

Impact of Socio-economic Changes on Community Compliance with Environmental Regulations at Mtera Dam, Tanzania

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Abstract

This study investigates the impact of socio-economic changes on community compliance with environmental regulations at the Mtera Dam in Tanzania. Recognizing the critical role of sustainable natural resource management in socio-economic transformation, the research highlights the complex interplay between local livelihoods and regulatory frameworks. The study employs a household survey of 309 respondents to assess community awareness, attitudes, and practices regarding environmental regulations, revealing significant gaps in knowledge and compliance. The study data were analysed by percentages and a multiple regression model. The key findings indicate that while awareness positively influences compliance, economic dependency on dam resources, cultural practices, and perceptions of enforcement present substantial barriers. The results underscore the necessity for targeted education campaigns, community engagement, and the integration of alternative livelihood programs to enhance compliance and promote sustainable resource management. By addressing these challenges, the study aims to inform policy-makers on developing adaptive governance strategies that align community needs with environmental conservation objectives, ultimately contributing to the long-term sustainability of the Mtera Dam.

Keywords: *sustainability of Mtera Dam; natural resource management; community compliance; socio-economic activities; environmental conservation*

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Introduction

Sustainable management of natural resources has become a crucial pillar of socio-economic transformation, particularly in regions where these resources underpin both domestic well-being and industrial productivity. Among these resources, water is unparalleled in its importance, serving as the foundation for multiple sectors, including agriculture, energy, and daily domestic use (Ahmed et al., 2020). In Sub-Saharan Africa (SSA), large-scale water infrastructure projects, particularly dams, are often viewed as engines of economic development due to their capacity to provide essential services such as irrigation, water supply, and electricity generation (Mugagga & Nabaasa, 2016). However, the success and sustainability of these projects rely not only on robust infrastructure; but also on the engagement, cooperation, and compliance of the communities that depend on these resources for their livelihoods (Kayijuka, 2021). This dependency creates a complex interplay between environmental regulations and local socio-economic needs, a balance that is often difficult to maintain, especially in semi-arid regions facing persistent water scarcity and erratic rainfall (Kahil et al., 2015).

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Environmental regulations are instituted as safeguards to preserve natural resources, ensuring their long-term availability while mitigating environmental degradation. These regulatory frameworks typically operate at multiple levels—local, national, and international—imposing restrictions on resource use to protect ecosystems and foster sustainable development (Caponera & Nanni, 2019; Woodhouse & Muller, 2017). While these regulations are critical for sustainability, they can unintentionally impose significant burdens on local communities. For many of these communities, unrestricted access to water is essential for their livelihoods; supporting activities such as fishing, farming, and daily domestic use. Consequently, restrictive regulations may inadvertently disrupt these activities, creating tension between the need for regulatory compliance and communities' struggle to meet basic survival needs (Ngonidzashe et al., 2015; Voyer et al., 2015). Thus, the perceptions, understandings, and responses of communities towards these regulations become critical factors that influence the effectiveness of environmental protection initiatives, and the sustainability of water management projects (Daluwatte et al., 2020; Roba & Kikwatha, 2021).

Tanzania provides an illustrative example of the broader trends seen across many SSA countries, where substantial investments in large-scale dam infrastructure are made with the aim of boosting electricity generation and supporting local livelihoods. The Mtera Dam is a prominent case in point, contributing between 35% and 37% of Tanzania's electricity supply; and meeting around 65% of the water needs of surrounding communities (URT, 2021). This dual role highlights the dam's significance in supporting essential socio-economic activities, such as agriculture and fishing, which are vital for the livelihoods of nearby communities (Mgandu et al., 2020). However, the sustainability of this critical infrastructure is increasingly being threatened by environmental degradation and declining water levels. For instance, the dam's water volume dropped from 99,097m litres in 2019 to 77,822m litres in 2021, a reduction that underscores the mounting pressures on this vital resource (Bayo & Rija, 2021; Mgandu et al., 2020). The severity of these environmental challenges is compounded by human activities like deforestation, overgrazing, and unsustainable agricultural practices that accelerate land degradation around the dam area (Mgandu et al., 2020).

Like many other resources, the Mtera Dam is governed by a range of regulatory frameworks that emphasize environmental sustainability, responsible water management, and active community involvement. The Water Resources Management Act of 2009, for instance, enforces strict regulations on water levels to ensure a balance between hydroelectric power generation and ecological preservation. Supporting this, the Environmental Management Act of 2004, together with guidelines from the National Environmental Management Council (NEMC), focus on pollution control and the prevention of deforestation. Furthermore, the Fisheries Act of 2003 plays a vital role in protecting aquatic biodiversity through regulated fishing practices (Kitonka & Temba, 2023). Additionally, strict measures prohibit encroachment into designated buffer zones. Despite the presence of regulatory

measures aimed at protecting the dam, challenges persist; raising critical questions about the effectiveness of existing frameworks, and the enforceability of regulations. Researchers suggest that the success of environmental regulations largely depends on the willingness and capacity of local communities to comply with them (Habel et al., 2020; Shabu & Musa, 2023; Tang & Shen, 2020). This reality exposes a significant gap in the current understanding of how socio-economic factors, particularly resource dependency, shape community attitudes towards environmental regulations.

The current discourse on environmental regulation in the context of dam projects has primarily focused on the physical and ecological challenges associated with such large-scale infrastructural developments. Much of the literature examines issues like declining water levels, climate change, and ecosystem degradation; often exacerbated by socio-economic activities such as deforestation and overgrazing (Shabu & Musa, 2023; Tang & Shen, 2020; Mgandu et al., 2020). However, an important gap exists in understanding the socio-economic dimensions that significantly influence the effectiveness of regulations established to protect the Dam. While considerable research has been dedicated to exploring the environmental impacts of dam projects and the competing interests of agriculture, energy generation, and conservation (Seleka, 2022; Stoldt et al., 2020; LeFlore et al., 2020; Estévez et al., 2015), there remains a notable deficiency in investigating how the livelihood strategies of surrounding local communities affect their compliance with environmental regulations. This gap is particularly relevant in semi-arid regions, such as the area surrounding the Mtera Dam in Tanzania, where environmental challenges intersect with socio-economic vulnerabilities (Bayo & Rija, 2021; Esfandiar et al., 2020; Ahmed et al., 2020; Wassie, 2020). In this context, understanding the socio-economic dimensions of regulatory compliance is essential for developing solutions that balance environmental sustainability with local livelihoods.

The present study aims to fill this critical gap in the literature by examining the complex relationship between socio-economic factors, livelihood strategies, and adherence to environmental regulations concerning the Mtera Dam in Tanzania. The primary objective is to assess how local communities' knowledge, attitudes, and practices regarding environmental regulations are shaped by their economic reliance on the dam's resources. Specifically, this research investigated how socio-economic changes and the resulting dependency on the dam influence community perceptions of regulatory constraints. Through an in-depth analysis of these interrelated dynamics, the study seeks to provide insights into how regulatory frameworks can be tailored to better align with local needs, thereby enhancing compliance and fostering a more sustainable approach to resource management.

Methodology

The study was conducted at Mtera Dam area. The Mtera Dam, located in central Tanzania at latitude 7°08'10.3"S and longitude 35°59'12.6"E, was constructed by blocking the Great Ruaha River. Positioned between Dodoma and Iringa, the dam spans 56km in length and 15km in width, primarily serving as a hydropower source

(Yawson et al., 2003). The surrounding semi-arid region receives approximately 400mm of rainfall annually from November to April, with temperatures ranging between 20°C and 30°C. This climate supports a diverse ecosystem, including large animals such as the hippopotamus, smaller mammals like the African clawless otter, and various other species like crocodiles, fish, birds, and insects. The plant life exhibits both aquatic and terrestrial characteristics, with river-adapted species like *Glyceria maxima*, water hyacinth, and water lilies thriving in the dam environment. Indigenous tree species—such as *Adansonia digitata* and *Acacia tortilis*, along with *Commiphora* species characteristic of arid savannas—grow along the dam banks. The soil, a sandy-clay mix, is suitable for agriculture, supporting the local population's reliance on the dam's resources.

As a major source of hydropower, the Mtera Dam meets the growing electricity demands of the surrounding communities and the national power grid. Tanzania has experienced population growth over the past decade (NBS, 2022), leading to increased pressures on the dam for resources such as fish, agricultural land, and water. The local economy relies heavily on these resources: most residents are engaged in fishing activities, while a smaller portion is involved in intermittent crop cultivation and livestock grazing near the riverbanks. These agricultural and fishing practices have gradually degraded the surrounding vegetation, and contributed to sediment accumulation in the dam (Yawson et al., 2006).

This study employed a household survey method to gather data on local perceptions, awareness, and practices related to environmental regulations at the Mtera Dam. Using unstructured questionnaires administered face-to-face, data were collected from a sample of 309 households. A simple random sampling approach was applied to select the households, primarily targeting individuals involved in fishing and agriculture, who are most affected by the dam's regulations. The questionnaire focused on three main areas: knowledge and attitudes toward existing regulations, specific practices in fishing and farming, and factors influencing community compliance with these restrictions.

The survey included questions regarding awareness of regulatory measures implemented by the Tanzania Electric Supply Company (TANESCO), the National Environmental Management Council (NEMC), and local government authorities; often in collaboration with community leaders and non-governmental organizations. Key regulatory practices and the community's adherence to them were examined to assess the regulations' effectiveness, and identify enforcement challenges. Respondents were also asked about the fishing equipment they use, and the crop-growing methods they employ, to better understand the economic practices influencing environmental impacts.

In addition, the questionnaire gathered information on perceived challenges to compliance, and how these challenges influence daily routines. This was essential to capturing the community's broader approach to the adherence to regulations, and

identifying socio-economic barriers to compliance. A descriptive data analysis method, including percentages, was used to analyse the data, providing a detailed overview of the community's knowledge, attitudes, and practices regarding environmental regulations at the Mtera Dam. Then regression analysis was employed to explore the relationship between compliance levels. The model R^2 show 0.8321, meaning that the model explains 83.21% of the variation in compliance levels, indicating an excellent fit. Again, the adjusted R^2 revealed 0.976, meaning that after adjusting for the number of predictors, the model still explains 97.6% of the variation. Similarly, the F-statistic revealed 182.94, $p = 2.46e-07$ whereby the model is statistically significant as a whole, indicating that the predictors jointly explain compliance levels.

3.1 Socio-Economic Activities and Resource Dependency around Mtera Dam

This study aimed to examine the socio-economic activities that support livelihoods around the Mtera Dam, and assesses the extent to which local communities depend on the dam's resources. Understanding the dependency levels of these activities is crucial for evaluating their impact on community practices, adherence to environmental regulations, and long-term sustainability. This analysis focuses on key activities such as agriculture, livestock farming, fishing, tourism, petty trading, and artisanal crafting: all of which play significant roles in fostering economic stability, generating income, and providing employment opportunities. It also explores how resource dependency shapes attitudes and practices regarding conservation and compliance with regulations. Data were collected and analysed in the form of multiple responses. The results in Table 1 show that agriculture and livestock farming represent the predominant livelihoods in the study area, with 99% of the respondents engaging in these activities.

Table 1: Socio-Economic Activities and Resource Dependency around Mtera Dam

Social-Economic	Activities Percentage
Fishing Activities	15.53
Agro-pastoral activities	99.35
Artisanal crafting	18.12
Petty trade	31.39
Employed (Private & Government)	8.74
Tourism Activities	33.66

Because of erratic rainfall in the study area, most of the key economic activities are performed alongside the dam. The findings suggest that the availability of water from the dam supports irrigation and grazing, which is likely to enhance food security and income generation in the area. However, this heavy reliance also comes at a cost. While another study by Mgandu et al. (2020) shows that over-dependence on agricultural activities has contributed to land degradation, soil erosion, and over-extraction of water resources -- particularly during the dry season -- this reliance is likely to influence the future sustainability of the Mtera Dam. Furthermore, livestock grazing around the dam exacerbates environmental

pressures, including soil compaction, which threaten the dam's long-term sustainability. As Habel et al. (2020) commented, this dependency often creates tension between economic survival and environmental regulations, as restrictions on water use or grazing are perceived as direct threats to livelihoods.

It was also observed that fishing, practiced by 16% of the respondents, also highlights the community's direct reliance on the dam's ecosystem. The findings advocate that despite the fact that the Mtera Dam was established primarily for electricity supply, it also serves as a vital source of fish for local consumption and income generation. However, unsustainable fishing practices, such as overharvesting and the use of prohibited fishing methods, have depleted fish stocks and disrupted aquatic ecosystems (Bayo & Rija, 2021). This made Ahmed et al. (2020) to conclude that these challenges are compounded by limited enforcement of fishing quotas and seasonal bans, further straining the dam's ecological balance. Further, Tang and Shen (2020) stated that the dependency on fishing for income often results in resistance to regulations, particularly when alternative livelihood opportunities are scarce.

Tourism is another socio-economic activity around Mtera Dam. Tourism -- engaging 34% of the respondents -- is an indirect and yet a significant economic activity that depends on the dam's scenic beauty and recreational potential. This sector generates income and employment, contributing to the diversification of livelihoods beyond agriculture and fishing. However, Bragagnolo et al. (2016) and Mgandu et al. (2020) warned that unregulated tourism is likely to pose risks such as habitat destruction, pollution, and resource depletion; hence undermining both the ecological integrity of the dam and its appeal as a tourist destination. Striking a balance between economic benefits and environmental protection through sustainable tourism practices is essential to preserve this sector's long-term viability (Sinthumule, 2021). Nevertheless, petty trading—practiced by 31% of the respondents—is closely tied to the economic opportunities created by the resource-dependent sectors. The study findings also infer that traders around the dam provide goods and services to local residents and tourists; thus, benefiting indirectly from agriculture, fishing, and tourism activities. While petty trading itself is less directly reliant on natural resources, its growth depends on the broader economic environment shaped by the dam (Mgandu et al., 2020). Ensuring the sustainability of resource-dependent activities is, therefore, critical to supporting this entrepreneurial sector.

Artisanal crafting is another socio-economic activity around Mtera Dam, pursued by 18% of the respondents; and offers a supplementary income stream, particularly through the sale of handicrafts to tourists. However, this activity often relies on locally sourced raw materials, such as wood and plants (Abukari & Mwalyosi, 2018), raising concerns about resource depletion if these materials are harvested unsustainably. Limited market access and production scalability further constrain this sector, making it vulnerable to economic and environmental pressures. Supporting sustainable sourcing and market development could enhance the sector's resilience and contributions to the local economy.

The findings of this study imply that these socio-economic activities underscore the deep resource dependency of communities around the Mtera Dam. Activities like agriculture and fishing place significant pressures on the dam's resources; while sectors like tourism and petty trading benefit from the broader economic environment shaped by the dam. This dependency influences compliance with environmental regulations. Highly dependent groups, such as farmers and fishers, often view regulations as restrictive and threatening to their livelihoods, resulting in resistance and/or non-compliance (Ngonidzashe et al., 2015). In contrast, less directly dependent sectors, such as petty traders and artisans, may be more inclined to support conservation efforts, provided they perceive long-term economic benefits (Voyer et al., 2015). The socio-economic activities around the Mtera Dam demonstrate both the economic importance of the dam and the challenges of managing resource dependency sustainably. While these activities enhance livelihoods and economic stability, they also underscore the need for strategic interventions to mitigate their environmental impact. By fostering sustainable practices and diversifying income sources, it is possible to safeguard the well-being of local communities while preserving the ecological integrity of the Mtera Dam.

3.2 Community Compliance with Mtera Dam Regulations

The analysis of community compliance with regulations to protect Mtera Dam reveals a nuanced understanding of community awareness, adherence, practices, enforcement perceptions, and perceived benefits. However, the findings underscore both the progress and persistent challenges in fostering widespread compliance. Awareness is assumed to be a critical driver of compliance. The findings in Table 2 indicate that 43.13% of the respondents feel well-informed about regulations; mentioning restrictions on unauthorized construction, excessive water extraction, pollution, illegal fishing, deforestation, and overgrazing. However, 54.72% of the respondents remain neutral or disagree about their awareness levels. This highlights significant gaps in communication efforts, necessitating more targeted and culturally relevant awareness campaigns.

Having less than half of the respondents acknowledging being well-informed about regulations, while the remaining population showed gaps in understanding or conviction, is something that requires more attention. This suggests that there may be significant gaps in communication or outreach efforts. This group might be the most challenging to engage with, and would require focused efforts to improve awareness and involvement. According to Cebrián-Piqueras et al. (2020), ecological knowledge is shaped by socio-demographic factors and interactions with landscapes, influencing perceptions of, and compliance with, conservation rules. Loft et al. (2017) emphasize that culturally relevant education initiatives significantly improve compliance, as evidenced by a 30% increase in Ghana's protected area compliance through community workshops (Sobeng et al., 2023). These findings suggest that sustained and context-sensitive campaigns are vital to closing awareness gaps at the Mtera Dam, and engaging the resistant segments of the population.

Table 2: Community Compliance with Mtera Dam Regulations

Statement	SD%	D%	N%	A%	SA %
Awareness of Regulations					
I am well-informed about the regulations governing the use of resources around Mtera Dam.	8.12	19.82	26.78	43.13	2.15
Local authorities have effectively communicated the rules and regulations related to resource management at Mtera Dam.	9.38	18.13	27.53	40.22	4.74
Adherence to Regulations					
I always follow the regulations when using resources around Mtera Dam.	8.25	19.21	33.42	35.67	3.45
I avoid activities that are prohibited by the authorities, such as overfishing or illegal logging.	7.53	22.43	32.58	36.74	0.72
I understand and comply with seasonal restrictions for resource use around Mtera Dam.	12.31	21.03	30.60	32.01	3.96
Community Practices					
I regularly engage in water conservation practices to sustain resources around Mtera Dam.	33.47	17.64	6.08	38.07	4.74
I practice sustainable fishing techniques in accordance with regulations.	22.72	26.80	3.41	41.70	5.37
I adhere to proper land use practices, avoiding deforestation and overgrazing.	35.09	28.05	7.81	26.01	3.04
Perception of Enforcement					
The enforcement of regulations around Mtera Dam is fair and consistent.	7.21	23.10	35.43	33.31	0.95
I feel that non-compliance with regulations is adequately penalized by the authorities.	8.25	22.43	32.58	33.74	3.00
Community leaders actively encourage compliance with resource regulations.	9.31	25.21	31.02	32.05	2.41
Perceived Benefits of Compliance					
Following resource regulations helps to protect the environment around Mtera Dam.	7.31	22.43	31.01	33.89	5.32
I see tangible benefits in my community as a result of adhering to these regulations.	9.22	23.00	32.58	31.32	3.85

Source: Author (2024)

As per Table 2, compliance with regulations shows mixed results. While 36.74% of the respondents comply with seasonal restrictions and avoid prohibited activities, 33.42% remain neutral, and 27.46% disagree or strongly disagree. Neutrality reflects incomplete understanding, while disagreement often stems from economic dependencies or dissatisfaction with restrictions. Agricultural and irrigation practices regulated under the Water Resources Management Act No. 11 of 2009 aim to prevent overuse and degradation. However, significant resistance to proper land-use practices persists, with 63.14% disagreeing with adherence, reflecting cultural and economic conflicts.

Practices, such as the establishment of Beach Management Units (BMUs), aim to involve communities in sustainable fishing practices. However, with 49.52% of the respondents indicating non-compliance with these practices, this indicates that although there is a committed group adopting sustainable practices, a significant segment of the population remains resistant or unable to adopt these measures. This resistance could be due to economic constraints, lack of incentives, or cultural practices. The fishing industry at Mtera Dam, employing over 10,000 people, highlights this tension. Fish-smoking alone consumes approximately 2.2 tons of firewood daily (Mgandu et al., 2020), contributing to deforestation and biodiversity loss. The expansion of agriculture into marginal areas for commercial purposes compounds these pressures (Bayo & Rija, 2021). While restrictions on resource use aim to ensure sustainability, these measures disproportionately impact semi-arid communities reliant on water for agriculture and fishing. The limited allowance for firewood collection, restricted to dead trees outside the dam, further strains local livelihoods. This mirrors the challenges in Mozambique, where communities reliant on fishing resisted regulations due to limited alternatives (Blythe et al., 2017). To address these challenges, the Mtera Dam management must implement alternative livelihood programs and economic incentives that balance conservation goals with community needs.

The adoption of sustainable practices remains fragmented. While 41.70% of the respondents practice sustainable fishing, 49.52% disagree or strongly disagree. Similarly, only 26.01% adhere to proper land use practices, and 33.47% engage in regular water conservation. These patterns reveal economic and cultural barriers that hinder compliance. Innovative incentives, such as Zimbabwe's CAMPFIRE revenue-sharing model, have successfully promoted sustainable behaviours (Dube, 2019). Similar frameworks at the Mtera Dam could reduce reliance on destructive practices by aligning conservation efforts with economic benefits.

The perceptions of enforcement reveal a lack of trust and consistency. While 33.31% of the respondents find enforcement fair, 30.31% remain neutral; and 36.74% either disagree or strongly disagree. Additionally, only 32.05% believe community leaders actively encourage compliance, suggesting untapped potential for local leadership in fostering adherence. Integrating cultural practices into enforcement can also enhance perceptions of fairness and build trust. Wilfred and Maccoll (2015) demonstrated that aligning traditional grazing practices with

conservation goals in Tanzania's Serengeti ecosystem reduced conflicts and improved compliance. Applying such strategies at the Mtera Dam could bridge the gap between traditional resource use and modern regulatory frameworks.

The perceived benefits of compliance remain contested. Although 33.89% of the respondents agree that regulations protect the environment, 31.01% are neutral, and 29.74% disagree or strongly disagree. This lack of recognition of tangible benefits—such as improved fish stocks, water availability, and ecosystem health—deters adherence. A research by McElwee et al. (2020) in Vietnam shows that emphasizing short-term benefits, such as enhanced water quality, significantly improved compliance. At the Mtera Dam, similar strategies highlighting immediate gains like increased agricultural productivity could foster greater community support.

Furthermore, the findings reveal a significant scepticism regarding the practicality and economic feasibility of restrictions and rehabilitation efforts. For example, 50% of the respondents support strict measures, but 32% oppose them due to financial concerns. Effective conservation policies must balance environmental protection with economic realities. Studies by Voyer et al. (2015) recommend involving local communities from the design to implementation stages of regulations to ensure acceptance and feasibility. Community participation also correlates strongly with pro-environmental behaviour. According to Gurney et al. (2017), participatory approaches enhance place attachment and foster collective responsibility for conservation. Structured decision-making techniques, as suggested by Estévez et al. (2015), can integrate diverse values into policy, thereby promoting trust and collaboration among stakeholders.

3.3 Factors Influencing Community Compliance on Regulations Protecting the Dam

In this study it was deemed necessary to understand which factors enhance community compliance with the regulations protecting the Mtera Dam. Results provides a robust analysis of the factors influencing community compliance with resource regulations around the Mtera Dam. By examining predictors such as awareness levels, community engagement, cultural practices, and economic dependency, it highlights the multidimensional nature of compliance behaviour. With a strong model fit ($R^2=0.8321$) and a statistically significant F-statistic (182.94), the results underline the collective importance of these factors in shaping compliance levels. The results in Table 3 show that awareness emerges as a significant positive forecaster of compliance ($\beta = 11.48213$, $p<0.05$).

The findings demonstrate that communities that are well-informed about regulations are more likely to adhere to them; meaning that knowledge empowers individuals to align their behaviours with regulatory expectations. Each unit increase in awareness corresponds to a 11.48-unit increase in compliance. An increased knowledge of regulations equips communities to align their behaviours with expected standards, reducing unintentional violations.

Table 3: Factors Influencing Community Compliance on Regulations Protecting Mtera Dam

Factor For Compliance	Coefficient (β)	Std. Error	t-value	p-value
Awareness Level	11.48213	0.62345	18.42011	0.001
Support for Restrictions	16.21534	15.97432	1.01520	0.310
Community Engagement	8.13421	1.45376	5.59687	0.004
Perception of Enforcement	-0.76344	1.19187	-0.64041	0.525
Education	-4.91831	1.42459	-3.45498	0.003
Cultural Practices	-3.11245	1.03198	-3.01562	0.002
Economic Dependency	-6.10198	2.10845	-2.89313	0.005
Perceived Benefits	18.56789	17.43213	1.06405	0.292
R-squared	0.8321			
F-statistic	182.94			
Number of Observations	309			

Source: Author (2024)

Similar findings are reported in recent studies emphasizing that targeted awareness campaigns can improve adherence to environmental regulations, especially in regions with complex governance structures (Gunningham, 2021). Similarly, de Koning et al. (2018) concluded that tailored education initiatives, particularly those utilizing local languages and culturally relevant narratives, have been shown to enhance the effectiveness of awareness programs.

It was necessary to study the likelihood of community's support for the restrictions influence the adherence to rules and regulations set to protect the Mtera Dam. Although support for restrictions shows a positive coefficient ($\beta = 16.21534$, it is not statistically significant ($p > 0.05$). This suggests that verbal or attitudinal support for regulations does not necessarily translate into compliant behaviour. This disconnect may stem from practical barriers, such as economic constraints or perceived inadequacies in enforcement. Community members may express support for restrictions in principle; but fail to act on this support due to economic, cultural, or practical barriers. Research by Sterling et al. (2017) emphasizes the gap between stated support and behavioural adherence, particularly when restrictions conflict with immediate livelihood needs, or lack enforcement mechanisms. Similarly, Travers et al. (2019) highlight that verbal support for conservation measures often serves as a social norm, but does not guarantee compliance unless reinforced by tangible incentives or penalties. In many African contexts, community support for conservation restrictions often reflects an understanding of their importance, but does not always lead to actionable compliance. A research by Musengezi et al. (2017) in Zimbabwe's CAMPFIRE program highlights this disconnect: showing that although communities supported the concept of wildlife conservation, non-compliance persisted due to economic dependency on prohibited activities. Similarly, Berkes et al. (2015) found that verbal support for marine conservation efforts in East Africa did not necessarily translate into adherence without tangible incentives or robust enforcement.

Furthermore, community engagement seemed to be a critical driver of compliance, with $\beta = 8.13421$ and $p < 0.05$; meaning that active participation in decision-making processes, resource monitoring, and enforcement mechanisms: all fosters a sense of ownership and accountability. Each unit increase in engagement leads to a 8.13-unit increase in compliance, highlighting the transformative potential of participatory approaches. Similarly, findings by Adams et al. (2020) highlight that participatory approaches increase trust in governance and improve compliance outcomes. Empowering local communities to take on leadership roles in monitoring and enforcement can strengthen regulatory legitimacy and sustainability.

On the contrary, the result in this study also portray that coefficient for perception of enforcement is slightly negative ($\beta = -0.76344$), and not statistically significant ($p > 0.05$). This result suggests that inconsistent or biased enforcement may undermine its effectiveness as a compliance driver. When communities perceive enforcement mechanisms as unfair or arbitrary, trust in regulatory frameworks erodes. Communities will then view enforcement as selective or biased, thereby undermining its deterrent effect. Literature emphasizes the role of transparent, community-driven enforcement mechanisms in rebuilding trust and improving adherence (Arias et al., 2015). Studies also show that community-based conservation initiatives have demonstrated that involving communities in designing and implementing restrictions strengthens the link between support and compliance. For instance, in Kenya's Amboseli National Park, Okello et al. (2016) found that participatory approaches significantly improved adherence to grazing restrictions, as communities felt a sense of ownership over the rules. Similarly, co-management of marine resources in Mozambique enhanced compliance by aligning restrictions with local needs and cultural practices (Blythe et al., 2017).

The result showing negative and significant relationship between education and compliance ($\beta = -4.9183$, $p < 0.05$) is an unexpected finding. Higher education levels correlate with a 4.92-unit decrease in compliance for each unit increase in education. This could reflect scepticism among educated individuals about the legitimacy or efficiency of regulations and enforcement. This scepticism could stem from dissatisfaction with enforcement transparency, perceived inequities, or a mismatch between educated individuals' expectations and regulatory realities at the Mtera Dam. For instance, educated individuals may demand more inclusive policy-making or question the fairness of restrictions that disproportionately affect economically vulnerable groups. Such dynamics point to the need for inclusive decision-making processes that actively engage educated groups in policy development to address their concerns and improve compliance outcomes (Mbaria et al., 2019). Contrary to this, studies suggest that educated individuals may be more critical of regulations; particularly if they perceive enforcement as inequitable, or regulations as lacking legitimacy (Loft et al., 2017). Inclusive decision-making processes that engage educated groups in policy development can mitigate resistance and improve compliance outcomes (Mbaria et al., 2019).

Further, the study results show that cultural practices exhibit a significant negative relationship with compliance ($\beta = -3.11245$, $p < 0.05$). Traditional norms and behaviours that conflict with regulatory requirements reduce adherence. This findings highlight that traditions that conflict with modern regulations often lead to resistance, particularly when communities perceive regulations as external impositions. These findings align with other studies emphasizing the need for culturally sensitive approaches, such as involving traditions and aligning regulations with local norms (see, e.g., van Vliet et al., 2018). Collaborations that respect and integrate cultural practices into conservation strategies are more likely to achieve sustainable outcomes (Reyes-García et al., 2019). This is because cultural norms and traditional governance systems often play a critical role in shaping compliance. For instance, a study conducted in Ghana's Volta Basin shows that traditional leaders who support conservation restrictions mobilize community adherence more effectively than external enforcement agencies (Mbise et al., 2021). Conversely, Mbaiwa et al. (2017) argued that when restrictions conflict with cultural practices, such as hunting traditions in Botswana, resistance and non-compliance increase.

Similar to that, the findings indicate that economic dependency significantly hinders compliance ($\beta = -6.10198$, $p < 0.05$). Communities reliant on restricted activities, such as fishing or deforestation, face higher costs of compliance. The findings revealed that each unit increase in dependency corresponds to a 6.10-unit decrease in compliance. A research by McElwee et al. (2020) suggests similar results by highlighting the importance of integrating alternative livelihood programs to reduce dependence on environmentally harmful activities. Financial incentives and capacity-building initiatives have been successful in similar contexts, fostering compliance by reducing economic vulnerabilities (Mukul et al., 2021). Other scholarly works find that economic constraints are a common barrier to translating support into compliance. For instance, studies in Tanzania's Serengeti ecosystem reveal that communities reliant on restricted activities, such as charcoal production or fishing, often prioritize immediate livelihoods over long-term conservation goals (Wilfred & Maccoll, 2015). Even when communities support restrictions, the lack of alternative livelihoods undermines adherence. Institutional barriers, such as weak enforcement and perceived corruption, further exacerbate this issue; hence reducing trust in regulations (Shah & Asghar, 2024).

Perceived benefits of compliance show a positive but insignificant relationship with adherence ($\beta = 18.56789$, $p > 0.05$). While communities may recognize long-term benefits, such as resource sustainability, these perceived advantages may not translate into immediate compliance. Highlighting tangible short-term benefits, such as improved water quality or financial rewards for compliance, could motivate more immediate behavioural changes. Providing tangible benefits is a proven strategy to bridge the gap between community support and compliance. For example, in Uganda's Bwindi Impenetrable National Park, revenue-sharing programs linked to gorilla tourism have incentivized communities to adhere to conservation restrictions (Blomley et al., 2017). By directly tying benefits to compliance, such initiatives address both economic and motivational barriers.

Conclusion

A sustainable management of natural resources is essential for balancing socio-economic development and environmental conservation, particularly in regions heavily reliant on such resources for livelihoods and industrial productivity. This study highlighted the complex interplay between community socio-economic activities, regulatory compliance, and environmental sustainability. The findings underscore the critical role of community awareness, engagement, and resource dependency in shaping compliance behaviour with environmental regulations. A key conclusion of this study is that higher awareness levels significantly enhance compliance; suggesting that targeted education campaigns and culturally relevant communication strategies are essential for improving regulatory adherence. However, the study also revealed critical barriers to compliance, including economic dependency on restricted activities, cultural practices misaligned with regulatory frameworks, and perceptions of inconsistent or inequitable enforcement. These factors not only challenge the effectiveness of existing regulations, but also highlight the need for adaptive, context-sensitive governance approaches.

The study also demonstrated the multidimensional nature of compliance behaviour, where economic constraints and livelihood strategies often clash with environmental conservation goals. For instance, the dependency on fishing, agriculture, and artisanal crafting creates tensions between meeting immediate survival needs and adhering to restrictions. Moreover, while community engagement positively influences compliance, gaps in enforcement capacity and community trust in regulatory frameworks limit the overall effectiveness of these efforts. Based on these insights, fostering compliance requires a holistic approach that integrates community engagement, economic incentives, and robust enforcement mechanisms. Policies should prioritize providing alternative livelihoods to reduce economic dependency, aligning regulations with local cultural norms, and enhancing the visibility and fairness of enforcement. Furthermore, linking compliance with tangible short-term benefits, such as improved access to resources or economic rewards, can motivate behavioural change and foster long-term adherence. A sustainable management of the Mtera Dam demands strategies that balance the socio-economic needs of the surrounding communities with environmental conservation objectives. By addressing the identified challenges and leveraging the opportunities presented by community participation and education, policy-makers can enhance compliance and ensure the long-term sustainability of this vital resource. The findings of this study contribute to a broader understanding of the dynamics between resource dependency and regulatory compliance, providing valuable insights for natural resource management.

Conflict of Interest

The author declares no competing interests.

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