportion of disagreement and neutrality highlights the need for more consistent, visible, and accessible capacity-building initiatives across institutions to strengthen the effectiveness of TTO personnel. (Veer Ramjeawon & Rowley, 2020)

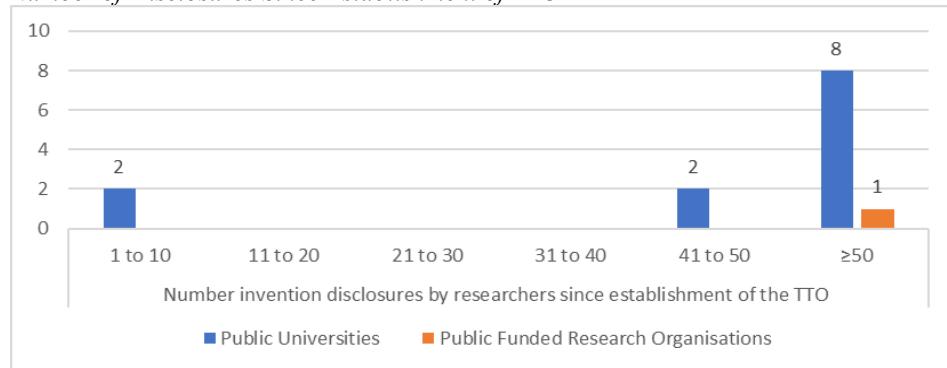
### **Invention Disclosures Submitted, Patents Filed, and Patents Granted.**

The second objective was to measure innovation output by tracking the number of invention disclosures within a defined period. Quantitative data were collected using a structured questionnaire. The respondents rated their perceptions of how effectively their organizations quantified innovation output based on seven items: Such as, the number invention disclosures, the technical fields of the invention disclosures, the number of patents filed, the technological fields of the filed patents, the number of patents granted, the number of patents commercialized through license ng, and the number of patents commercialized through start-ups.

#### **The Number of Invention Disclosures**

The number of invention disclosures, in this context, refers to the quantitative measure of innovations formally reported to Technology Transfer Offices (TTOs) by researchers and inventors. To gather this data, the researcher employed questionnaires directed at managers and researchers within TTOs, enabling the collection of structured, quantitative insights. This approach aimed to capture the frequency and trends of invention disclosures, in public universities and research institutions. As shown in Figure 1 below.

**Figure 1**  
*Number of Disclosures Since Establishment of TTO*



The number of invention disclosures reported since the establishment of TTO in public universities and research institutions is presented in figure 1 above. The responses from TTO managers at public universities show that the majority 8 (62%) out of 13 respondents reported having received  $\geq 50$  invention disclosures since their TTOs were established. A smaller number of respondents 2 (15.4%) reported between 41- 50 disclosures, while another 2 (15.4%) reported between 1 – 10 disclosures. In contrast, only 1 (8%) response was received from a TTO manager at a public research institution, indicating  $\geq 50$  disclosures since establishment. The other 2 (5.88%) respondents from public research institutions stated that their institutions focus on policy and social science issues, which are not typically patentable. Therefore, they were excluded in the invention disclosure responses.

In the same vein, Siegel, Waldman, & Link (2003; Tseng & Raudensky. 2014) emphasized that universities with well-structured TTOs tend to report higher invention disclosures and commercialization activity. Thus, the high number of disclosures reported in this survey suggests that TTO performance is good in terms of high numbers of invention disclosures. Thus, the TTO managers and their staff are effectively capacitating and motivating researchers in these public universities and research institutions to innovate more and to disclose their inventions to the TTOs.

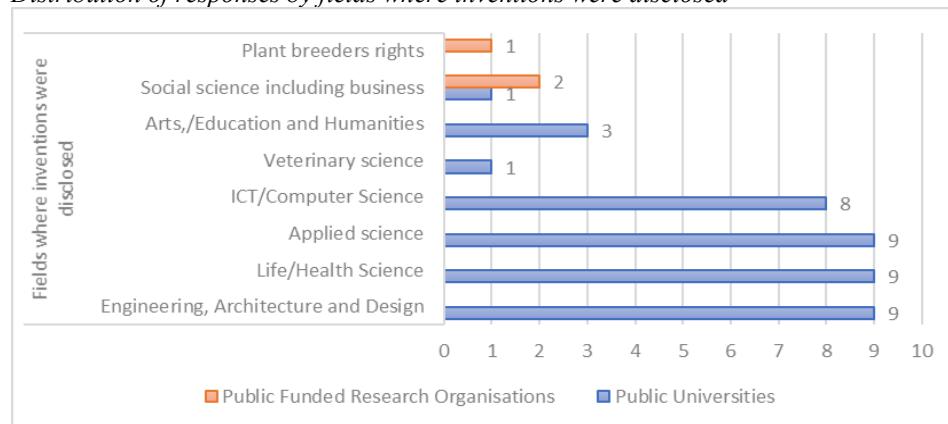
### **The Technical Fields of the Invention Disclosures**

The fields of invention of disclosures are shown in figure 2 below. The responses from TTO managers and staff from public universities show

majority (N=9) to indicate the technology disclosed were engineering, architecture and design, while another majority (N=9) to be in the field's life/health science, other majority (N=9) applied science and other majority (N=8) computer science. While the public research institutions the TTO Managers disclosed the fields social science including social business and Plant breeders right (N=2).

**Figure 6.2**

*Distribution of responses by fields where inventions were disclosed*



The fact that majority of respondents of TTO managers from both public university and research institutions indicated to have a lot of inventions disclosure in different fields of technologies, it is regarded as a strength in these institutions that they are producing knowledge that are solving different need of the citizens supporting the objective of the IPR act of 2008. However, the technology fields shown in this table depend on the area of the focus of research specialized by the university.

### **The Number of Patents Filed**

The researcher employed questionnaires to collect quantitative data, whereby respondents were asked to indicate their views regarding issues related to patents filed in their institutions. The results are presented in Table 5 below.

**Table 5**

*Number of Patents Filed Since Establishment of TTO*

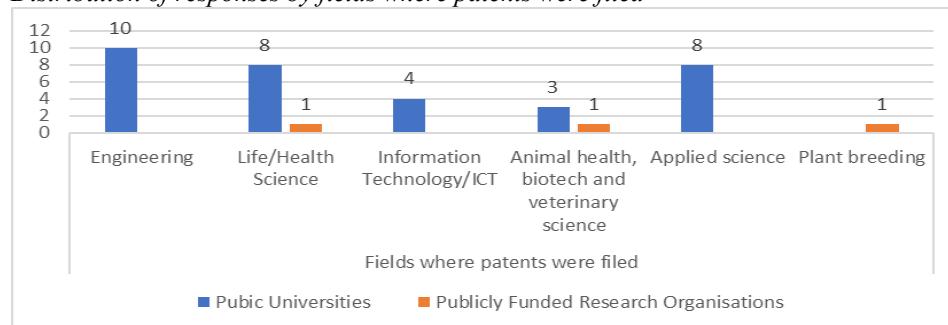
<b>Number of patents filed since establishment of TTO</b>	<b>Public Universities</b>	<b>Public Funded Research Organizations</b>
≤10	1	
11-20	1	
21-30		2
31-40		
41-50		
≥50	9	

The findings revealed that 10 (77%) out of 13 TTO managers from public universities said that their institutions filed more than fifty ( $\geq 50$ ) patent applications since establishment of their TTO, while less majority about 1 (7.69%) TTO respondent said to have filed 10-20 patent applications. Also, 1 (7.69%) hold that their institutions filed (less than 10 patent applications. However, only 1 (2.94%) respondent from public research institutions indicated that their institution filed ( $1 \leq 10$ ) patent applications. Having majority of ten (N=9) (69%) respondents of TTO managers indicating to have filed more than 50 patents and 15% respondents to have filed 21-30 patents since establishing of their TTO is one of good TTO performance in terms of high numbers of patent filing in these institutions under this study. This view is also supported by Brant & Sibanda (2018) Who hold a study on public universities in South Africa where he observed the increase in patenting after IPR act and other regulations that was put in place government to support these institutions. However, the less majority of 16% show 1-10 patent filed since the establishment of their TTO.

### **The Technological Fields of the Filed Patents**

Majority of ten (10) TTO managers from public universities said to have filed patent applications in the field of engineering, while majority of (8) indicated to file patent applications life science another eight (8) in applied sciences (8) as shown in Figure 3 below. While responses received from research institute TTO managers said the filed patents in the field of life sciences, animal health, biotechnology and plant breeding.

**Figure 3**  
*Distribution of responses by fields where patents were filed*



The fact that majority of TTO managers from public universities and research institutions indicated to have filed their patent applications in different fields of technologies which is one of strength of the organizations under study. These findings on Figure 6. above, means these public institutions are doing researcher in different fields of technology trying to solve the problems affecting the south Africa universities from health, food security, Information Technology, and others. These results are in line Sect 2(1) of IPR act where the research conducted should solve the problem of citizens. However, the technical fields of invention disclosed depend on university technical focus for example medicine, or agriculture, energy while some fields can be patent centric or confidential information on military or for other security reasons.

### The Number of Patents Granted

In this item the researcher intended to reveal the number of patents granted in public universities and research institutions. The researcher employed questionnaires so as to collect quantitative data, as it has shown in table 6 below.

**Table 6**  
*Number of Patents Granted Since Establishment of TTO*

Number of patents granted since establishment of TTO	Public Universities	Public Funded Research Organizations
≤10	1	
11-20	1	2
21-30		
31-40	2	
41-50		
≥50	7	

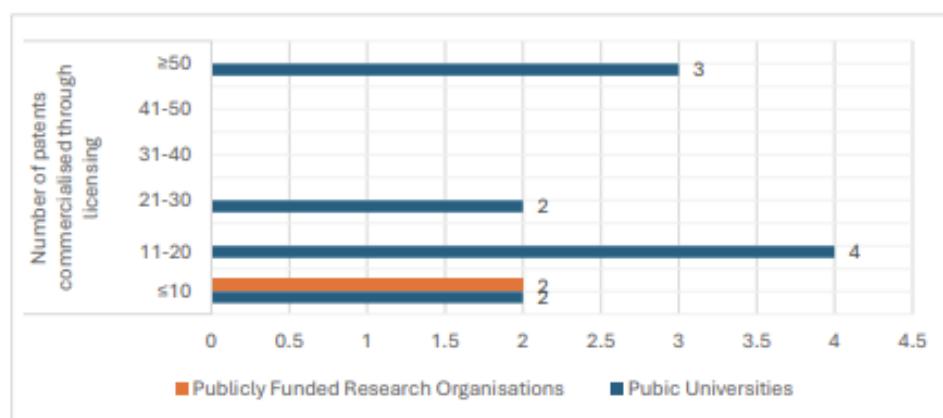
The data revealed that about 8 (62%) out of 13 TTO managers and staff from public universities and public research organizations indicated to have granted more than 50 patents, while less majority 2 (15.38%) said to be granted 31-40 applications, and 1 (7.69) granted between 11-20 and 1 (7.69) granted less than 10 patent applications. Only 1 (7.69%) response was received from TTO manager from public research institution said to receive granting between less than 10 patents.

Thus, having majority of 62 % of response from TTO managers indicating to having more than 50, 15% responses for 11-40 Patent granted since establishment is good sign of effective TTO in the institution under study. An effective TTO is measured by the numbers of Patent granted Lee (2023) cited Vinig & Lips, (2015). Though this thesis measuring patent filed, but patent granted add more weight to the TTO effectiveness since having more granted patents it shows good quality of the patent file. Thus, majority of TTO show high performance of their TTO in terms of filing high quality of patents which most of them ended up to be granted. However less majority of 16% respondents have 1-10 patent granted since their establishment which do not show a good performance of the TTO.

### **The Number of Patents Commercialized Through Licensing**

Questionnaires tools were used to collect primary data. The researcher intended to reveal the number of patents commercialized through licensing as shown in figure 4 below.

**Figure 4**  
*Number of Patents Commercialized Through Licensing*



Therefore, the findings revealed that, 4 (30.76%) out of 13 TTO manager from public universities responded on numbers of invention commercialized by license that 11-20 patents were commercialized by license while second majority 3 (23%) said more than fifty (50) patents commercialized by license. On the other hand, less majority 2 (15%) indicated 21-30 patents were commercialized by license. While 4 (30.76%) of TTO managers and staff from public research institutions said that patents commercialized by license since establishing of their TTO range between 1-10 patent applications.

Thus, having majority (70%) of response from TTO managers from both public universities and research institutions indicating to have 11 to more than 50 Patent scommercialized through licenses, it shows good sign of high performance of TTO in terms of commercialization in the institution under study. An effective TTO is measured by the numbers of Patent licensed among others. Having more patent filed, granted and then commercialized through license, it shows, the patented inventions by TTO are of good quality which can be commercialized to the market, which can generate a return on investment for the institutions and Government.

Thus, these institutions, their TTO are meeting the objective of IPR Act of 2008 which required the PU and PRO to commercialize the inventions generated from public money for the benefit of South African citizens.

### **The Number of Patents Commercialized Through Start-ups**

The responses from TTO managers and staff from public universities is shown on Table 7 below. However, no response was received from public research institutions on patents licensed by spin out or start-up. Majority of respondents 3 (27%) out of 13 said their institution had 6-10 patents licensed as start-ups, while the other majority of three 3 (27%), noted 21-25 patents were commercialized by start-up, where less majority of 2 (18%) has more than 26 start up established through start-ups and also the less majority of 3 (27%) have less than 5 start up established since the establishment of their organizations.

**Table 7**  
*Number of Patents Commercialized Through Spin Outs or Start-ups*

<b>Number of patents commercialized spin outs/start-ups</b>	<b>Public Universities</b>	<b>Public Funded Research Originations</b>
≤5	3	
6-10	3	
11-15		
16-20		
21-25	3	
≥26	2	

The results presented in Table 7 above, shows majority of TTO managers (73%) under study indicating their TTO to have more than six Patents commercialized through start-ups since establishment, this is a good sign of effective TTOs in the institutions under study. An effective TTO is measured by the numbers of start-ups formed. However, IPR Act do not provide a clause on Start-up, it is to the institution Policy and other factors where TTO operates.

But recently, there has been an increase in the number of new technologies generated by these universities, which require the formation of start-ups. Since there is no government policy, TTO managers face challenges in allocating a buyer. Thus, an increase in start-ups is a good sign of strong TTO performance in terms of commercialization.

## **CONCLUSION AND RECOMMENDATIONS**

This study has pointed out that Technology Transfer Offices (TTOs) play a critical role in facilitating the patenting, licensing and commercialization of research outputs by providing institutional support, legal guidance, and strategic industry linkages. Regarding the first objective, the study found that TTOs streamline intellectual property management by assisting researchers with invention disclosures, navigating patent filling processes, and negotiating licensing agreements with commercial partners, thereby accelerating the path from innovation to market. In relation to the second objective, the study presents data demonstrating that TTOs are performing well. It found that more inventions are being reported to TTOs, with most of these being converted into patent applications. A large number of these applications are granted and eventually commercialized, particularly at research-intensive universities such as the University of Cape Town, University of Johannesburg, and University of Pretoria.

Even some newer universities such as the Cape Peninsula University of Technology have shown positive performance in patenting and commercialization of research results, largely due to the support they receive from NIPMO in intellectual property (IP) management. This indicates that, while there has been overall progress, some public universities still face challenges in patenting and commercialization. These findings highlight the need for strengthened institutional capacity and improved alignment with industry partners. It is recommended that South African TTOs receive increased funding, specialized training, and policy support to enhance their operational effectiveness and to ensure that more research outputs successfully transition into impactful commercial products.

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## Foreign Remittance and Economic Growth in Nigeria: An Empirical Survey

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### **Abstract**

In this research, an empirical survey was done to evaluate the link between international remittances and economic growth using Nigeria as our case of interest. The link between international remittances inflow, foreign portfolio investment, foreign direct investment, and economic growth of Nigeria was extensively analysed. The survey research design was chosen and employed for this specific inquiry. In this research, the Nigerian economy functioned as the population of interest. Between the years 1990 and 2022, a total of 33 years were covered by the data that was acquired. The Fully Modified Ordinary Least Squares (FMOLS) was then employed in order to conduct the analysis on the data that was received, and the tool that was utilised was EViews 9. According to the results of the research, there is a strong positive association between the inflow of international remittances, foreign portfolio investment, foreign direct investment, and economic progress in Nigeria. According to the findings of the study, the Nigerian government and its policymakers should take into consideration the possibility of harmonising the nation's economic policies in order to better stimulate and facilitate international remittances, foreign portfolio investment, and foreign direct investment. They should encourage, diversification in sources of foreign investment, implement initiatives that enhance financial inclusion, making it easier for remittances to reach a broader population and have a more widespread impact and invest in infrastructure projects that can leverage foreign direct investment for economic development.

**Keywords:** *Foreign Remittance; International Remittances Inflow; Foreign Portfolio Investment; Foreign Direct Investment; Economic Growth.*

## INTRODUCTION

The gross domestic product (GDP) works as a significant measure of economic growth and performance internationally (Ali and Yasmin, 2020; Depken, Nikšić Radić, and Paleka, 2021). The GDP of a country often reflects the outputs of different economic activities across diverse sectors such as agriculture, education, health, aviation, manufacturing, power, and oil and gas amongst others. These endeavours are typically financed from domestic savings and government earnings. However, as economies expand, domestic resources often prove inadequate for financing development projects, prompting reliance on external financial inflows such as foreign direct investment (FDI), foreign portfolio investment (FPI), official development assistance, and foreign remittances (Adebayo and Beton Kalmaz, 2020; Ali and Yasmin, 2020).

Foreign remittances have emerged as a crucial factor for economic development in many developing countries, playing a vital role in poverty reduction, income redistribution, and economic growth (Ojha, 2019; Depken, Nikšić Radić, and Paleka, 2021). Faced with challenging economic conditions, many inhabitants seek better chances overseas and contribute to their home economies by sending remittances, which assist balance capital deficiencies that impede growth and development (Akhimien and Osifo, 2019; Adebayo and Beton Kalmaz, 2020).

In Nigeria, remittance inflows have mostly increased throughout the years, albeit with significant fluctuation. The World Bank (2024) presents steady remittance data from 2013 to 2022: 20.8, 21, 20.63, 19.70, 22.04, 24.31, 23.81, 17.21, and 19.48 billion dollars, respectively (Adebayo and Beton Kalmaz, 2020; Abdulai, 2023). Given the importance of these financial transfers, the present article empirically studies the influence of overseas remittances on Nigeria's economic growth and presents policy proposals based on these results.

## LITERATURE REVIEW

### **Concept of Foreign Remittance**

International remittances are defined as cross-border transfers of migrant earnings and have been related to issues such as diaspora movement, international migration, workers' remittances, financial development, official development assistance (ODA), poverty

alleviation, exchange rates, capital flows, human capital development, and economic growth. The macroeconomic repercussions of remittances involve poverty reduction, consumption, savings, balance of payments, currency rates, trade balances, and investment (GFMD, 2013; Adebayo and Beton Kalmaz, 2020).

Remittance inflows are considered as vital to the GDP of poor and middle-income nations, with stable annual growth. Economists appreciate their crucial influence in decreasing global poverty and inequality. In nations such as Nigeria, remittances represent a critical financial resource valued by stakeholders across financial institutions, governments, and civil society (GFMD, 2013; Akhimien and Osifo, 2019).

In addition to cash inflows, the diaspora assists to economic growth through skills and knowledge transfer, as proven by efforts like as the Migration for Development in Africa (MIDA) project, which stimulates economic development through training programs (IOM, Chile Diasporas). Success stories, such as the Indian diaspora's participation in the invention of information technology, highlight the diverse contributions of remittances (IOM, 2009; Mushi, 2024).

Globally, remittances have become a major resource transfer mechanism from industrialised to developing nations, second only to foreign direct investment (Buch and Kuckulenz, 2004; Karagoz, 2009; Ratha, 2003; Russell, 1992). Their persistence over financial crises highlights their value in solving challenges including credit market failures, economic injustice, and poverty (Karagoz, 2009). Remittances also assist economic growth, human capital development, and infrastructure investment. However, poor management can lead to negative outcomes, such as currency appreciation and de-industrialisation, underlining the importance for strategic exploitation of these inflows (Beine et al., 2010; Bryan, 2004).

### **International Remittances Inflow**

International remittance inflows relate to the transfer of money from individuals working overseas to their home nations, generally sent to family members or dependents. These transfers are an important element of the global economy, primarily enabled through banks, money transfer services, and digital platforms (World Bank, 2013;

Abdulai, 2023). Remittances support basic needs, fund education and healthcare, and contribute to the general well-being and development of receiving households (World Bank, 2013; Devkota and Pokhrel, 2023).

Remittances have a substantial impact on the economies of developing nations by raising household incomes, reducing poverty, and serving as a stabilising force during economic downturns. They are also a key source of foreign exchange (World Bank, 2013; Cheema, Noor, and Ul-Haq, 2021). In many cases, remittance inflows surpass official development aid (ODA) and foreign direct investment (FDI) (World Bank, 2013; Ali, Shoaib, and Waseem, 2022).

The development of digital technology has revolutionised remittance transfers, making them more efficient, accessible, and transparent through mobile banking and online platforms (World Bank, 2013; Cheema, Noor, and Ul-Haq, 2021). Despite these advancements, obstacles such as high transaction costs, currency rate fluctuations, and the use of informal channels persist, necessitating continuing efforts to promote secure, cost-effective remittance services (World Bank, 2013; Maune and Matanda, 2022).

Governments and policymakers often focus on reducing transaction costs and improving financial inclusion to increase remittance flows (World Bank, 2013; Devkota and Pokhrel, 2023). As a dynamic financial mechanism, remittances not only support people and families but also contribute greatly to the economic development of receiving countries. Efforts to enhance the efficiency, affordability, and security of these transfers remain vital for maximising their positive impact (World Bank, 2013).

### **Concept of Economic Growth**

Economic growth is the progressive increase in the output level of a country's goods and services. Often, it can be assessed by its Gross Domestic Product (GDP) or Gross National Product (GNP). It comprises consumer spending, company investments, government expenditures, and net exports. Key drivers of economic growth include investments in physical capital, technology, education, healthcare, and the efficient management of natural resources (Barro and Becker, 1989; Solow, 1956; Mankiw, Romer and Weil, 1992; Auby, 1993;

Mushi, 2024). Strong institutions, such as legal frameworks and governance, are also vital in producing an environment conducive to growth (Acemoglu and Robinson, 2012).

Growth rates differ across nations, driven by variables such as globalisation, trade policies, and international collaboration (Barro and Sala-i-Martin, 2003). A expanding economy offers jobs, removes poverty, improves living circumstances, earns tax money, and promotes global competitiveness (Dollar and Kraay, 2002; Lucas, 1988; Tanzi and Schuknecht, 1997; Porter, 1990). However, economic expansion generates worries for potentially contributing to environmental deterioration, income disparity, and overreliance on finite resources (Sachs, 2015; Piketty, 2014; Radic, Bogdan and Beloglavec, 2023).

### **Empirical Review**

Mohamed (2023), using data from the World Bank, experimentally studied the influence of remittances on economic development and unemployment in Nigeria during the period between 1991 and 2020. The study reveals that remittances have a small and positive effect on economic growth using autoregressive distributive lag (ARDL). Abdulai (2023) uses the ARDL bound testing approach to study the influence of remittances on economic growth in Ghana over the period 1990-2020. Hence, the study revealed a long-run relationship between the growth rate of gross domestic product (GDP) and remittance inflows in the Ghanaian economy. Amir and Amir (2023) employed a generalized method of moments (GMM) and fixed effects technique to look at data from 2001 to 2020 in forty-two (42) African countries. The results demonstrated a considerable beneficial influence of remittances on economic growth in the African countries they analysed. The study by Maune and Matanda (2022) employed the autoregressive distributive lag (ARDL) to evaluate the impact of foreign remittances on economic growth of Zimbabwe between 1960 to 2020. The data for the study were acquired from World Bank Development Indicators and the analysis indicated both a unidirectional and bi-directional causation between the two variables and foreign remittance favourably and significantly impact on Zimbabwe economic growth. Wadood and Hossain (2017) evaluated the influence of remittances on the economy of Bangladesh. They used annual data from 1972 to 2012. They employed several methodologies

such as the Johansen cointegration methodology, Vector Error Correction Model, and Granger Causality test. The results revealed a long-run association between remittances and economic growth and that remittances contribute a lot to the growth in the economy of Bangladesh. Cjanci and Cerav (2014) explored how remittances support the financial growth in post-communist Albania. They employed the ARDL bounds testing method and multiple regression models to examine their data. Their research showed that remittances had a considerable beneficial effect, where a 10% increase in remittances is associated to around an 11.78% gain in financial development. Mwangi and Mwenda (2017) evaluated the impact of international remittances on economic growth in Kenya. They utilized development metrics from the World Bank running from 1993 to 2013. They did ordinary least square estimations and Granger causality tests. These studies demonstrated strong positive effects of remittances on economic growth for Kenya. Tolcha and Rao (2016) evaluated the impact of remittances on economic growth in Ethiopia. They utilised the ADF unit root test and the ARDL technique using data during 1981-2012. The data showed that remittances had favourable benefits in the short-run but negative consequences in the long-run. Lime (2016) investigated the impact of abroad remittances on Kenya's economic growth stretching from 1980 to 2014. They employed multiple regression analysis, a unit root test, and the Johansen test. The finding demonstrated that there was no long-term association. Remittances, commercial openness, and government spending directly but little affected the economic growth. Okodua (2014) investigated the impact workers' remittances had on economic growth and development in Sub-Saharan African Countries. He applied a technique termed the Generalised Method of Moments (GMM) towards the estimation. The study studied how remittances connect to production growth, domestic investment and trade balance.

## **METHODOLOGY**

This part covered the research design, demographic, sample, data sources, theoretical framework, model construction, variable operationalisation, and data analysis procedures. The study utilised an ex-post facto research strategy, where the researcher has no influence over the independent variables as they have already occurred. The study's population spanned the Nigerian economy, focusing on macroeconomic variables, while the sample consisting of data on

international remittance inflows (IRI), foreign portfolio investment (FPI), foreign direct investment (FDI), and real gross domestic product (RGDP) from 1990 to 2022. The secondary data were acquired from the Central Bank of Nigeria's Statistical Bulletin, the World Bank, United Nations Centre for Trade and Development, and Index Mundi.

Operationally, in this study, economic growth is defined as the increase in goods and services production inside Nigeria, assessed annually using RGDP. International remittance inflows were referred to be non-commercial money transfers by international workers to Nigeria. FPI was seen as the passive ownership of financial assets without influence over enterprises, whereas FDI was perceived as foreign investments in Nigerian corporate interests.

## Theoretical Framework and Model Specification

The study is based on the Output-Remittance model of the neoclassical endogenous growth theory, which posits that output and remittances are driven by altruism, often displaying countercyclical patterns (Chami et al., 2003). The assumption of philanthropically driven remittances is sufficiently expressed within a set of equations characterized by three endogenous variables namely: Growth rate of output (YGR), Workers' remittances (WR), and Per capita income (PCI).

The neoclassical production function, a Cobb-Douglas form, specifies output (GDP) as a function of labour, capital, workers' remittances, and technological efficiency:<sup>39</sup>

Where A represents technological efficiency, L is labour, K is capital, WR is workers' remittances, and PCI is per capita income. The model is adjusted for this investigation as:

$$GDP = AL\alpha K(1 - \alpha)WR, PCI \quad (0 < \alpha < 1) \quad ?$$

Where  $\alpha$  is the relative share of labour in total production and  $(1-\alpha)$  is the relative share of capital in total output.

The aforementioned model was then considerably changed to accommodate the relevant variables in this investigation as:

and the econometric form is

$$RGDP = \beta_0 + \beta_1 IRI + \beta_2 FPI + \beta_3 FDI + \varepsilon t \quad 4$$

Where:

RGDP = Real Gross Domestic Product; IRI = International Remittance Inflows; FPI = Foreign Portfolio Investment; FDI = Foreign Direct Investment;  $\beta_0$  = Constant; and  $\epsilon_t$  = Error term.

The a priori expectations are:

$\beta_1 > 0$ : The coefficient of international remittance inflows (IRI) is projected to be positive, demonstrating a positive correlation with real gross domestic product (RGDP).

$\beta_2 > 0$ : The coefficient of foreign portfolio investment (FPI) is anticipated to be positive, reflecting a positive link with RGDP.

$\beta_3 > 0$ : The coefficient of foreign direct investment (FDI) is anticipated to be positive, showing a positive influence on RGDP.

The study applied the Fully Modified Ordinary Least Squares (FMOLS) with E-Views 9.0 to estimate the coefficients, t-statistics, F-statistics, standard errors, and the Durbin Watson statistic to test for serial correlation.

## Data Presentation, Analysis and Interpretation

This section displays, examines, and interprets data gathered from the Central Bank of Nigeria (CBN) and the World Bank database.

## Descriptive Statistics

Table 1 below presents the summary statistics for the variables utilised in this study, including the mean, median, minimum and maximum values, standard deviation, skewness, kurtosis, and Jarque-Bera test results.

**Mean Values:** The mean values for the variables are as follows: Real Gross Domestic Product (RGDP) averaged ₦40,804.26 billion, international remittance inflows (IRI) ₦1,771.66 billion, foreign direct investment (FDI) ₦490.06 billion, and portfolio investment (FPI) ₦384.32 billion.

**Standard Deviations:** The standard deviations are: RGDP ₦18,371.25 billion, IRI ₦2,129.40 billion, FDI ₦447.92 billion, and FPI ₦782.62 billion.

**Distribution Characteristics:** All variables showed positive skewness, indicating right-skewed distributions with frequent large gains and lesser reductions. Portfolio Investment displayed leptokurtic behaviour (excess kurtosis), suggesting big outliers. International Remittance Inflows showed mesokurtic behaviour, consistent with a normal distribution, but RGDP and FDI were platykurtic, indicating the presence of minor outliers.

**Normality Test:** The Jarque-Bera statistic suggests that RGDP and FDI were normally distributed, however IRI and FPI were not.

**Table 1**  
*Descriptive statistics of the variables used in the study*

	Gross Domestic Product at 2010 Constant Basic Prices (₦' Billion)	International Remittance Inflows (₦' Billion)	Foreign Direct Investment (₦' Billion)	Portfolio Investment (₦' Billion)
<b>Mean</b>	40804.26	1771.66	490.06	384.32
<b>Median</b>	36431.37	302.02	258.39	51.08
<b>Maximum</b>	70536.35	7441.19	1360.31	2687.23
<b>Minimum</b>	21680.20	0.08	4.69	-698.29
<b>Std. Dev.</b>	18371.25	2129.40	447.92	782.62
<b>Skewness</b>	0.44	1.09	0.46	2.01
<b>Kurtosis</b>	1.63	3.46	1.76	6.26
<b>Jarque-Bera</b>	3.20	5.98	2.86	32.39
<b>Probability</b>	0.20	0.05	0.24	0.00
<b>Sum</b>	1183324	51378.16	14211.72	11145.36
<b>Observations</b>	29	29	29	29

Source: Authors' computation (2024) using E-views 12

## Analysis of the Pairwise Correlation Statistics

Table 2 depicts the correlation matrix, illustrating the pairwise relationships among the variables. Correlation analysis studies the degree and direction of correlations between data, using the Pearson correlation coefficient, which goes from -1 to 1. A coefficient of +1 suggests a perfect positive connection, -1 a perfect negative correlation, and 0 signifies no association.

The analysis indicates a substantial positive connection between real GDP and overseas remittance inflows (0.93 or 93%), foreign direct investment (0.85 or 85%), and portfolio investment (0.56 or 56%). This illustrates that increases in these characteristics are associated with economic growth in Nigeria. The results are detailed in Table 2.

**Table 2**  
*Correlation Statistics of all Variables Employed*

	Real Gross Domestic Product	International Remittance Inflows	Direct Investment	Portfolio Investment
<b>RGDP</b>	1.00	0.93	0.85	0.56
<b>IRI</b>	0.93	1.00	0.77	0.46
<b>FDI</b>	0.85	0.77	1.00	0.57
<b>FPI</b>	0.56	0.46	0.57	1.00

Source: Authors' computation (2024) using E-views 12

## Testing for Stationarity

Following Granger and Newbold (1974), time series variables typically demonstrate non-stationary patterns at their level distributions. Using such non-stationary series in regression models could lead to spurious estimates, which are unsuitable for policy consideration. To address this, the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were performed, as noted in Table 2 above.

The goal was to investigate the stationarity of the time series and establish their order of integration. Both ADF and PP tests reject the null hypothesis of a unit root at the first difference for all variables, as the absolute values of the test statistics exceed the critical values at the 1% level for real GDP, foreign direct investment, and portfolio investment, and at the 5% level for international remittance inflows. This shows that the variables are stationary at their first differences.

These findings support the adoption of the Fully Modified Ordinary Least Squares (FMOLS) technique, which depends on the stationarity assumption (Granger and Newbold, 1974; 1977a, 1977b; Sims, 1977; Quah, 1994). Results of the stationarity tests are reported in Tables 3A and 3B.

**Table 3A**  
*Stationarity Tests at Levels- Augmented Dickey-Fuller and Phillips-Perron Tests Approaches*

Series	t-Statistic	1% level	5% level	10% level	Remark
<b>Augmented Dickey-Fuller test</b>					
RGDP	1.72	-3.69	-2.97	-2.63	Non-Stationary
IRI	1.42	-3.70	-2.98	-2.63	Non-Stationary
FDI	-1.51	-3.69	-2.97	-2.63	Non-Stationary
FPI	-2.24	-3.70	-2.98	-2.63	Non-Stationary
<b>Phillips-Perron Test</b>					
RGDP	0.93	-3.69	-2.97	-2.63	Non-Stationary
IRI	2.95	-3.69	-2.97	-2.63	Non-Stationary
FDI	-1.40	-3.69	-2.97	-2.63	Non-Stationary
FPI	-3.38	-3.69	-2.97	-2.63	Stationary*

\* Denotes significant at 5%

**Source:** Authors' computation (2024) using E-views 12

**Table 3B**  
*Stationarity Tests at Differences- Augmented Dickey-Fuller and Phillips-Perron Tests Approaches*

Series	t-Statistic	1% level	5% level	10% level	Remark
<b>Augmented Dickey-Fuller test</b>					
RGDP	-5.56***	-3.71	-2.98	-2.63	Stationary
IRI	-2.40**	-2.65	-1.95	-1.61	Stationary
FDI	-5.99***	-3.70	-2.98	-2.63	Stationary
FPI	-4.48***	-3.71	-2.98	-2.63	Stationary
<b>Phillips-Perron Test</b>					
RGDP	-6.00***	-3.71	-2.98	-2.63	Stationary
IRI	-2.98**	-3.70	-2.98	-2.63	Stationary
FDI	-6.06***	-3.70	-2.98	-2.63	Stationary
FPI	-6.34***	-3.70	-2.98	-2.63	Stationary

**NB:** \*\*Significant at 5%, and \*\*\*Significant at 1%.

**Source:** Authors' computation (2024) using E-views 12

### Co-Integration Test

Cointegration testing is crucial for evaluating if a long-run relationship exists among variables in a regression model. This work uses the

single equation methods established by Engle and Granger (1987) and Phillips and Ouliaris (1990) to test for cointegration under the null hypothesis of no cointegration in linear combinations. Engle and Granger's approach address autocorrelation with a parametric ADF methodology, while Phillips and Ouliaris utilise a non-parametric PP technique.

The results, described in Table 4, reveal that both Engle-Granger and Phillips-Ouliaris tau-statistics failed to reject the null hypothesis of no cointegration. Specifically, these tau-statistics found no evidence of a long-run link among the variables in the real GDP model. According to Pesaran (1997), this absence of cointegration shows there is no stable long-run relationship among the series. Consequently, the FMOLS approach remains appropriate, given its emphasis on stationarity. Thus, the variables will be integrated at their differenced forms. Results of the cointegration tests using both strategies are provided in Table 4.

**Table 4**

*Cointegration Tests Results-Eagle-Granger and Philip-Ouliaris Approach*

Null hypothesis: Series are not cointegrated

Series: FDI FPI IRI RGDP

Sample: 1990 2024

Included observations: 33

Cointegrating equation deterministics: C

Dependent	Eagle-Granger Approach				Philip-Ouliaris Approach			
	Automatic lags specification based on Schwarz criterion (maxlag=1)				Long-run variance estimate (Bartlett kernel, Newey-West fixed bandwidth)			
	tau-statistic	Prob.*	z-statistic	Prob.*	tau-statistic	Prob.*	z-statistic	Prob.*
FDI	-1.87	0.90	-8.44	0.82	-2.76	0.57	-13.06	0.51
FPI	-3.65	0.21	-33.23	0.00	-5.17	0.01	-26.56	0.02
IRI	-4.01	0.12	-105.37	0.00	-1.83	0.91	-9.39	0.76
RGDP	-4.06	0.11	-40.52	0.00	-2.87	0.52	-12.47	0.55

\*MacKinnon (1996) p-values.

Source: Authors' computation (2024) using E-views 12

## Empirical Results and Discussion of Findings

Following the confirmation of stationarity and the absence of cointegration among the variables, the FMOLS technique was utilised to analyse the link between economic growth and the factors of foreign remittance.

The FMOLS estimations suggest that overseas remittance inflows significantly and positively impact real GDP at the 1% level. This shows that greater remittances boost economic development by providing additional investment capital and enhancing liquidity. Higher remittance inflows lead to more frequent transactions, enhancing financial system stability and overall economic activity. Specifically, a billion Naira increase in remittances resulted in about N5.06 billion rise in real GDP, consistent with findings from Cjanci and Cerav (2014), Tolcha and Rao (2016), Wadood and Hossain (2017), and Mwangi and Mwenda (2017).

Foreign direct investment also demonstrates a significant positive association with real GDP at the 1% level. This suggests that higher FDI contributes to economic expansion by providing additional investible capital. A billion Naira surge in FDI resulted in a N14.61 billion increase in real GDP, consistent with another research by Aminu et al. (2015), Shuaib et al. (2015), Adigwe et al. (2015), and Fapetu et al. (2015).

Foreign portfolio investment has a positive and considerable influence on real GDP at the 10% level. A rise in FPI correlates with increased economic engagement and growth. Specifically, a billion Naira growth in FPI translates to a N3.55 billion gain in real GDP.

The coefficient of determination ( $R^2$ ) suggests that approximately 90% of the variability in real GDP is explained by the combined effects of FDI, FPI, and IRI, with the remaining 10% attributable to other factors. This shows that the model is well-specified. The comprehensive estimation results are shown in Table 5.

**Table 5**

*Fully Modified Least Squares (FMOLS) Estimates*

**Dependent Variable: RGDP**

**Sample (adjusted): 1991 2022**

**Included observations: 31 after adjustments**

**Cointegrating equation deterministics: C**

**Long-run covariance estimate (Bartlett kernel, Newey-West fixed bandwidth = 4.00)**

Variable	Coefficie nt	Std. Error	t- Statistic	Prob.
<b>C</b>	23181.93	2054.36	11.28	0.00***
<b>IRI</b>	5.06	0.98	5.15	0.00***
<b>FDI</b>	14.61	5.09	2.87	0.01***
<b>FPI</b>	3.55	2.08	1.71	0.10*
<b>R-squared</b>	0.90	Mean dependent var		41487.26
<b>Adjusted R- squared</b>	0.89	S.D. dependent var		18330
<b>S.E. of regression</b>	6167	Sum squared resid		913000000
<b>Long-run variance</b>	49795924			

NB: \*Significant at 10 per cent and \*\*\*Significant at 1 per cent.

Source: Authors' computation (2024) using E-views 12

### Post-Estimations Tests

As part of robustness checks, the study conducted multicollinearity test utilising the variance inflation factor (VIF) and Autocorrelation presented in Table 6 and Table 7 accordingly.

### Multi-Collinearity Test

Multicollinearity denotes the presence of an exact linear connection among the explanatory variables in a regression model. This exact relationship (multicollinearity) is a problem in econometrics because such collinearity makes it difficult to disentangle the effect of specific independent variable on the dependent variable. The Decision Rule from the rule is that, if the variance inflation factor is greater than 10, we conclude that there is multicollinearity. Otherwise, there is no multicollinearity among the explanatory variables in the model. From table 4.6 below, it can be seen that the centered and the uncentered VIF for all the explanatory variables are less than 10 (i.e.  $VIF < 10$ ). This signifies; there is absence of multicollinearity among the variables in the FMOLS model computed.

**Table 6**  
*Variance Inflation Factors*

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
IRI	0.965862	4.228154	2.399553
FDI	25.92913	6.551654	2.798097
FPI	4.330373	1.863885	1.478055
C	4220407.	2.373114	NA

Source: Authors' computation (2021) using *E-views 12*

### Autocorrelation and Partial Correlation

From the autocorrelation test result, the related probability values for the 12 lag periods were more than the statistical 5% critical values. This shows that, Autocorrelation, was not present in the estimated model. Thus, the estimations can therefore be assessed to be strong, consistent, efficient and dependable. The outcome is reported in Table 7 below.

**Table 7**  
*Autocorrelation Test Result*

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob*
.  **.	.  **.	1	0.301	0.301	2.8171 0.093
.  **.	.  *.	2	0.274	0.201	5.2366 0.073
.  *.	.  *.	3	0.212	0.098	6.7435 0.081
.   .	.  *.	4	-0.063	-0.217	6.8813 0.142
.   .	.   .	5	0.004	-0.001	6.8820 0.230
.   .	.   .	6	0.000	0.050	6.8820 0.332
.   .	.   .	7	-0.062	-0.022	7.0374 0.425
.   .	.   .	8	-0.015	-0.026	7.0463 0.532
.   .	.   .	9	-0.041	-0.029	7.1223 0.624
.   .	.  *.	10	0.043	0.103	7.2084 0.706
.  *.	.   .	11	0.080	0.070	7.5245 0.755
.   .	.  *.	12	-0.020	-0.100	7.5456 0.820

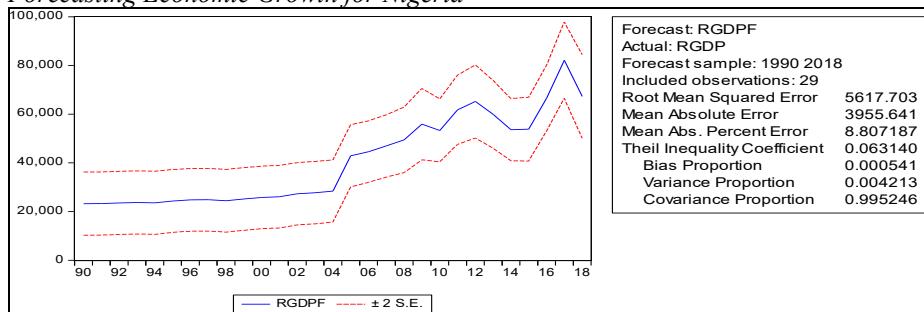
Source: Authors' computation (2024) using *E-views 12*

### Forecasting Economic Growth for Nigeria

In order to further validate the aforementioned empirical findings, it becomes beneficial to simulate the actual behaviour of real GDP with changes in foreign direct investment, portfolio investment and

international remittance inflows. This is done by applying forecasting methods with the E-views application and the result is reported in Figure 1 below. Explicitly, the result reveals that, the predicted real GDP (RGDPF) for Nigeria remained inside the 2 standard error key lines, hence supporting the strength and accuracy of the projection. Also, judging from relevant economic theories, the projected outcome is accurate given the fact that the Theil inequality index of 0.06 is closer to zero.

**Figure 1**  
*Forecasting Economic Growth for Nigeria*

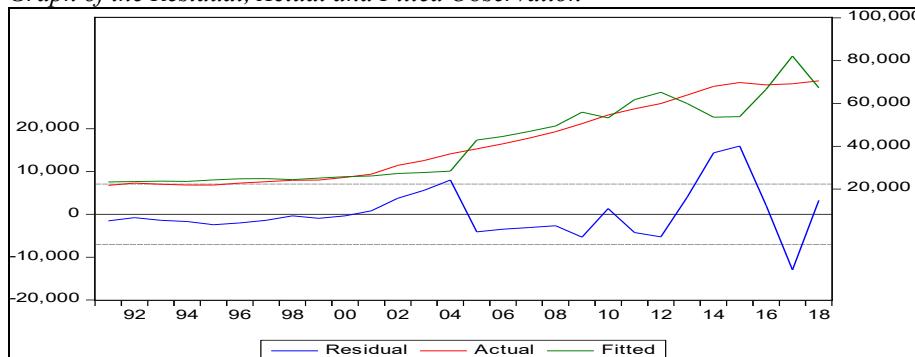


Source: Authors' computation (2024) using E-views 12

### Graph of the Residual, Actual and Fitted Observations

The graphs in Figure 2 below demonstrate that, the actual and the fitted observations from the model are almost close to each other. This suggests that the forecast and final prediction errors are at minimum point, thus, enhancing the accuracy of the parameter estimates in the FMOLS model. Thus, the estimated models are resilient.

**Figure 2**  
*Graph of the Residual, Actual and Fitted Observation*



Source: Authors' computation (2024) using E-views 12

## **Policy Implications of Findings**

From the FMOLS data, foreign direct investment, portfolio investment and international remittance inflows were determined to be of great relevance in the time under review. The inference that may be drawn is that, for a desirable level of economic growth to be reached in Nigeria, policy makers need to give significant attention to these variables in the process of macroeconomic policy conception, formulation and execution in the country. Thus, foreign direct investment, portfolio investment and international remittance inflows are particularly vital for promoting economic expansion in the country.

## **CONCLUSION AND RECOMMENDATIONS**

The intention of this study was to objectively assess the impact of overseas remittances, foreign portfolio investment (FPI), and foreign direct investment (FDI) on Nigerian economic growth from 1990 to 2022, employing data from the Central Bank of Nigeria (CBN) and the World Bank. The Fully Modified Least Squares (FMOLS) approach was employed to analyse these associations, with real GDP acting as a proxy for economic growth.

The data reveals that international remittance inflows, foreign portfolio investment, and foreign direct investment all have a considerable beneficial impact on Nigerian economic growth. These numbers suggest that increased overseas remittances, FPI, and FDI contribute considerably to Nigeria's economic growth. The study contributes to the empirical literature by highlighting the role of these variables in driving economic development in the country.

Policymakers should mandate and support programs that diversify investments. This comprises strengthening interaction with Nigerians in the diaspora to enhance remittance inflows and attract a mix of remittances, FPI, and FDI, so developing a more robust and diverse economic basis.

Authorities should increase the management of remittance data and streamline remittance channels to guarantee that funds from the diaspora are efficiently and effectively transmitted to Nigeria. Collaborating with financial institutions, fintech startups, and international organisations could increase the speed and cost-effectiveness of these payments.

To attract both portfolio and direct investments, Nigeria needs maintain a stable and investor-friendly climate. This means lowering legal, institutional, and bureaucratic impediments, offering investor incentives, and creating a stable economic and political climate.”

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## Is traditional medicine controversial in Africa? A critical review

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### **Abstract**

*Traditional medicine (TM) remains an essential component of healthcare in Sub-Saharan Africa, where up to 80% of the population relies on it for primary care. Deeply rooted in cultural beliefs and local health practices, TM continues to play a significant role in disease prevention and treatment. Several African countries are working to integrate TM into national health systems, recognizing its accessibility, affordability, and alignment with community values. This critical review examined whether TM is indeed contentious in the region. Using literature sourced from Google Scholar, PubMed, and African Journals Online, the review thematically analyzed data from academic publications, books, and institutional reports. Findings reflect an imbalanced debate. Supporters emphasize TM's contribution to universal health coverage, its holistic approach, use of indigenous resources, and reported effectiveness in areas such as maternal and mental health. High utilization, especially in rural and underserved populations, underscores its continued relevance. However, critics point out the limited scientific validation, safety concerns, regulatory weaknesses, and difficulties in standardization and formal integration on the use and development of TM. Additional issues include inadequate practitioner training, environmental pressures on medicinal plants, and risks linked to commercialization. Overall, the debate stems from tension between TM's cultural importance and unresolved concerns about evidence, safety, and sustainability.*

**Keywords:** Culture; Integration; Regulation; Safety; Traditional medicine

### **INTRODUCTION**

Traditional medicine (TM) remains a cornerstone of healthcare across Africa, with an estimated 80% of the population relying on it as their primary source of care (Bishoge et al., 2024). Deeply rooted in cultural traditions and community practices, TM encompasses a wide range of

healing modalities, including herbal remedies, spiritual and faith-based healing, traditional bone setting, and the services of traditional birth attendants (Ahmed et al., 2023; Chebii et al., 2020). Its widespread use reflects not only historical continuity but also practical relevance, as many individuals turn to TM to address diverse health conditions. Prevalence rates vary significantly across regions and populations, ranging from 4.6% to 94% in the general population and 12% to 90% among pregnant women (Mbowe et al., 2025). Ethiopia, for example, is reported to have over 80% usage, mostly herbal ( $\approx$ 95%), making it a cornerstone of primary healthcare, particularly in rural and underserved areas, underscoring its pervasive role in everyday healthcare (Tuasha et al., 2023).

One of the key drivers of TM's prominence is its accessibility and affordability, particularly in rural and underserved areas where biomedical infrastructure is limited. In Tanzania, for example, studies indicate that between 60% and 80% of the population depends on TM due to the scarcity of conventional healthcare services and the prohibitive costs associated with them (Amegbor et al., 2019). Beyond economic factors, the continued reliance on TM is shaped by cultural beliefs, dissatisfaction with aspects of conventional medicine, and the perceived holistic nature of traditional healing practices (Opoku Agyemang et al., 2025). TM often serves not only as a medical resource but also as a culturally resonant form of care that aligns with community values and expectations.

Despite its widespread use and cultural significance, TM faces ongoing challenges related to regulation, standardization, and safety. Concerns about the scientific validation of traditional remedies, potential adverse effects, and inconsistent quality control have prompted calls for more rigorous oversight (Wang et al., 2023). Additionally, efforts to integrate TM into formal healthcare systems are complicated by stigma, skepticism from biomedical practitioners, and divergent epistemologies (Ikhoyameh, Okete, Ogbeye, Owoyemi, et al., 2024). While some African countries have begun to recognize the value of TM and are exploring pathways for its formal inclusion, the debate remains polarized. Ghana, for example, established the Traditional and Alternative Medicine Directorate under its Ministry of Health and has integrated TM into select public hospitals, allowing patients to access herbal treatments alongside conventional care (Ampomah et al., 2022). Similarly, Nigeria has developed regulatory frameworks through its Traditional Medicine Department within the

Federal Ministry of Health, aiming to standardize practices and ensure safety (Pal & Isa, 2024). These efforts are often supported by the World Health Organization (WHO), which advocates for evidence-based integration to improve health equity and preserve indigenous knowledge systems (Patwardhan et al., 2023). Advocates emphasize its potential to complement conventional medicine and expand healthcare access, while critics caution against uncritical adoption without robust evidence and safeguards.

## **METHODOLOGY**

This narrative synthesis of literature aimed to explore and summarize the existing literature on the contentiousness of TM in Africa. A systematic but flexible search of literature was used to access articles from PubMed, Google Scholar, Scopus, and African Journals Online. The inclusion criteria were English-language published articles in the period from 2015 to 2025. Relevant reports from organizations such as the World Health Organization (WHO) were also reviewed to capture additional sources. Excluded those studies of purely anecdotal, lacked relevance to health system implications, or did not provide substantive evidence or discussion on the role of TM in health care delivery. Data were extracted and synthesized thematically rather than quantitatively, allowing identification of recurring patterns, arguments, and gaps across the literature. The narrative approach was chosen given the heterogeneity of study designs, outcomes, and contexts, enabling integration of diverse perspectives.

## **FINDINGS**

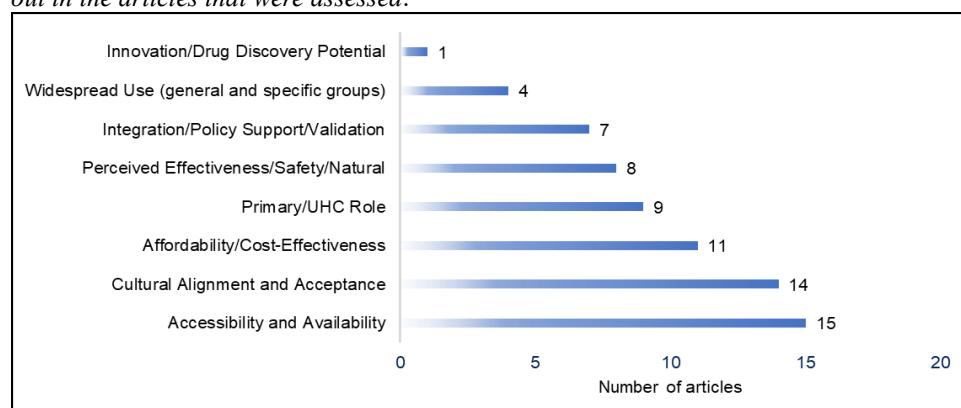
### **Arguments for TM**

This study has identified several arguments in support of the use of traditional medicine in Africa. TM is accessible and affordable (Christian, 2023; Ikhoyameh, Okete, Ogboye, Gbadebo, et al., 2024; James et al., 2018; Kasilo et al., 2019; Kendi, 2024; Mponda et al., 2025; Nixon, 2022; Reza Fadly, 2024; Shey Nsagha et al., 2020), culturally and spiritually aligned (D'Almeida et al., 2024; Kendi, 2024; Reza Fadly, 2024; Tuasha et al., 2023), and deeply embedded in community life, especially in rural and underserved areas (D'Almeida et al., 2024; Ikhoyameh, Okete, Ogboye, Gbadebo, et al., 2024; James et al., 2023; Tuasha et al., 2023). TM is a holistic approach, addressing physical, mental, and spiritual well-being (Christian, 2023; Kendi, 2024; Nixon, 2022).

TM resonates with local beliefs and practices (D'Almeida et al., 2024; James et al., 2018; Kendi, 2024; Nixon, 2022; Shey Nsagha et al., 2020), and it often requires minimal infrastructure, utilizing indigenous, natural materials perceived as safe and effective (James et al., 2018; Nixon, 2022), culturally and spiritually aligned (D'Almeida et al., 2024; James et al., 2018; Kasilo et al., 2019; Nixon, 2022; Reza Fadly, 2024; Shey Nsagha et al., 2020).. TM serves as a primary healthcare option for many (Ikhoyameh, Okete, Ogbeye, Owoyemi, et al., 2024; James et al., 2023; Mujinja & Saronga, 2022), including people with chronic illnesses such as HIV/AIDS (Mponda et al., 2025; Mudonhi & Nunu, 2022) and hypertension (Lassale et al., 2022), and it complements conventional care where formal services are limited or procedure-heavy (D'Almeida et al., 2024; James et al., 2018).

The growing policy frameworks and WHO-endorsed tools for scientific validation (Kasilo et al., 2019), along with integration efforts, position TM as a practical contributor to Universal Health Coverage (UHC) and primary care delivery (D'Almeida et al., 2024; Kasilo et al., 2019; Nixon, 2022) and even biomedical innovation through drug discovery (Ikhoyameh, Okete, Ogbeye, Owoyemi, et al., 2024). Its cultural familiarity, widespread acceptance, and versatility across prenatal, labor, postnatal, mental health, and general wellness needs (Kendi, 2024; Maina, 2024) (Kendi, 2024) make TM a relevant, trusted, and potentially cost-effective pillar of African health systems (D'Almeida et al., 2024; Nixon, 2022) (see Figure 1).

Figure 1:  
*The arguments for the use of TM in Africa represented by the frequency of issues pointed out in the articles that were assessed.*



## **Arguments Against TM**

The arguments against TM highlight a wide range of concerns, including significant safety issues such as reported adverse effects (Christian, 2023; James et al., 2018; Lassale et al., 2022; Mponda et al., 2025), particularly gastrointestinal and blood pressure compli

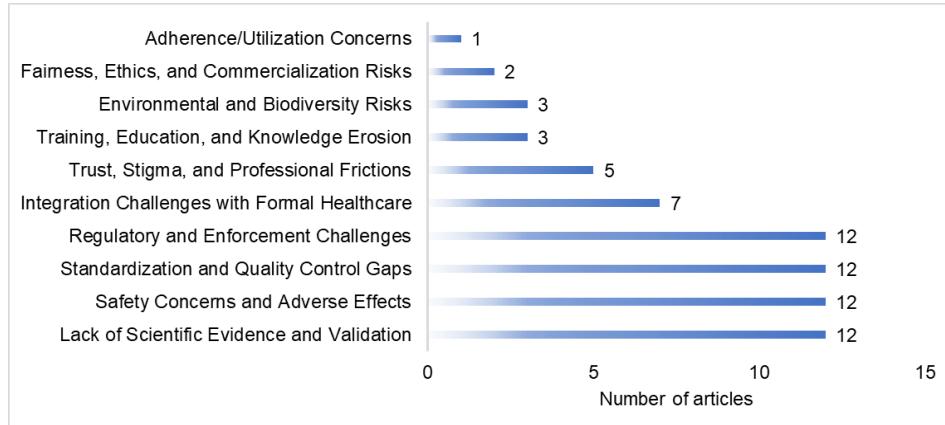
cations (James et al., 2018; Lassale et al., 2022), along with the lack of scientific evidence on safety and efficacy (Kasilo et al., 2019; Mujinja & Saronga, 2022), and risks of misdiagnosis or harm due to unverified treatments (Christian, 2023; Kendi, 2024; Reza Fadly, 2024).

Many criticisms revolve around the absence of standardization (D'Almeida et al., 2024; Nixon, 2022; Shey Nsagha et al., 2020), inadequate regulation, and weak enforcement of manufacturing and labeling standards (Ikhoyameh, Okete, Ogbeye, Gbadebo, et al., 2024; Kasilo et al., 2019; Mudonhi & Nunu, 2022), as well as poor monitoring of practitioners' training and education (Christian, 2023; James et al., 2023). Additional challenges include mistrust between biomedical and traditional practitioners (Shey Nsagha et al., 2020), cultural stigma linking TM to witchcraft or sorcery (James et al., 2023) and difficulties integrating TM into formal healthcare systems (Christian, 2023; Mponda et al., 2025; Mudonhi & Nunu, 2022).

Broader risks also include biodiversity loss and resource limitations (Kasilo et al., 2019; Nixon, 2022), environmental harm (Nixon, 2022), potential exploitation through commercialization ([9]), and knowledge erosion (Nixon, 2022). Overall, TM faces persistent skepticism due to gaps in safety, regulation, quality control, and evidence (D'Almeida et al., 2024; James et al., 2018; Mponda et al., 2025; Reza Fadly, 2024; Shey Nsagha et al., 2020), which hinder its acceptance and effective integration into mainstream health systems (see Figure 2).

**Figure 2**

Arguments against the use of TM in Africa shown by the frequency of issues pointed out in the articles that were assessed.



## DISCUSSION

The *Accessibility and affordability* of TM make it an important aspect of healthcare delivery in Africa, particularly in populations where conventional healthcare is not easy to access (Ikhoyameh, Okete, Ogbeye, Gbadebo, et al., 2024). Traditional medicine is widely available in rural areas and affordable at a low cost (Onukansi et al., 2025). Traditional healers and remedies are often the first, and sometimes only, source of care for individuals facing financial constraints or geographic barriers to modern health facilities (Cruz et al., 2022; Jayte et al., 2025). This reliance is especially noticeable among vulnerable groups, including people living with HIV/AIDS, pregnant women, the elderly, and children who frequently turn to traditional medicine to meet their basic health needs in the absence of adequate formal healthcare infrastructure.

TM often plays a critical role in contexts where *formal health systems are under-resourced or unevenly distributed*. In many regions, especially rural or remote areas, hospitals and clinics may be scarce, inadequately staffed, or lack essential medical supplies (Yenet et al., 2023). TM fills these gaps by providing accessible, culturally familiar, and community-based care, allowing individuals to address common illnesses and maintain well-being without relying entirely on formal healthcare facilities (Ikhoyameh, Okete, Ogbeye, Gbadebo, et al., 2024; Ngere et al., 2022). By reducing the immediate demand on overstretched hospitals and health workers, TM can help alleviate pressure on formal health systems, ensuring that limited

resources are reserved for cases requiring specialized medical intervention.

TM has a *deep cultural resonance*, making it widely acceptable in these communities compared to formal medical services (Kropi et al., 2024). The African cultural values and beliefs align with the practices of traditional medicine that have been established for a long period of time in the communities (Katonge, 2025), hence establishing trust and acceptance among the people. TM takes on a holistic approach combining herbal treatment, spiritual therapies, and social activities to promote mental, emotional, and spiritual well-being (Hoenders et al., 2024). The *perceived effectiveness* of TM is linked to its reliability in treating chronic illnesses where conventional medicine may seem too costly, too far to reach, or seen as offering only palliative relief (Poli et al., 2025). TM is also commonly relied upon in maternal health, where it is used to support fertility, ease childbirth, and aid recovery after delivery (Makombe et al., 2023). Youla and colleagues reported that the highest prevalence of women using TM for child illnesses was found in Ghana (16.3%) and Guinea (13.80%) (Youla et al., 2025).

TM has the *potential to complement conventional healthcare systems*, particularly in areas such as primary care and maternal health, where accessibility and affordability are often major challenges (Sichalwe et al., 2025). Its integration aligns with the WHO's vision of achieving Universal Health Coverage, as it can help bridge healthcare gaps and expand treatment options for underserved populations (Akhigbe et al., 2025). By 2018, significant progress had been made in advancing African TM, with 34 research institutions established across 26 African countries to scientifically study and validate traditional practices. Importantly, 14 of these countries had utilized research findings to authorize the marketing of traditional medicine products, thereby ensuring their safety, efficacy, and quality (Mssusa et al., 2023). Furthermore, 8 countries had gone a step further by including traditional medicine products in their national essential medicines lists, signaling policy-level recognition of their value and creating opportunities for broader public access. This demonstrates both the growing institutional support for TM and its potential role in strengthening healthcare systems across Africa.

TM plays an important role in *advancing Primary Health Care (PHC)* and the broader goal of *Universal Health Coverage (UHC)*, particularly

in many African and low-resource settings (Kasilo et al., 2019). For a significant portion of the population, TM is the first point of care due to its accessibility, affordability, and deep cultural acceptance (Febriyanti et al., 2024). When properly regulated and integrated into national health systems, TM has the potential to complement biomedical care, strengthen primary health care delivery, and move countries closer to achieving UHC by ensuring that more people, especially vulnerable groups, have access to essential health services without financial hardship.

TM represents a valuable reservoir of bioactive compounds that hold significant *potential for pharmaceutical research and drug discovery* (Aware et al., 2022). Many modern drugs have their origins in compounds first identified in plants, minerals, or other natural sources used in the discovery of traditional therapies (Mushtaq et al., 2018). By systematically documenting and analyzing traditional knowledge, researchers can identify promising therapeutic candidates more efficiently, reducing the time and cost associated with the early stages of drug development (Fu & Chen, 2025). This integration of TM into modern biomedical research not only facilitates the discovery of novel treatments for complex diseases but also encourages the development of innovative therapeutic strategies that are informed by centuries of empirical use.

On the other hand, there is persistent *lack of scientific evidence* supporting the efficacy and safety of TM (Liheluka et al., 2023). This lack of scientific backing casts doubts on the quality, consistency, and reliability of traditional therapies, hindering the seamless integration of TM into formal healthcare (Ikhoyameh, Okete, Ogboye, Gbadebo, et al., 2024). Many traditional practices are deeply rooted in cultural and spiritual beliefs, making them difficult to study using conventional scientific methods (Katonge, 2025). Another hindrance is the lack of transparency and record-keeping, where often information is transferred through word of mouth (Mujinja & Saronga, 2022). Lastly, western-centric approaches in medicine and research tend to undervalue indigenous practices, reinforcing a bias against their scientific study (Gall et al., 2025). One of the *safety concerns of traditional medical products* is the risk of contamination with harmful microorganisms, heavy metals, or being deliberately mixed with other substances to enhance perceived efficacy (Luo et al., 2020). Coupled with this is a lack of standardization, meaning that doses, preparation methods, and ingredient concentrations

vary widely, leading to unpredictable therapeutic outcomes (Chaachouay, 2025).

Another major challenge in the use of TM is the *issue of quality, manufacturing, and labelling*. Unlike conventional pharmaceuticals, which are produced under strict regulatory standards, many traditional medicines often lack standardized production processes (Chaachouay, 2025). This can result in significant variability in the concentration of active ingredients, contamination with harmful substances, or inconsistent potency across batches. Additionally, labelling is frequently incomplete or inaccurate, leaving consumers unaware of the correct dosage, potential side effects, or interactions with other medications (Gamil et al., 2025). Such gaps not only compromise the therapeutic effectiveness of traditional remedies but also pose serious health risks, particularly when patients rely solely on these products for treatment.

The *risk of misdiagnosis and poor adherence* also compounds the doubts cast on traditional medical products, as traditional medicine practitioners may sometimes lack formal diagnostic tools or standardized clinical guidelines, which can lead to incorrect identification of medical conditions (Thipanyane et al., 2022). Patients relying on these remedies might therefore receive inappropriate treatments, potentially delaying timely medical intervention for serious illnesses. The decline in preference for TM in Africa is closely linked to rising levels of formal education and changing social dynamics, which have contributed to the erosion of indigenous medical knowledge (Logiel et al., 2021; Malapane et al., 2024). One of the central concerns is the aging population of traditional healers, many of whom lack successors as younger generations increasingly pursue modern education and careers outside traditional practices (Ahmed et al., 2023).

Additionally, the decline of medicinal plant use threatens biodiversity conservation, creating a cycle of loss that weakens both cultural identity and healthcare resilience in the region (Ssenku et al., 2022). As a result of this, communities risk losing cultural heritage and potential gaps that may arise in the provision of medical care.

## **LIMITATIONS OF THE STUDY**

The lack of strict systematic protocols may introduce selection bias, and the heterogeneity of included studies, varying in design, quality, and

context, limits generalizability. Publication and language biases may also affect comprehensiveness, as some relevant studies, particularly unpublished or non-English sources, could have been missed. Additionally, the thematic synthesis relies on the reviewer's interpretation, which may introduce subjectivity. To mitigate these issues, a comprehensive search of multiple databases and grey literature sources was conducted, with predefined inclusion and exclusion criteria to guide selection. Triangulation of evidence from peer-reviewed articles, policy documents, and reports enhanced representativeness, while transparency in reporting and critical appraisal of study relevance and quality helped reduce bias and strengthen the reliability of conclusions.

## **CONCLUSION AND REMARKS**

The debate over traditional medicine in Africa reflects the tension between its cultural importance, widespread use, and the concerns about safety, evidence, and regulation. TM remains vital for underserved populations and contributes meaningfully to primary healthcare, yet ongoing weaknesses in quality control, practitioner training, and scientific validation limit its full potential. Strengthening regulatory frameworks, promoting collaborative research, and fostering respectful integration with conventional care are essential steps forward. Ensuring that TM is safe, evidence-based, and culturally grounded will help maximize its benefits while protecting public health and supporting more equitable, responsive healthcare systems across the continent.

## **Competing interests**

The authors declare no conflicts of interest.

## **ACKNOWLEDGMENTS**

Not applicable

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## Young Adults' Perception of Peacebuilding System for Sustainable Development and Security

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### **Abstract**

There have been concerted efforts from government at all levels, international bodies and other peacekeeping agencies all over the world, in Africa which include Nigeria. The perceived aggressors and agitators are the young adults who are now contrarily seen as change agents if involved in peacebuilding. This paper sought to examine the significant basis of the young adult's perception of peacebuilding system for sustainable development. The study employed a descriptive survey research design; a research question was answered and three hypotheses tested using 1,830 participants from different parts of the country. A validated instrument tagged Young Adults' Perception Questionnaire (ALESDLQ;  $r=0.93$ ) was used for data collection in the study. Data obtained were analysed using descriptive statistics of simple percentage, mean, standard deviation and inferential statistics of t-test and ANOVA. The findings revealed that there is significant difference in young adults' perception ( $mean=1.24$ ). Besides, these findings were gender sensitive ( $t(1,1726) =-0.03$ ;  $p=0.95>0.05$ ); age biased ( $F(2,1727)=0.45$ ;  $p=0.61>0.05$ ) and educational attainment ( $F(2,1727)=0.05$ ;  $p=0.95>0.05$ ) different. Young adults' perception was discussed and it was recommended among others that full multi-sector programmes that target youth in specific areas of activity, such as employment creation and/or peacebuilding projects should be encouraged. It is therefore recommended that this group should be better catered for and included in peacebuilding.

**Keywords:** Young Adults, Perception, Peacebuilding System, Sustainable Development and Security.

### **INTRODUCTION**

There have been violence and unrest all over the world at various times leaving no particular area safe but despite the insecurity, live continues.

Young adults have been seen overtime as agent of conflict and destruction (Kishani, 2024). They are considered on one hand as being vulnerable and on the other, feared as dangerous, violent, unconcerned and as threats to security (Vilchez and Trujillo 2023). Their images are stereotyped as being angry, drugged and violent and as threat, particularly those who were involved in armed conflict as fighters (Harmony Ridge, 2025). Ironically, about 1.3 billion 25-24 years old across the globe as reported by Whitten, Tzoumakis, Green and Dean (2024) have witnessed violence and have vivid experience of it. This percentage of young adults due to the experience is in the best position to be considered for in peacebuilding programmes given their imagination of peaceful existence.

Crisis is often caused by exuberance, impatience and anxiety of young adults, their quest and willingness to be seen as responsible and independent, the urgency of increasing the speed of their social mobility, the perception of government as cog in the wheel of their progress and the determination to ruthlessly and jointly deal with such. Thus, joblessness, poverty, and social or political deprivation become the bone of contention. This kind of societal dynamics, segregation and discrimination vary across groups (Forrest, 2025).

The young adults play adaptable roles in different situation they find themselves, they can be champions as well as the oppressed, rescuers and courageous in the midst of crisis, as well as villains in political crisis and military affairs in trouble areas (Modi, 2023). Hence, they have the capacity of playing immense role in peacebuilding, besides their inclusion is imperative in order to fulfil Goal 16 of Sustainable Development. The goal aim is to promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels. Significantly reduce all forms of violence and related death rates everywhere (United Nations, 2020). According to Ujomu (2002) including young adults in peacebuilding poses to promote peace in the society when their energies are diverted to the application of productive peace projects. Peacebuilding efforts should go beyond signing agreements to stop violence but also involve equity and social justice for sustainable development. The availability of adequate educational infrastructure and systems, employment opportunities and other structures through which youths can be active participants in making decisions concerning their wellbeing and that of the country at large. The inclusion of this group of people in

peacebuilding can be meaningful only when there is fair play, equity, youth empowerment, right placement, adequate engagement major social restructuring predicated by continuous emphasis on these germane areas for instituting belongingness, civil and harmonious nation (Nesterova & Ozcelik, 2021). This paper sought to examine the extent to which social justice favour young adults and how it affects their inclusion in decision making in matters that concern them.

Over the years, the young adults seem not to have been given enough spaces in many areas like admission, employment, appointments, political platforms and decision making (Timreck and Emmons, 2024). They are left out in some of these things and many of them become idle, angry and hungry (Orukwue, 2024). The issues got complicated by the nation's poor economic condition created by bad governance and unrest in Nigeria and across the globe (Oke and Ahoton, 2024, Hassan, Abalaka and Ajiteru, 2024). Some of the young adults engaged in illegitimate means of livelihood while others moved far away in search of greener pastures (Muna, 2025). How great will the nation be when these young old people are given full consideration in the scheme of things? This study therefore assessed young adults' perception of peace building system for sustainable development and security.

Over time, young adults have been perceived as agents of war and devastation due to the violence and instability that have occurred around the world at different times, making no region safe. Involving young adults in peacebuilding initiatives can help advance social harmony by directing their energies toward the implementation of successful peace initiatives (Ajak, 2021).

Availability of adequate peace building systems make youths to be active participants in making decisions concerning their wellbeing and that of the country at large (Kern, 2025). The inclusion of this group of people in peace building can be meaningful only when there is fair play, equity, youth empowerment, right placement and adequate engagement in major social restructuring (citation). Empowerment theory advocates adequate engagement of youth through steady involvement in profitable activities and skills as opined by Kern (2025). Abiola (2023) also asserted the imperative of theory of change which helps articulate the type of change desire in peacebuilding. Contact theory affirms the essentials of intergroup discussion with youth as it may be difficult or almost

impossible to meet with the total population at once. However, young adults seem not to have been given meaningful inclusion in peace building decision making. This study therefore assessed young adults' perception of peace building system for sustainable development and security. The main objectives of the study are to:

- i) Assess young adults' perception of peace building system for sustainable development and security.
- ii) Determine if there are any notable disparities in young adults' perception of peace building system for sustainable development and security according to gender, age and educational qualification.

As a result of the research problem stated above, this study examined the following question: *What is young adults' perception of peace building system for sustainable development and security in Nigeria?* The following null hypotheses were formulated and tested at 0.05 level of significance:

*H<sub>01</sub>: There is no significant gender difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.*

*H<sub>02</sub>: There is no significant age difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.*

*H<sub>03</sub>: There is no significant educational level difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.*

## **METHODOLOGY**

Non-experimental design of descriptive survey type was adopted for the study. This aims at investigating phenomena that are already in existence in the society, especially among the young adults. The targeted population for this study comprised all young adults from the age of twenty across the country which is about 160 million (70% of the total population of the country) as estimated by Development Research and Project Center (2024). The reason for the choice of this group of people is partly because they have major stake in peace building system, and partly because they are the change makers (DRPC, 2024). Multistage sampling technique was used to select the participants of this study across the country (first by zone and later by state). Simple random sampling was used to select three geo-political zones (southwestern, southeastern and north central zones)

from the six geo-political zones (north east, north west, south south, southwestern, southeastern and north central zones) in the country. Simple random sampling was also used to select five major cities in each zone (Abuja, Lagos, Aba, Ibadan and Owerri). Total inclusive accidental sampling technique was used to select the young adults at their different working places across these cities resulting into 1,830 young adults that participated in the study, 366b participants were selected from each city.

### **Instrumentation**

An instrument tagged young adults' Perception of Peacebuilding Questionnaire (YPPQ) which was adapted from the publication of USAID (2020) was used to elicit information from the participants on issues that have to do with their perception of peace building in Nigeria. This is a 15-item instrument designed to collect information from the participating young adults. The instrument was made up of two sections. Sections A dealt with the background information of the respondents like their gender, age, highest educational qualification; section B consisted items in relation to young adults' perception of peace building in Nigeria. The items were rated on a four-point likert scale of Very High Extent (VHE), High Extent (HE), Low Extent (LE), and Very Low Extent (VLE). An initial pool of twenty (20) items was developed in the instrument. The items were subjected to face and content validity, in which experts in adult education and educational evaluation validated the items (how about youth experts, political scientist experts? Social development expert?). Fifteen (15) items survived the scrutiny (how was the scrutiny performed? Why are 5 variables removed? Any justification?). Comments about wordings and arrangement of items made were incorporated into the final edition of the instrument. The instrument was therefore pilot tested at a zone apart from the sampled zones (where was it piloted? Who were involved? How many participants were included?). The reliability of the instrument was calculated using Cronbach Alpha Coefficient, and the instrument yielded a reliability index of 0.91. The researchers with some trained research assistants directly administered the questionnaire to the participants.

### **METHOD OF DATA ANALYSIS**

To make meaningful deductions, the data collected were statistically analyzed using descriptive statistics, which involve simple frequency count, simple percentage, mean and standard deviation to produce answer

to the research question and inferential statistics of t-test and Analysis of Variance (ANOVA) to test the hypotheses at 0.05 level of significance.

## RESULTS

The tables below show the analysis of data and results of the study.

**Table 1**  
*Socio-demographic Attributes of the Respondents*

Variable		Freq.	%
Young Adults' Gender	Male	876	47.9
	Female	954	52.1
	Total	1830	100.0
Young Adults' Age	20-24 Years	680	37.2
	24-40 Years Adult	916	50.1
	Below 50 Years	234	12.8
	Total	1830	100.0
Young Adults' Educational Level	No Formal Education	495	27.0
	Secondary Education	957	52.3
	Tertiary Education	378	20.7
	Total	1830	100.0

Table 1 shows the socio-demographic attributes of the respondents. 876 (47.90%) of the respondents were males while 954 (52.10%) were females. 680 (37.20%) were between the age range of 31 - 35 years, 916 (50.10%) were within the age range of 36 – 40 years, while the remaining 234 (12.80%) were below 50 years. 495 (27.00%) were without formal education, 957 (52.30%) were with secondary education, while the remaining 378 (20.70%) were with tertiary education as at the time of data collection.

### *Answering the Research Question*

Results in table 2 show the mean and standard deviation scores of the rating scales items on young adults' perception of peace building system for sustainable development and security in Nigeria. All the items have mean rating scale above 2.50. This shows that the extent at which young adults' perceived peace building system for sustainable development and security in Nigeria was on the high side.

**Table 2**

*Descriptive Statistics of young adults' perception of peace building system for sustainable development and security in Nigeria*

		Freq.	%	Mean	SD	Decision
The most common sources of conflict in Nigeria included land disputes, domestic violence and debt collection.	Very Low Extent	74	4.0	3.55	0.82	Very High Extent
	Low Extent	164	9.0			
	High Extent	274	15.0			
	Very High Extent	1318	72.0			
	Total	1830	100.0			
The predominant mechanisms to manage conflict in Nigeria are household elders, town chiefs and traditional councils.	Very Low Extent	74	4.0	3.07	0.85	High Extent
	Low Extent	384	21.0			
	High Extent	714	39.0			
	Very High Extent	658	36.0			
	Total	1830	100.0			
I first seek conflict resolution through elders and the family structure.	Very Low Extent	92	5.0	3.49	0.88	High Extent
	Low Extent	199	10.9			
	High Extent	255	13.9			
	Very High Extent	1284	70.2			
	Total	1830	100.0			
Land dispute cases are the most likely to escalate to the government officials.	Very Low Extent	55	3.0	3.37	0.86	High Extent
	Low Extent	291	15.9			
	High Extent	402	22.0			
	Very High Extent	1082	59.1			
	Total	1830	100.0			
Peace Committees were found to have maximum role in dispute resolution and conflict prevention in Nigeria.	Very Low Extent	73	4.0	3.60	0.79	Very High Extent
	Low Extent	128	7.0			
	High Extent	255	13.9			
	Very High Extent	1374	75.1			
	Total	1830	100.0			
I view indigenous alternative dispute resolution mechanisms more favorably than the formal judicial system.	Very Low Extent	55	3.0	3.48	0.87	High Extent
	Low Extent	291	15.9			
	High Extent	202	11.0			
	Very High Extent	1282	70.1			
	Total	1830	100.0			
I have never used the formal judicial system.	Very Low Extent	55	3.0	3.48	0.81	High Extent
	Low Extent	200	10.9			
	High Extent	383	20.9			

		Freq.	%	Mean	SD	Decision
	Very High Extent	1192	65.1			
	Total	1830	100.0			
The formal judicial system is expensive.	Very Low Extent	37	2.0	3.63	0.67	Very High Extent
	Low Extent	91	5.0			
	High Extent	390	21.3			
	Very High Extent	1312	71.7			
	Total	1830	100.0			
The formal judicial system takes a long time to resolve cases.	Very Low Extent	91	5.0	3.68	0.80	Very High Extent
	Low Extent	110	6.0			
	High Extent	92	5.0			
	Very High Extent	1537	84.0			
	Total	1830	100.0			
The formal judicial system causes litigants to suffer other costs.	Very Low Extent	127	6.9	3.58	0.91	Very High Extent
	Low Extent	129	7.0			
	High Extent	146	8.0			
	Very High Extent	1410	77.0			
	5.00	18	1.0			
	Total	1830	100.0			
The formal justice system is seen to promote discord as opposed to social harmony.	Very Low Extent	56	3.1	3.53	0.78	Very High Extent
	Low Extent	164	9.0			
	High Extent	362	19.8			
	Very High Extent	1248	68.2			
	Total	1830	100.0			
Indigenous alternative dispute resolution mechanisms promote unity.	Very Low Extent	55	3.0	3.69	0.70	Very High Extent
	Low Extent	92	5.0			
	High Extent	221	12.1			
	Very High Extent	1462	79.9			
	Total	1830	100.0			
Formal judicial system appears more susceptible to influence from privileged and powerful individuals.	Very Low Extent	55	3.0	3.66	0.71	Very High Extent
	Low Extent	91	5.0			
	High Extent	272	14.9			
	Very High Extent	1412	77.2			
	Total	1830	100.0			
Elders and youth work together frequently on town projects such as communal	Very Low Extent	36	2.0	3.62	0.76	Very High Extent
	Low Extent	204	11.1			
	High Extent	185	10.1			

		Freq.	%	Mean	SD	Decision
cleaning or construction.	Very High Extent	1405	76.8			
	Total	1830	100.0			
I feel comfortable bringing conflicts to local leaders.	Very Low Extent	55	3.0	3.68	0.73	Very High Extent
	Low Extent	128	7.0			
	High Extent	166	9.1			
	Very High Extent	1481	80.9			
	Total	1830	100.0			

### Testing the Hypotheses

*H<sub>01</sub>: There is no significant gender difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.*

**Table 2**

*Descriptive Statistics of young adults' perception of peace building system for sustainable development and security in Nigeria based on gender*

	Young Adults' Gender	N	Mean	Std. Deviation	Std. Error Mean
Young Adults' Perception	Male	876	53.0514	3.50097	.11829
	Female	954	53.1698	2.98413	.09661

**Table 3**

*t-test analysis of young adults' perception of peace building system for sustainable development and security in Nigeria based on gender*

		F	Sig.	t	df	Mean Diff.	Std. Err.Dif.
Young Adults' Perception	Equal variances assumed	29.817	.000	-	1828	-.11844	.15170
	Equal variances not assumed		.781				
				-	1726.431	-.11844	.15273
				.776			

A **t-value of -0.781** indicates that the difference between the two group means (or the test value) is very small. The negative sign only shows direction, not significance. It implies that there is no significant difference between the groups being compared. The observed mean difference is likely due to chance.

Results in tables 3 and 4 show that there was statistically significant difference ( $t_{(1,1828)} = -0.78$ ) in young adults' perception of peace building system for sustainable development and security in Nigeria based on

gender ( $p = 0.00 < 0.05$ ). The mean and standard deviation values also show statistically significant difference in young adults' perception of peace building system for sustainable development and security in Nigeria based on gender. Therefore, the null hypothesis that says that there is no significant gender difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria is accepted. It means this hypothesis needs to be accepted, implying that the perception of young adults when it comes to peace building system for sustainable development and security in Nigeria does not differ gender-wise.

*H02: There is no significant age difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.*

**Table 5**

*Descriptive Statistics of young adults' perception of peace building system for sustainable development and security in Nigeria based on Age.*

	N	Mean	Std. Deviation	Std. Error
31-35 Years	680	53.9721	3.31429	.12710
36-40 Years	916	52.5044	3.37315	.11145
Below 50 Years	234	53.0000	1.47074	.09615
Total	1830	53.1131	3.24147	.07577

**Table 6**

*ANOVA of young adults' perception of peace building system for sustainable development and security in Nigeria based on Age. There is a statistically significant difference between the group means. This means the differences among groups are not due to random chance, but due to a real effect.*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	844.134	2	422.067		
Within Groups	18373.452	1827	10.057	41.969	.000
Total	19217.585	1829			

Results in tables 5 and 6 show that there was statistically significant difference ( $F_{(2,1829)} = 41.97$ ) in young adults' perception of peace building system for sustainable development and security in Nigeria based on Age ( $p = 0.00 < 0.05$ ). The mean and standard deviation values also show statistically significant difference in young adults' perception of peace building system for sustainable development and security in Nigeria based on Age. Therefore, we do not accept the null hypothesis that says

that there is no significant age difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.

*H<sub>03</sub>: There is no significant educational level difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.*

**Table 7**

*Descriptive Statistics of young adults' perception of peace building system for sustainable development and security in Nigeria based on educational level.*

	N	Mean	Std. Deviation	Std. Error
No Formal Education	495	54.1192	3.46818	.15588
Secondary School	957	52.8067	3.28577	.10621
Tertiary School	378	52.5714	2.44438	.12573
Total	1830	53.1131	3.24147	.07577

**Table 8**

*ANOVA of young adults' perception of peace building system for sustainable development and security in Nigeria based on educational level.*

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	701.809	2	350.904		
Within Groups	18515.776	1827	10.135	34.625	.000
Total	19217.585	1829			

Results in tables 7 and 8 show that there was statistically significant difference ( $F_{(2,1829)} = 34.63$ ) in young adults' perception of peace building system for sustainable development and security in Nigeria based on educational level ( $p = 0.00 < 0.05$ ). The mean and standard deviation values also show statistically significant difference in young adults' perception of peace building system for sustainable development and security in Nigeria based on educational level. Therefore, we do not accept the null hypothesis that says that there is no significant educational level difference in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.

## DISCUSSION OF FINDINGS

The discussion in this study was done according to the findings of this study. Findings from table two showed that the extent at which young

adults' perceived peace building system for sustainable development and security in Nigeria was on the high side. Besides, there was no significant difference in gender except for age and educational level differences in the mean response of young adults' perception of peace building system for sustainable development and security in Nigeria.

The findings support the view of Abubakar (2021) who discovered that young adults are critical stakeholders in peacebuilding and should be involved at all stages of peace process for the sake of sustainability. It is also in line with the view of Berent & McEvoy-Levy (2014) who examined the age specific as well as gender, and other contextually specific roles of youth as they relate to everyday peacebuilding. However, this finding is at variance with those of Valentino (2007) who observed that the perception of peacebuilding nowadays is neither here nor there, people in selected community tend to be skeptical of transformation. The author explained further that given the segregation and abuse suffered in the past, there is likely to be distrust for change particularly when it does not meet the need of whatever group. Enforcement or imposition of change will likely result in resistance and counter productivity, thereby causing unrest in such places.

## **CONCLUSION**

Based on the findings of this study, it was concluded that young adults' perception of peacebuilding is significantly based on age, gender and education. This means that the inclusion in peacebuilding and care of this group of citizens in the society would consequently enable the development of sustainable peace and security. Adequate investment in young people's agency in peace processes has good potential of yielding positive results, the peace dividend will increase significantly.

## **RECOMMENDATION:**

Based on the findings of this study, the following recommendations were made:

- i) Full multi-sector programmes that target youth and is devoid of gender in specific areas of activity, such as employment creation and/or peacebuilding projects should be encouraged.
- ii) Policies and institutions that enable investment in youth to succeed at various levels should be encouraged.
- iii) Peacebuilding programmes should involve the demand of the target group.

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## **Matumizi ya Akiliunde Katika Kutafsiri Matini za Kiutamaduni: Changamoto na Suluhihisho**

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### ***Ikisiri***

*Makala hii inahusu matumizi ya Akiliunde (AI) katika kutafsiri matini za kiutamaduni kwa kuangazia changamoto na suluhihisho. Katika kipindi cha sasa cha maendeleo ya sayansi na teknolojia, kumekuwepo na mapinduzi makubwa katika mbinu za kurahisisha kazi mbalimbali za binadamu, ikiwemo kazi ya tafsiri. Miongoni mwa mbinu hizo ni matumizi ya Akiliunde ambayo imekuwa nyenzo maarufu ya kutafsiri matini katika lugha mbalimbali duniani. Hata hivyo, pamoja na ufanisi wake wa kiteknolojia, kuna maswali muhimu yanayojitokeza: Je, Akiliunde inaweza kutafsiri kwa ufanisi matini zenye maudhui ya kiutamaduni? Ni changamoto zipi zinayojitokeza katika matumizi hayo ya Akiliunde? Makala hii imelenga kuchunguza changamoto za kutumia Akiliunde kutafsiri matini za kiutamaduni kutoka Kiswahili kwenda Kiingereza. Lengo ni kubainisha matini za kiutamaduni, kuchambua changamoto zinayojitokeza katika mchakato wa kutafsiri matini hizo kwa kutumia Akiliunde, na kupendekeza suluhihisho la changamoto hizo. Data za makala hii zilikusanywa kwa kutumia mbinu ya usomaji makini na mbinu ya usaili nusu-funge. Data za makala hii zimewasilishwa kwa kutumia mkabala wa kitaamuli. Nadharia ya Skopos imetumika kama mwongozo wa uchunguzi, uchambuzi na uwasilishaji na mjadala wa data za utafiti huu. Kwa ujumla, makala hii inadhihirisha kuwa ingawa Akiliunde inaweza kurahisisha kazi ya tafsiri, bado inakumbwa na changamoto kubwa katika kufanikisha mawasiliano yenye uzito wa kiutamaduni. Hii ni kwa sababu kila lugha huakisi utamaduni, mitazamo na muktadha wake wa kijamii na kihistoria, ambao si rahisi kutafsiriwa kwa usahihi na mashine bila msaada wa mfasiri binadamu.*

### **UTANGULIZI**

Katika karne ya ishirini na moja (21), ulimwengu umeshuhudia mabadiliko makubwa ya kiteknolojia yaliyogusa karibu kila sekta ya maisha ya binadamu, ikiwemo lugha na tafsiri. Miongoni mwa maendeleo hayo ni ujio wa Akiliunde (*Artificial Intelligence - AI*), teknolojia

inayowezesha mashine kujifunza, kuchakata na kutoa maamuzi kama binadamu. Katika muktadha wa tafsiri, Akiliunde imekuwa chombo muhimu kinachotumiwa na watu binafsi, taasisi na mashirika mbalimbali kutafsiri matini kwa kasi na kwa gharama nafuu. Hali hii imefungua milango ya fursa nyingi katika mawasiliano ya lugha mbalimbali. Hata hivyo, pamoja na faida zake, matumizi ya Akiliunde katika kutafsiri matini zenye maudhui ya kiutamaduni yameibua maswali kuhusu ufanisi wake katika kuwasilisha maana, dhamira na muktadha wa lugha chanzi kwa usahihi (Gasparini, 2021; Kim, 2020).

Kimsingi, lugha na utamaduni ni dhana mbili ambazo hufungamana kwa karibu, kwani lugha ni kielelezo cha utamaduni wa jamii. Matini za kiutamaduni hujumuisha semi (methali, nahau, vitendawili, misemo na mafumbo), mila, desturi, mitazamo na hisia ambazo ni vigumu kutafsiri kwa usahihi bila uelewa wa kina wa muktadha wa jamii inayozungumziwa. Kwa msingi huo, tafsiri si tu mchakato wa kuhawilisha maneno kutoka lugha moja kwenda nyingine, bali ni zoezi la uhamishaji wa maana ya kijamii na kiutamaduni (Nida, 1964; Mwansoko na wenzake, 2006; Jilala, 2014). Fauka ya hayo, Akiliunde kwa upande wake, inategemea zaidi modeli za kiisimu na kitakwimu kuliko uelewa wa kijamii au kihisia. Hali hii huifanya ishiriki katika tafsiri ya kiufundi au ya kimaandishi kwa ufanisi, lakini inapungikiwa uwezo inapojoitokeza tafsiri zenye maudhui ya kiutamaduni ambayo yanahitaji tafsiri ya kina ya maana fiche na dhamira za kijamii (Tymoczko, 2007).

Matumizi ya Akiliunde katika tafsiri ya matini za Kiswahili yenye maudhui ya kiutamaduni yameanza kuchukua nafasi kubwa katika mazingira ya elimu, fasihi, uandishi wa habari na mawasiliano ya kijamii. Kwa mfano, wanafunzi, watafiti na waandishi wamekuwa wakitumia *Google Translate, ChatGPT, Talkpal, Mimise, Duolingo, Deepol* na zana nyingine za Akiliunde kuwasaidia kutafsiri maandishi yao kutoka Kiswahili kwenda Kiingereza au kinyume chake. Pamoja na msaada unaopatikana kupitia zana hizo, zipo changamoto nyingi zinazobainika ikiwemo tafsiri isiyoleweka, kupotosha maana halisi, tafsiri pana, tafsiri finyu, kushindwa kutambua hisia na heshima ya kijamii, au hata kutafsiri matini kwa mitazamo isiyo ya utamaduni husika (Lusweti, 2020; Mukhwana, 2022; Kimaro, 2022). Changamoto hizi zimeibua mjadala mpana mionganoni mwa wataalamu wa lugha kuhusu uhalali wa kutegemea teknolojia pekee katika kutafsiri masuala yanayogusa utambulisho na urithi wa jamii.

Aidha, tafiti mbalimbali zimeonesha kuwa Akiliunde hushindwa kutofautisha maana ya maneno yenyi maana nyingi zenyi uhusiano wa karibu (*polysemous words*), kutambua tamathali za usemi kama vile sitiari na kejeli, pamoja na kuelewa muundo wa lugha unaobeba heshima, hasa katika lugha kama Kiswahili inayozingatia sana hadhi ya mzungumziwa. Kwa mfano, msemo kama “amevua nguo hadharani” hutafsiriwa na Akiliunde kuwa “*he took off his clothes in public*”, tafsiri ambayo ni sahihi kisarufi lakini potofu kihisia na kijamii (Gasparini, 2021). Vilevile, Akiliunde hushindwa kuelewa majukumu ya kihisia katika mashairi, hadithi, au hotuba rasmi ambapo maana ya lugha hujengwa katika muktadha wa kijamii. Kwa hivyo, mahitaji ya kutathmini na kuchunguza matumizi ya Akiliunde katika tafsiri ya matini za kiutamaduni yanazidi kuwa ya msingi.

Katika kukabiliana na mapungufu haya, wataalamu mbalimbali wamependekeza matumizi ya mfumo wa tafsiri mseto (*hybrid model*) unaochanganya teknolojia ya Akiliunde na ujuzi wa wafasiri wa kibinadamu. Mfumo huu huwezesha Akiliunde kufanya tafsiri ya awali (*draft translation*), kisha mfasiri binadamu hufanyia uhariri na marekebisho kwa kuzingatia muktadha, maadili na ladha ya lugha. Mbinu hii imetumika kwa mafanikio katika taasisi za kimataifa kama Umoja wa Mataifa na imebainika kuwa suluhisho la muda na la kudumu kwa tafsiri zinazohitaji uhalisia wa kijamii na kihisia (Pym, 2010; Floridi & Cowls, 2019; Sayers & Kalita, 2022). Hii inaonesha kuwa Akiliunde licha ya uwezo wake wa kiteknolojia, bado inahitaji akili ya binadamu ili kufanikisha tafsiri sahihi na zenyi maadili ya kiutamaduni.

Hata hivyo, pamoja na kuwa tafiti zinaonesha kuwa Akiliunde imekuwa ikitumika katika tafsiri na pia kudhihirisha ufanisi wake kiteknolojia, bado kuna maswali muhimu ambayo yalichochea utafiti huu: Je, Akiliunde inaweza kutafsiri kwa ufanisi matini zenyi maudhui ya kiutamaduni? Je, ni changamoto zipi zinazojitokeza pale ambapo Akiliunde inapotumika kutafsiri matini za kiutamaduni? Je, nini kifanyike ili kukabiliana na changamoto za matumizi ya Akiliunde katika kutafsiri matini za kiutamaduni? Utafiti huu umezingatia tafiti zilizopo, mifano halisi ya tafsiri potofu, pamoja na maoni ya wataalamu wa lugha na tafsiri. Tatizo la utafiti huu lilikuwa ni kuchunguza changamoto zinazojitokeza katika kutafsiri matini za kiutamaduni kwa kutumia Akiliunde. Lengo la makala hii ni kubainisha changamoto za kutafsiti matini za kiutamaduni kwa kutumia Akiliunde na kisha kupendekeza

suluhisho la matumizi ya Akiliunde katika kutafsiri matini za kiutamaduni. Makala hii ni muhimu katika kipindi cha sasa cha matumizi ya teknolojia katika tafsiri kwa sababu imelenga kutoa mchango wa kitaaluma kwa walimu, watafiti, watunga sera kuhusu namna bora ya kutumia teknolojia ya Akiliunde bila kupoteza uhalisia wa lugha na utamaduni.

Tafiti zilizotangulia zimetoa mchango mkubwa kuhusu changamoto za kutafsiri matini za kiutamaduni. Kulingana na tafiti hizo, kutafsiri matini za kiutamaduni ni kazi ngumu na yenyе changamoto nyingi ukilinganisha na matini zingine zisizokuwa na maudhui ya kiutamaduni. Hii ni kwa sababu lugha hufungamana na utamaduni wa jamii na ni kielelezo cha utamaduni wa jamii mahususi (Mwansoko, 1996; Jilala, 2014; Haokip, 2021; Wang, 2024). Utafiti huu unatofautiana na tafiti zilizotangulia kwa sababu umejigemeza katika kuchunguza changamoto za kutumia Akiliunde katika kutafsiri matini za kiutamaduni. Hivyo, makala hii inapanua wigo mpana wa kiutafiti kuhusu matumizi ya Akiliunde katika kutafsiri matini za kiutamaduni kutoka Kiswahili kwenda Kiingereza.

## **MKABALA WA KINADHARIA**

Makala hii imetumia Nadharia ya Skopos katika kuchunguza, kuchambua na kujadili data za makala hii. Nadharia ya Skopos ni nadharia ya tafsiri ambayo iliasisiwa na Hans J. Vermeer katika miaka ya 1970 huko Ujerumani na baadaye kuendelezwa na (Nord, 2012:26). Nadharia hii iliendelezwa na kufafanuliwa zaidi katika kitabu alichokiandika kwa kushirikiana na Katharina Reiss mwaka 1984 kilichoitwa *Grundlegung einer allgemeine Translationtheorie [Groundwork for General Theory of Translation]* (Munday, 2012: 122). Nadharia hii inasisitiza kuwa madhumuni ya tafsiri (*Skopos*) ndiyo yanayopaswa kuongoza mchakato mzima wa kutafsiri. Tafsiri haipaswi kuzingatia tu muundo wa lugha chanzi, bali inalenga kutimiza lengo fulani katika muktadha wa lugha lengwa. Kwa mujibu wa *Skopos*, mfasiri anapaswa kufanya maamuzi ya kimkakati kulingana na hadhira inayolengwa, dhamira ya ujumbe, na mazingira ya kijamii au kiutamaduni ya lugha lengwa. Kwa mfano, iwapo matini ya Kiswahili inabeba methali au sitiari inayotokana na mazingira ya Kiafrika, mfasiri anayefuata muktadha wa *Skopos* anaweza kutumia mbinu ya kubadilisha tamathali hiyo ili iendane na muktadha wa Kiingereza unaoeleweka na hadhira ya walengwa. Hivyo, muktadha unachukua nafasi muhimu kuliko ulinganifu wa maneno. Nadharia hii ni muhimu hasa katika tafsiri ya matini za kiutamaduni kwa sababu

huzingatia muktadha wa kijamii wa lugha na tamaduni tofauti. Katika matumizi ya Akiliunde, ambapo muktadha mara nyingi hupuuzwa, Skopos inatufundisha kuwa tafsiri sahihi ni ile inayokidhi dhamira ya mawasiliano ya awali kwa njia inayokubalika na kueleweka na walengwa. Hili linaweka msingi wa kuhitaji ushiriki wa binadamu katika kusaidia Akiliunde kutafsiri matini zenyenye uzito wa kiutamaduni na kihisia.

## **METHODOLOJIA YA UCHUNGUZI**

Utafiti huu ulifanyika Dar es salaam. Data za utafiti huu zilikusanywa kwa kutumia mbinu kuu mbili ambazo ni: mbinu ya usomaji makini na mbinu ya usaili nusu-funge. Kwa kutumia mbinu ya usomaji makini, mtafiti alisoma na kufanya uchambuzi wa tafiti, makala za kitaaluma, machapisho na ripoti zinazohusiana na mada hii katika tovuti na maktaba. Lengo lilikuwa ni kupata ushahidi wa kitafiti na kitaalamu uliopo kuhusu changamoto za matumizi ya Akiliunde katika tafsiri ya matini za kiutamaduni na mapendekezo. Maandiko haya yalisaidia kuelewa mitazamo ya wataalamu wa tafsiri na teknolojia kuhusu matumizi ya Akiliunde katika mazingira ya lugha zenyenye tamaduni tofauti. Aidha, mbinu ya usaili nusu-funge ilitumika kwa kufanya usaili na wafasiri kumi (10). Kundi hili liliteuliwa kwa kuzingatia kigezo kwamba hawa ni wafasiri, wanafanya shughuli za tafsiri na wana uzoefu wa matumizi ya Akiliunde katika kutafsiri. Kundi lingine ni wahadhiri wa tafsiri watatu (3), kundi hili pia liliteuliwa kwa kutumia mbinu ya madhumuni maalumu kwa kigezo kwamba, hawa ni wahadhiri wa tafsiri na wanafundisha kozi za tafsiri. Hivyo, wanao uzoefu wa kinadharia na vitendo katika tafsiri. Kundi la tatu ni wanafunzi 20 wa umahiri katika Kiswahili wa Chuo Kikuu Huria cha Tanzania. Kundi hili liliteuliwa kwa kuzingatia kuwa wanatumia zana za Akiliunde kama *Google Translate* na *ChatGPT* katika tafsiri. Kwa kutumia mbinu ya usaili nusu-funge, mtafiti aliandaa karatasi zenyenye maswali ambazo aliwagawia wafasiri, wahadhiri wa tafsiri na wanafunzi wa umahiri. Mbinu hii ya Usaili nusu-funge ililenga kupata data kuhusu changamoto wanazokutana nazo wanapotafsiri matini za kiutamaduni kwa kutumia Akiliunde, na mapendekezo ya namna ya kukabiliana na changamoto hizo. Hivyo, utafiti huu ulikuwa na jumla ya walengwa thelathini na tatu (33) ambao walishiriki katika kutoa data za utafiti huu. Kwa kutumia makundi yote matatu tuliweza kutapata data za kutosha kukidhi malengo ya utafiti huu. Makala hii imetumia mkabala wa kitaamuli katika ukusanyaji, uchambuzi, uwasilishaji na mjadala wa data na matokeo ya utafiti huu. Mkabala wa kitaamuli ni mkabala ambao data zake zinafafanuliwa kwa kutumia maelezo na si takwimu katika

kuwasilisha na kujadili data za utafiti. Hivyo, mkabala huu ulitusaidia kupata uelewa wa kina kuhusu uzoefu, mitazamo na changamoto za matumizi ya Akiliunde katika tafsiri ya matini zenyne muktadha wa kiutamaduni. Utafiti huu ulizingatia masuala ya kiitikeli kwa kuomba ridhaa ya wasailiwa, kuwahakikishia kuwa data wanazozitoa ni kwa minajili ya utafiti huu na lengo la kitaaluma na pia kuwahakikisha usiri wa utambulisho na taarifa zao.

## **UWASILISHAJI WA DATA NA MATOKEO**

Utafiti huu ulikuwa na malengo mahususi mawili ambayo ni: kubainisha changamoto za kutumia Akiliunde katika kutafsiri matini za kiutamaduni kutoka Kiswahili kwenda Kiingereza na kupendekeza suluhisho la kukabiliana na changamoto hizo. Matokeo ya utafiti huu ni kama yanavyojadiliwa katika sehemu zinazofuata.

### **Changamoto za Matumizi ya Akiliunde katika Kutafsiri Matini za Kiutamaduni**

Utafiti huu ulichunguza changamoto za kutumia Akiliunde katika kutafsiri matini za kiutamaduni kutoka Kiswahili kwenda Kiingereza. Kupitia mbinu ya usaili ambayo wahojiwa walitakiwa kueleza changamoto wanazokumbana nazo wanapotafsiri matini za kiutamaduni kwa kutumia Akiliunde. Matokeo yalikuwa kama ifuatavyo:

#### **Jedwali Na. 1**

*Matumizi ya Akiliunde katika kutafsiri matini za Kiutamaduni*

#### **Na. Changamoto**

1.	Kutozingatia muktadha wa kiutamaduni
2.	Kushindwa kutambua maana ya maneno yenye maana nyingi
3.	Ukosefu wa ubunifu na hisia
4.	Tofauti za lugha na utamaduni
5.	Masuala ya usalama na faragha

*Chanzo: Data za utafiti (Januari, 2025)*

#### **Kutozingatia Muktadha wa Kiutamaduni**

Katika utafiti huu tulibaini kuwa moja ya changamoto ya kutumia Akiliunde (AI) kutafsiri matini za kiutamaduni, ni kutozingatia muktadha wa kiutamaduni. Kutozingatia muktadha wa kiutamaduni husababisha upotoshaji wa maana halisi ya nahau, misemo, vitendawili, methali, mafumbo na maudhui yenye mizizi katika mazingira ya jamii husika. Muktadha wa kiutamaduni ni msingi muhimu katika kutafsiri matini yoyote yenye maudhui ya kiutamaduni. Muktadha huu hujumuisha

maarifa ya kijamii, kiimani, kihistoria, na lugha ya jamii inayozungumziwa. Tafsiri inayofanywa na Akiliunde hutegemea kanuni za kiisimu na data zilizohifadhiwa, ambazo mara nyingi hukosa vionjo au ladha ya kiutamaduni. Matini za kiutamaduni zina tabia ya kubeba maana fiche zinazotegemea zaidi uelewa wa kijamii kuliko tafsiri ya moja kwa moja ya maneno. Kwa kuwa Akiliunde haina "hisia ya kijamii", uwezo wake wa kutambua au kuelewa mitazamo ya ndani ya jamii ni mdogo mno.

Kwa mfano, msemo wa Kiswahili "amevua nguo hadharani" unaweza kumaanisha kwamba mtu amefichua siri au mambo ya ndani ya familia au taasisi hadharani. Akiliunde inaweza kutafsiri kwa Kiingereza kuwa "*he took off his clothes in public*", ambayo ni tafsiri ya kisarufi lakini haileti maana halisi ya kijamii iliyokusudiwa. Tafiti kama ile ya Gasparini (2021) zinaonesha kuwa zaidi ya 35% ya tafsiri zinazofanywa na *Google Translate* kutoka lugha za Kiafrika hadi Kiingereza zinakosa uhalisia wa kiutamaduni au muktadha sahihi. Vilevile, utafiti uliofanywa na Mukhwana (2022) kuhusu tafsiri ya Akiliunde ya matini za Kiswahili chenye maudhui ya kiutamaduni, asilimia arobaini na moja (41) ya tafsiri hizo zilionesha kupotosha maana kwa kupuuza muktadha wa kiutamaduni. Mifano ifuatayo inaonesha baadhi ya misemo ya Kiswahili ambayo Akiliunde mara nyingi hushindwa kuielewa kisemantiki na kiutamaduni:

1.
  - a) "*Anacheza na moto*" – maana ya Kiswahili ni kuwa mtu anajihatarisha au anafanya jambo la hatari; Akiliunde huweza kutafsiri kuwa "*he is playing with fire*", ambayo inaweza kuelezwu kama mchezo wa kawaida badala ya tahadhari ya kitabia.
  - b) "*Anapanda mbegu ya fitina*" – humaanisha mtu anachochea ugomvi au migogoro, lakini Akiliunde huweza kutafsiri kuwa "*he is planting a seed of strife*", bila kuwasilisha dhamira ya kijamii ya uhasama unaokusudiwa.
  - c) "*Kufa na kuzikana*" – msemo huu hutumika kuonesha uaminifu mkubwa baina ya watu wawili, lakini Akiliunde mara nyingi hutafsiri kwa maandishi ya moja kwa moja kuwa "*to die and bury each other*", ambayo hupotosha maana ya undugu wa dhati.
  - d) "*Chini ya kapeti*" – hutumika kumaanisha jambo limefichwa au limepindishwa ili lisijulikane, lakini Akiliunde huweza

kutoa tafsiri ya ajabu kama "*under the carpet*", bila kufafanua muktadha wa kuficha ukweli.

e) "*Kuvua gamba*" – huashiria kujisafisha au kuachana na tabia potofu, lakini Akiliunde hutoa tafsiri "*to shed the shell or bark*", ambayo haifiki dhamira ya mabadiliko ya kitabia au kisiasa.

**Chanzo:** Data za utafiti (Januari, 2025)

Mifano katika data namba 1. (a) - (e) hapo juu inaonesha kuwa tafsiri ya Akiliunde inapokumbwa na maneno au misemo ya methali, huelemea kwenye maana ya moja kwa moja ya kisarufi bila kuelewa uzito wa kijamii au maana fiche ya kiutamaduni. Kwa hivyo, ni wazi kuwa matumizi ya Akiliunde pekee hayawezi kutoa tafsiri timilifu ya matini zinazotokana na jamii zenye utajiri wa matumizi ya lugha ya picha, misemo na methali kama Kiswahili.

Kulingana na Nadharia ya Skopos ambayo inaeleza kuwa tafsiri haipaswi kuzingatia tu muundo wa lugha chanzi, bali inalenga kutimiza lengo fulani katika muktadha wa lugha lengwa. Pia, mfasiri anapaswa kufanya maamuzi ya kimkakati kulingana na hadhira inayolengwa, dhamira ya ujumbe, na mazingira ya kijamii au kiutamaduni ya lugha lengwa. Hivyo basi, tafsiri ya Akiliunde haijazingatia muundo wa lugha chanzi bali imejikita kwenye lengo la kutimiza muktadha wa lugha lengwa.

Kwa hiyo, kutokuwepo kwa uwezo wa Akiliunde kutambua na kulinda muktadha wa kiutamaduni kunasababisha tafsiri zinazopotosha maana, zinazosababisha upotevu wa dhamira ya mwandishi na hata kuathiri uhalali wa matini husika. Matumizi ya semi mbalimbali, tamathali za semi, au lugha ya picha inayotegemea mazoea ya jamii hayawezi kufasiriwa ipasavyo bila uelewa wa kina wa maisha ya watu hao. Utafiti huu ulibaini kuwa, katika kutafsiri matini za kiutamaduni, matumizi ya Akiliunde pekee haitoshi, hivyo, kunahitajika mchango wa mfasiri binadamu mwenye weledi wa lugha na utamaduni husika ili kuleta tafsiri timilifu. Kwa muktadha huo, tafsiri shirikishi kati ya Akiliunde na wafasiri binadamu ndio njia bora ya kuepuka upotoshaji wa muktadha wa kiutamaduni.

### ***Kushindwa Kutambua Maana ya Maneno yenze Maana Nyingi***

Changamoto nyingine ambayo inajitokeza katika matumizi ya Akiliunde (AI) katika kutafsiri matini za kiutamaduni ni kushindwa kutambua

maana ya maneno yenyeye maana nyingi zinazotofautiana (homonimu) hasa pale ambapo muktadha wa matumizi ya neno husika hauko wazi au haujafafanuliwa vya kutosha. Katika lugha nyingi, maneno huwa na maana zaidi ya moja zinazotofautina kulingana na matumizi yake katika sentensi, muktadha wa kijamii, au dhamira ya mzungumzaji. Akiliunde, kwa kutegemea mifumo ya kihisabati na data zilizohifadhiwa, hukosa uwezo wa kutofautisha maana hizi kwa usahihi ikiwa hajapewa muktadha wa kutosha. Hali hii huathiri sana tafsiri ya matini za kiutamaduni ambazo mara nyingi hutegemea uchezaji wa maana na matumizi ya lugha ya picha.

Kwa mfano, wahojiwa walitoa mfano wa neno la Kiswahili “kufunga” ambalo linaweza kumaanisha “kuweka kitu kisifunguke,” “kufunga ndoa,” “kufunga ibada ya Ramadhani au Kwaresma,” au hata “kufunga safari.” Walieleza kuwa Akiliunde inaweza kuchagua tafsiri moja tu ya neno hilo bila kuzingatia muktadha. Kwa mfano, katika tafsiri moja ya *Google Translate*, neno “kufunga” lilipotumiwa katika sentensi “Waislamu hufunga mwezi wa Ramadhani,” lilitafsiriwa kuwa “Muslims close the month of Ramadan” badala ya “Muslims fast during the month of Ramadan”, ikionesha kutokuwepo kwa utambuzi wa maana sahihi ya neno hilo katika muktadha wa kidini. Utafiti wa Omondi (2020) ulionesha kuwa zaidi ya 28% ya tafsiri za Akiliunde kwa maneno yenyeye maana nyingi kutoka Kiswahili hadi Kiingereza ziliwa na makosa ya maana kutokana na ukosefu wa muktadha bayana. Mifano ifuatayo inaonesha maneno ya Kiswahili yenyeye maana nyingi ambayo Akiliunde hushindwa kuyafasiri kwa usahihi bila muktadha:

2.

- a) *Kufunga* - Maana: kuweka kitu kisifunguke, kuacha kula kwa ibada, kuanzisha safari, au kuingia kwenye ndoa. Akiliunde hutafsiri kwa ujumla kuwa “to close” bila kuelewa matumizi maalumu katika muktadha husika.
- b) *Kuchoma* - Maana: kupika kwa moto (kuchoma nyama), kuumiza kwa moto, au hata kuchoma sindano. Akiliunde inaweza kusema “burning” hata kama muktadha ulikuwa wa tiba.
- c) *Kukata* - Maana: kukata kitu kwa kisu, kukata tiketi, kukata tamaa, au kukata shauri. Akiliunde huweza kusema “cut” bila kuelewa kama ni kukata tamaa au kukata kitu kimwili.
- d) *Kufungua* - Maana: kufungua mlango, kufungua biashara, au kufungua akaunti benki. Akiliunde mara nyingi husema “to

*open*”, lakini haibainishi iwapo ni shughuli ya kibiasara au ya kifedha.

e) *Kupanda* - Maana: kupanda mti, kupanda daladala, au kupanda mbegu. Akiliunde hutafsiri kuwa “*to climb*” hata kama muktadha ni wa kilimo au usafiri.

**Chanzo:** *Data za utafiti (Januari, 2025)*

Mifano katika data namba 2. (a) - (e) hapo juu inaonesha kuwa bila kuwepo kwa uelewa wa muktadha wa kijamii, kisemantiki au kiutamaduni, Akiliunde hushindwa kutofautisha maana za maneno yenyе matumizi mengi, na hivyo kutoa tafsiri potofu au zisizokidhi dhamira ya awali ya mzungumzaji au mwandishi. Tafsiri ya aina hii hudhahirisha kuwa Akiliunde inakosa ufanisi katika matini zenyе mantiki changamano au za kiutamaduni.

Maelezo hayo hapo juu yanaelekeea kufanana na yale ya Nadharia ya *Skopos* ambayo yanaeleza kuwa tafsiri haipaswi kuzingatia tu muundo wa lugha chanzi, bali inalenga kutimiza lengo fulani katika muktadha wa lugha lengwa. Pia, mfasiri anapaswa kufanya maamuzi ya kimkakati kulingana na hadhira inayolengwa, dhamira ya ujumbe, na mazingira ya kijamii au kiutamaduni ya lugha lengwa. Hivyo basi, tafsiri ya Akiliunde imekosa ufanisi katika matini zenyе mantiki changamano au za kiutamaduni.

Kwa msingi huo, ni wazi kuwa uwezo wa Akiliunde katika kutafsiri maneno yenyе maana nyingi bado ni changamoto kubwa, hasa inapokosekana mifumo ya kutambua muktadha au dhana fiche zinazohusiana na matumizi ya maneno hayo. Ili kuhakikisha tafsiri zenyе maana timilifu na sahihi, inahitajika tafsiri ifanywe kwa kushirikisha binadamu mwenye uelewa wa lugha, muktadha, na utamaduni. Akiliunde inaweza kusaidia kwa kiwango fulani, lakini haipaswi kutegemewa pekee kwa tafsiri za matini zenyе uzito wa kisemantiki na kiutamaduni.

### ***Ukosefu wa Ubunifu na Uelewa wa Hisia***

Utafiti huu ulibaini kuwa changamoto nyingine inayojitokeza katika matumizi ya Akiliunde katika kutafsiri matini za kiutamaduni ni ukosefu wa ubunifu na uelewa wa hisia. Tafsiri ya matini za kiutamaduni haitegemei tu ulinganifu wa maneno kati ya lugha chanzi na lugha lengwa, bali pia hutegemea uelewa wa hisia, dhamira, na lengo la mzungumzaji au mwandishi. Akiliunde, kwa asili yake, haina uwezo wa

kihisia wala kutambua muktadha wa kihisia, jambo linaloathiri kwa kiwango kikubwa tafsiri ya matini zinazobeba hisia kama huzuni, furaha, kejeli, au mshawasha wa kihisia unaotokana na mazingira ya kijamii au kiutamaduni.

Kwa mfano, katika hadithi za kiutamaduni au mashairi ya Kiswahili, hisia huoneshwa kupitia matumizi ya tamathali za usemi kama sitiari, kejeli, au taswira za kihisia. Sentensi kama “moyo wake ulivunjika vipande saba” inaonesha huzuni ya kina, lakini Akiliunde inaweza kutafsiri kwa maandishi ya moja kwa moja kuwa “*his heart broke into seven pieces*”, bila kuelewa kuwa hiyo ni taswira ya huzuni si hali ya kimwili. Tafiti zinaonesha kuwa mifumo ya Akiliunde kama *Google Translate* na *ChatGPT*, licha ya maendeleo ya kisasa, bado haijafikia kiwango cha kutambua na kutafsiri hisia kwa usahihi katika muktadha wa kiutamaduni. Katika utafiti wa Nyongesa (2021), ilibainika kuwa asilimia 63 ya tafsiri zilizofanywa na Akiliunde kwa mashairi ya Kiswahili yalipoteza dhamira ya kihisia ya matini ya awali. Mifano ifuatayo inaonesha baadhi ya tamathali za semi au taswira zenyehisia ambazo Akiliunde mara nyingi hushindwa kuzitafsiri kwa usahihi:

3.
  - a) “*Alichomwa na mshale wa mapenzi*” – huonesha mtu aliye pagawa kwa mapenzi; AI hutafsiri kama “*he was pierced by an arrow of love*”, ambayo inaweza kueleweka kama maumivu ya kimwili badala ya hisia za mapenzi.
  - b) “*Alilia kama mtoto aliyenyimwa ziwa*” – inaonesha huzuni ya kina na hali ya kutoweza kuvumilia maumivu; AI husema “*he cried like a baby denied milk*”, bila kuelewa uzito wa huzuni inayofananishwa.
  - c) “*Uso wake ulikunjana kama karatasi iliyochanwa*” – huonesha huzuni au hasira ya waziwazi; AI hutafsiri kuwa “*his face folded like a torn paper*”, isiyo na maana ya kihisia.
  - d) “*Alicheka lakini macho yake yalilia*” – huonesha huzuni iliyofichwa nyuma ya tabasamu; AI inaweza kusema “*he laughed but his eyes cried*”, lakini bila kueleza msuguano wa kihisia uliopo.
  - e) “*Ndani ya kifua chake kulikuwa na radi na ngurumo*” – ni taswira ya hasira au msongo wa mawazo; AI husema “*there was thunder and lightning in his chest*”, ambayo ni tafsiri ya moja kwa moja na isiyoleweka kihisia

**Chanzo:** Data za utafiti (Januari, 2025)

Mifano katika data namba 3. (a) - (e) hapo juu inaonesha kuwa Akiliunde haijafikia kiwango cha kuelewa taswira na tamathali zenyе hisia zinazotumiwa sana katika fasihi na mawasiliano ya kiutamaduni ya Kiswahili. Tafsiri ya maneno bila hisia hufanya matini kupoteza maana yake halisi, dhamira ya mwandishi, na ushawishi kwa hadhira lengwa. Hivyo, tafsiri zenyе hisia bado zinahitaji akili ya kibinadamu yenyе uwezo wa “kusoma kati ya mistari.”

Katika kuunga mkono hoja hiyo, Kim (2020) anaeleza kuwa tafsiri ya matini zenyе maudhui ya hisia huchukua nafasi ya kipekee katika kazi ya mfasiri kwa sababu huhitaji uelewa wa kina wa saikolojia ya lugha na maana fiche ya tamaduni. Kwa mfanu, tafsiri ya wimbo wa kiutamaduni wa maombolezo wa Kipemba si rahisi kutafsiriwa na Akiliunde kwa usahihii, kwa sababu maneno yake yana uzito wa kihisia unaobebwa na sauti, mila, na mazingira ya kisemaji ya jamii hiyo, ambayo hayawezi kufasiriwa na mashine.

Kwa msingi huo, ni wazi kwamba Akiliunde haina uwezo wa ubunifu wa kisanaa wala uwezo wa kuingilia hisia za binadamu katika maandishi, jambo linalosababisha upotevu wa dhamira, uzito wa kihisia, na mvuto wa matini za kiutamaduni. Tafsiri za matini hizo zinapaswa kupewa wafasiri binadamu ambao wanawenza “kusoma kati ya mistari” na kuwasilisha dhamira iliyokusudiwa kwa weledi wa lugha na hisia. Hivyo, tafsiri sahihi ya matini za kiutamaduni inahitaji akili ya kihisia ambayo Akiliunde haina, na kwa hali hiyo, binadamu bado ana nafasi ya kipekee katika kazi hii.

### ***Tofauti za Lugha na Utamaduni***

Utafiti huu ulibaini kuwa, tofauti za kiisimu na kiutamaduni kati ya lugha chanzi na lugha lengwa ni mojawapo ya changamoto zinazozifanya tafsiri zinazotegemea Akiliunde (AI) kuwa na mapungufu makubwa, hasa katika muktadha wa matini za kiutamaduni. Lugha si chombo cha mawasiliano tu, bali ni kielelezo cha utamaduni wa jamii husika. Maneno, miundo ya sentensi, na mitindo ya usemi huakisi fikra, mitazamo na imani za kijamii ambazo si rahisi kutafsiriwa moja kwa moja kutoka lugha moja hadi nyingine. Akiliunde hata ikiwa imefunzwa kwa data nyingi, mara nyingi huathirika na ukosefu wa uelewa wa kina wa tofauti hizi za msingi kati ya lugha na tamaduni, na hivyo kushindwa kutoa tafsiri sahihi au inayolinda maadili ya tamaduni zote mbili.

Kwa mfano, katika lugha ya Kiswahili, ni kawaida kutumia lugha ya heshima, hasa kwa wazee au watu wenye mamlaka, kwa kutumia viwakilishi kama “-tu-” kwa “tunaomba” au “tushukuru.” Akiliunde inaweza kutafsiri maneno haya kwa Kiingereza kwa mtindo wa moja kwa moja kuwa “*we ask*” badala ya “*may we kindly ask*” au “*let us respectfully request*”, hivyo kuondoa ladha ya heshima ambayo ni kiini cha mawasiliano katika tamaduni nyingi za Kiafrika. Utafiti wa Lusweti (2020) ulionesha kuwa AI inakosa uwezo wa kushughulikia lugha ambazo hutegemea muktadha wa kijamii kama msingi wa ujenzi wa sentensi, jambo linalopelekea tafsiri ambazo ni sahihi kisarufi lakini potofu kitabia na kiutamaduni. Mifano ifuatayo inaonesha jinsi tafsiri za Akiliunde zinavyoshindwa kuakisi heshima ya kijamii inayopatikana katika Kiswahili:

4.

- a) “*Samahani kwa kutatiza muda wako...*” AI hutafsiri kuwa “*Sorry to disturb your time...*” badala ya tafsiri ya kiheshima kama “*Pardon me for taking a moment of your time...*” inayodhihirisha adabu.
- b) “*Tushukuru kwa kuwa nasi...*” AI hutoa “*Let us thank for being with us*”, ikikosa tafsiri kama “*Let us respectfully express our gratitude for your presence...*” ambayo ina ladha ya heshima.
- c) “*Kwa heshima na taadhima...*” AI hutafsiri kwa moja kwa moja kuwa “*With respect and honour*”, lakini haielezi uzito wa kiutamaduni wa salamu hii rasmi ambayo ni ya kawaida katika hotuba na barua.
- d) “*Tunaomba radhi kwa usumbufu wowote...*” AI huweka “*We ask forgiveness for any disturbance*”, ikikosa muktadha wa kimaadili unaowekwa na maneno haya katika Kiswahili rasmi.
- e) “*Umetufariji mno kwa uwepo wako...*” AI huweza kusema “*You have comforted us a lot with your presence*”, lakini bila utondoti wa kiadabu kama “*Your gracious presence has truly comforted us.*”

**Chanzo:** Data za utafiti (Januari, 2025)

Mifano katika data namba 4. (a) - (e) hapo juu inaonesha kuwa Akiliunde haijawa na uwezo wa kutafsiri mawasiliano ya heshima kwa ufasaha katika lugha kama Kiswahili ambayo huchochea usawazishaji wa kijamii kupitia lugha. Uelewa wa hadhi, umri, mamlaka, au nafasi ya kijamii wa

mzungumziwa ni kiini cha tafsiri timilifu katika jamii nyingi za Kiafrika – jambo ambalo Akiliunde bado hajaliweza kulipambanua kikamilifu.

Katika kushadidia hilo Nadharia ya *Skopos* ambayo inaeleza kuwa tafsiri haipaswi kuzingatia tu muundo wa lugha chanzi, bali inalenga kutimiza lengo fulani katika muktadha wa lugha lengwa. Pia, mfasiri anapaswa kufanya maamuzi ya kimkakati kulingana na hadhira inayolengwa, dhamira ya ujumbe, na mazingira ya kijamii au kiutamaduni ya lugha lengwa. Hivyo basi, tafsiri ya Akiliunde imekosa ufanisi katika matini zenyenye mantiki changamano au za kiutamaduni ambazo zinagusia masuala ya hadhi, umri, mamlaka, au nafasi ya kijamii wa mzungumziwa ni kiini cha tafsiri timilifu katika jamii nyingi za Kiafrika, jambo ambalo Akiliunde bado hajaliweza kulipambanua kikamilifu. Hivyo basi, yanahitajika maarifa ya mfasiri kwenye kukamilisha mchakato wa tafsiri. Zaidi ya hayo, tofauti za kiutamaduni zinaweza kuathiri tafsiri ya majina ya heshima, mikataba ya mawasiliano, au hata tamaduni za kuelezea hisia na uhusiano wa kijamii. Katika baadhi ya jamii, kutaja mtu kwa jina lake moja tu ni dalili ya kukosa adabu, lakini Akiliunde inaweza isione tatizo hilo na ikatoa tafsiri ya moja kwa moja isiyooonesha heshima au haiba ya muktadha. Tafsiri hizi zinaweza kusababisha si tu upotoshaji wa maana bali pia mivutano ya kiutamaduni pale matini inapowasilishwa kwa hadhira yenye maadili tofauti.

Katika kuunga mkono hoja hiyo, Nida (1964) alisisitiza umuhimu wa “ubadala wa kidhima” (*functional equivalence*) badala ya “ubadala wa kimuundo” (*formal equivalence*) katika tafsiri. Hii inaonesha jinsi tafsiri ya matini inavyopaswa kuzingatia lengo la ujumbe na mazingira ya utamaduni unaolengwa. Akiliunde kwa kukosa uwezo wa kiuchambuzi na kijamii, hushindwa kufikia kiwango hiki. Hali hii imethibitishwa pia na matokeo ya utafiti wa Ajol.info (2023) unaoeleza kuwa asilimia kubwa ya tafsiri za Akiliunde kutoka lugha za asili za Kiafrika hadi Kiingereza au Kifaransa zina kasoro zinazotokana na kupuuzwa kwa tofauti za kiutamaduni na kiisimu.

Data za utafiti huu zinadhihirisha kuwa, tofauti za lugha na tamaduni huweka kizingiti kikubwa kwa Akiliunde katika kutoa tafsiri zilizo sahihi na zenyenye hadhi. Utafiti huu ulibaini kuwa, ingawa Akiliunde inaweza kusaidia katika kutafsiri taarifa za kawaida au kiufundi, tafsiri za matini zenyenye mizizi ya kiutamaduni zinahitaji mtaalamu wa tafsiri mwenye maarifa ya lugha zote mbili na muktadha wa kijamii wa matini husika.

Tafsiri bora ni ile inayozingatia si tu maana ya maneno bali pia hisia, mila, na maadili ya jamii inayotumiwa, jambo ambalo bado halijamudu kutekelezwa kikamilifu na teknolojia ya Akiliunde.

### ***Masuala ya Usalama na Faragha***

Utafiti huu ulibaini kuwa, baadhi ya taarifa za kiutamaduni hubeba masuala nyeti ya kiutamaduni au hata ya kiimani ambayo yanaweza kusababisha madhara ikiwa yatasambazwa au kufasiriwa vibaya. Kwa mfano, matini kuhusu ibada za siri au mila za wazee wa kijadi ambazo huaminika kuwa hazipaswi kusomwa na kila mtu, zikitafsiriwa na kuhifadhiwa kwenye mifumo ya Akiliunde bila ridhaa ya jamii husika, kuna uwezekano wa kusababisha migogoro ya kiutamaduni au kimaadili. Masuala haya yanazua hoja za kisheria na kijamii kuhusu haki ya kumiliki maarifa ya kiutamaduni (*cultural intellectual property*), ambapo jamii nyingi za Kiafrika na asilia bado zinapambana kulindwa dhidi ya uporaji wa maarifa yao na matumizi yasiyo halali.

Oyewole (2023) anasisitiza umuhimu wa kuwepo kwa sera za kulinda taarifa za lugha na tamaduni asilia dhidi ya matumizi holela ya teknolojia ya Akiliunde. Aidha, Azavedo na Borges (2021) wanasema kuwa tafsiri za Akiliunde zinapaswa kuzingatia kanuni za maadili, uwazi, na faragha hasa wakati wa kushughulikia matini ambazo zinahusiana na haki za kiutamaduni au taarifa binafsi za watu. Bila kuwapo kwa miundombinu madhubuti ya udhibiti wa matumizi ya Akiliunde katika tafsiri, kuna uwezekano mkubwa wa uvunjifu wa haki ya faragha na hata kuibuka kwa mizozo ya kimila na kijamii.

Kwa kuhitimisha, matumizi ya Akiliunde katika tafsiri ya matini za kiutamaduni yanapaswa kuangaliwa kwa jicho la tahadhari, hasa kuhusu usalama wa taarifa na ulinzi wa faragha ya jamii zinazohusika. Uwekezaji katika teknolojia lazima uende sambamba na uwepo wa sera madhubuti na miongozo ya maadili ya matumizi ya Akiliunde, ili kuhakikisha kwamba tafsiri zinazofanywa hazivunji haki za msingi za watumiaji au jamii zinazohusika. Hii ni changamoto ambayo haiwezi kutatuliwa kwa teknolojia peke yake, bali kwa ushirikiano wa wataalamu wa lugha, wanasheria, na jamii zenyewe.

### **Suluhisho la Changamoto**

Moja ya malengo mahususi ya makala hii ilikuwa ni kupendekeza suluhisho la changamoto za matumizi ya Akiliunde katika kutafsiri matini

za kiutamaduni. Kupitia mbinu ya usomaji makini na usaili, utafiti huu ulibaini kuwa ili kukabiliana na changamoto zinazosababishwa na matumizi ya Akiliunde (AI) katika tafsiri, kama vile kupotosha maana za kiutamaduni, kutokuwepo kwa hisia, kushindwa kutambua muktadha, na ukosefu wa heshima ya kijamii – wahojiwa walipendekeza matumizi ya mbinu shirikishi ya kutumia mchanganyiko wa Akiliunde na wafasiri binadamu (*hybrid model of translation*). Mbinu hii pia imependekezwa na wataalamu wa lugha na teknolojia (Pym, 2010; Floridi & Cowls, 2019; Sayers & Kalita, 2022).

Mbinu hii inalenga kuchukua faida ya kasi na uwezo wa Akiliunde kuchakata taarifa nyingi kwa haraka, lakini pia kuhakikisha kuwa tafsiri hizo zinapitiwa na mtaalamu wa lugha mwenye uelewa wa kina wa muktadha wa kijamii, kiutamaduni na kihisia wa matini. Wafasiri binadamu wana uwezo wa kutambua ladha ya lugha, mabadiliko ya mitindo ya mazungumzo, maana fiche, na maadili ya jamii ambavyo Akiliunde haina uwezo wa kuvielewa au kuvihusianisha. Kwa mfano, wakati Akiliunde inaweza kutafsiri sentensi ya methali au nahau kwa njia ya moja kwa moja, mfasiri binadamu anaweza kurekebisha tafsiri hiyo ili iwasilishe maana ya kweli, hisia zilizokusudiwa, na uhalisia wa tamaduni ya lugha lengwa.

Hii ni muhimu zaidi katika matini za fasihi, hotuba rasmi, ibada za kidini, au nyaraka za kijamii zinazohitaji lugha ya heshima, utambuzi wa daraja za kijamii, na usahihi wa kihisia. Katika muktadha huu, Akiliunde inachukuliwa kama *msaidizi* wa mwanzo – inafanya kazi ya awali ya kutafsiri rasimu ya tafsiri, ambayo baadaye hufanyiwa uhariri na marekebisho na mfasiri binadamu. Njia hii imeanza kutumika katika taasisi nyingi za tafsiri duniani, kwa mfano Umoja wa Mataifa, ambapo tafsiri ya mashine hutumika kama nyenzo ya kusaidia wafasiri kupunguza muda wa kazi lakini si mbadala wa wafasiri wa kitaalamu.

Zaidi ya hayo, matumizi ya modeli mseto husaidia pia katika kutengeneza mifumo ya Akiliunde bora zaidi kwa siku za usoni kwa kuwa wafasiri binadamu wanaweza kutoa mrejesho kuhusu makosa au mapungufu ya tafsiri zilizofanywa na mashine, jambo ambalo huwezesha kuhuishwa kwa mifumo hiyo ili iendelee kujifunza kutoka kwa wataalam. Hili ni jambo muhimu katika lugha kama Kiswahili ambazo bado hazina rasilimali nyingi za kiteknolojia ukilinganisha na lugha kubwa za kimataifa. Kwa hivyo, mchanganyiko wa Akiliunde na wafasiri binadamu

si tu suluhisho la muda bali pia ni mkakati endelevu wa kuhakikisha tafsiri zenyе ubora, zinazoheshimu utamaduni, lugha, na hisia, sambamba na mahitaji ya kasi na teknolojia ya kisasa. Hii ni njia inayowezesha fasihi, elimu, dini, na mawasiliano ya kiutamaduni kuendelea kuwasilishwa kwa ufasaha katika enzi ya kidijitali.

## **HITIMISHO**

Katika enzi ya maendeleo ya kasi ya teknolojia, matumizi ya Akiliunde (AI) katika tafsiri yamekuwa na mchango mkubwa katika kurahisisha mawasiliano ya lugha tofauti. Hata hivyo, makala hii imebainisha kuwa pamoja na faida zake, Akiliunde inakumbwa na changamoto kadhaa kubwa inapojaribu kutafsiri matini za kiutamaduni. Changamoto hizi ni pamoja na kutokuwepo kwa uelewa wa muktadha wa kiutamaduni, kushindwa kutambua maana ya maneno yenye maana nyingi, ukosefu wa ubunifu na hisia, kutotambua tofauti za lugha na utamaduni, pamoja na hatari za usalama na faragha ya taarifa. Tafiti mbalimbali zimeonesha kuwa Akiliunde kwa sasa haiwezi kuchukua nafasi ya mfasiri binadamu katika matini zinazobeba maana ya kina, hisia, au dhamira ya kijamii na kiutamaduni. Tafsiri sahihi ya aina hii inahitaji uelewa mpana wa lugha, jamii, mila na desturi zinazozingira ujumbe unaotafsiriwa, uwezo ambao kwa sasa uko zaidi kwa binadamu kuliko mashine. Kwa msingi huo, suluhisho bora ni mbinu shirikishi ya kutumia Akiliunde kama nyenzo ya awali, lakini ikifuatwa na uhariri wa wafasiri wa kibinadamu wenyе weledi wa lugha na muktadha wa kiutamaduni. Hili litahakikisha kuwa tafsiri zinazotolewa zinakuwa sahihi, zenyе heshima, na zinazowasilisha maana halisi kama ilivyokusudiwa katika lugha chanzi. Kwa kuwekeza katika tafsiri shirikishi, tunalinda utajiri wa lugha zetu, tunadumisha heshima za tamaduni zetu, na tunahakikisha kuwa teknolojia inatumiwa kwa njia shirikishi, yenye maadili na inayojali muktadha wa jamii. Kwa hiyo, makala hii inatoa mchango wa maarifa katika uga wa tafsiri na teknolojia kwa kuangazia changamoto za matumizi ya Akiliunde katika kutafsiri matini za kiutamaduni na kutoa mapendekezo ya kukabliliana na changamoto hizo. Aidha, makala hii inahitimisha kuwa matumizi ya Akiliunde hayawezi kufanyika bila mfasiri binadamu kwa sababu kila lugha imefungamana na utamaduni mahususi, mazingira na muktadha wa utamaduni huo. Hivyo, pamoja na kwamba teknolojia ya Akiliunde ni muhimu katika kurahisha shughuli za tafsiri, uzingativu wa utamaduni chanzi, mazingira na muktadha ni muhimu ili kufanikisha mawasiliano ya kiutamaduni.

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