

**ENVIRONMENTAL SECURITY AND GOVERNANCE IN RESILIENCE
BUILDING FOR EASTERN MAU FOREST COMMUNITIES, NAKURU
COUNTY, KENYA**

By

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DEDICATION

To my lovely wife Betty, Mom and my siblings. I thank you all for your unwavering support while undertaking my doctoral studies. To my Late Dad, Army Sergeant Major Warrant Officer Class 1 (Rtd) Timothy Brown Wando, I know you are smiling knowing that the inheritance you promised, fell on fertile soil. This is for all of you!

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
BE	Built Environment
CBO	Community Based Organization
CFA	Community Forest Association
CI	Confidence Interval
CIDP	County Integrated Development Plan
CPE	Certificate of Primary Education
EMAS	European Environmental Management Standard
EMS	Environmental Management Standards
GDP	Gross Domestic Product
HIV/AIDS	Human Immunodeficiency / Acquired Immunodeficiency Syndrome
ISO 14001	International Organization for Standardization 14001
KARLO	Kenya Agriculture and Livestock Research Organization
KCE	Kenya Certificate of Education
KCPE	Kenya Certificate of Primary Education
KCSE	Kenya Certificate of Secondary Education
KEFRI	Kenya Forestry Research Institute
KFS	Kenya Forest Services
KFWG	Kenya Forest Working Group

KNBS	Kenya National Bureau of Statistics
KWS	Kenya Wildlife Services
KWTA	Kenya Water Tower Agency
LULC	Land Use Land Cover
MFC	Mau Forest Complex
MK	Mann-Kendall
MLG	Multi-Level Governance
NACOSTI	National Commission for Science, Technology, and Innovation
NGO	Non-Governmental Organization
NTFPs	Non-Timber Forest Products
RDI	Resilience Design Institute
REDD+	Reduction of Emissions from Degradation and Deforestation
SD	Standard Deviation
SEIs	Socio-Economic Indicators
SES:	Socio-Ecological System
SPSS	Statistical Package for the Social Sciences
STDs	Sexually Transmitted Diseases
UN	United Nations
VTSM	Vulnerability, Threats, Stressors, and Mitigation
WCED	World Commission on Environment and Development

ABSTRACT

Environmental shocks and stressors, ranging from natural hazards to conflicts and political upheavals, have inflicted profound disruptions on community livelihoods worldwide. These challenges have magnified risks and vulnerabilities, particularly among communities in the developing world who rely on natural resources for their sustenance. Resilience building, a concept frequently invoked by stakeholders across environmental, political, security, and peacebuilding domains, aims to mitigate these threats. However, the literature reveals limited success in achieving broader sustainability goals, with some strategies inadvertently embedding vulnerabilities in communities' futures. This study proposes an innovative approach to resilience building by integrating the concepts of environmental security and governance. Its overarching objective is to investigate the existing environmental security and forest governance systems within the Eastern Mau Forest and their impact on community resilience. The study draws upon four key theories, including natural resource management, people-centred development, nature/nurture, and the resource curse theory, to inform its conceptual framework. Collectively, these theories provide a roadmap for enhancing community resilience through the development of a comprehensive environmental security framework, supported by well-structured stakeholder coordination and comprehensive resource governance policies. To facilitate rigorous measurement and data analysis, the study employs a mixed-methods research design, blending qualitative and quantitative methodologies. The selection of administrative units follows purposive sampling, with households randomly chosen within these units. Quantitative data undergoes analysis using SPSS, leveraging regression models to explore livelihood trends, risk assessments, insecurity, resource scarcity linkages, and other critical indicators. The study's findings hold significance for various stakeholders, offering insights into collaborative strategies to address identified gaps and fortify the resilience of Eastern Mau forest communities. Additionally, the study's implications extend beyond the study area, potentially informing resilience-building efforts in similar ecosystems across the country. Key findings include the prevalence of serious environmental degradation, attributed by 43.3% of respondents, as well as socioeconomic challenges linked to low education attainment (only 10.4% completed high school). A notable 57.6% of the community expressed the desire for greater inclusion in forest governance. In light of these findings, the study recommends a more participative approach to enhance the governance and environmental security framework underpinning the Eastern Mau forest. It calls for heightened awareness among Eastern Mau forest communities regarding the significance of forest resources, emphasizing conservation to prevent degradation and promote sustainability. Furthermore, increased engagement from private and public stakeholders is advocated, with active participation in forest resource management as a means to build resilience. Finally, the study suggests a review of existing policies and legislative frameworks governing environmental security and forest resource governance to align with emerging challenges and opportunities.

CHAPTER ONE: INTRODUCTION

1.1 Background to the Study

Environmental security is a global concern that has gained increasing prominence in the post-Cold War era (Hough, 2020). This concept revolves around safeguarding populations from environmental hazards, whether they originate within or beyond a nation's borders, stemming from either natural or human-induced causes (Altieri et al, 2017). The dynamics of global natural resource competition have intensified, involving a multitude of stakeholders, entities, and corporations with disparate interests (Bigliardi et al., 2021). Amid these global challenges, many societies rely on forest governance as a means of managing environmental volatility and change. Within climate change policy discussions, forest and natural resource governance are often championed as strategies to enhance carbon sequestration, adaptive capacities, and biodiversity conservation (Fraser & Kirbyshire, 2017).

The realm of environmental governance is a complex tapestry marked by compromises, disputes, and a multitude of objectives, all embedded within broader political and policy contexts (Chabeda-Barthe & Haller, 2018). Programs and regulations in environmental governance, such as those addressing climate change and land use, serve as arenas where states and citizens interact and vie for influence (Bakker & Ritts, 2018). Understanding the significance of forest resource governance within the broader context of societal responses to ecological challenges, necessitates an examination of how this approach is entwined with larger political transformations and people's efforts to withstand environmental shocks within these intricate governance landscapes.

The global landscape showcases instances of environmental degradation due to unsustainable land use practices. In Australia, for example, vast tracts of tropical rainforests have been cleared in contravention of conservation mandates to accommodate expanding urban centres as populations surge and land resources dwindle (Tarus et al., 2020). Similar challenges are seen in the United States Forest Complex, where studies delve into the complexities of land management and stakeholder engagement (Muok et

al., 2021). These investigations also probe the theoretical and empirical aspects of environmental land degradation, encompassing issues such as declining agricultural productivity and the establishment of permanent settlements.

Europe's voracious appetite for wood resources has fuelled illegal trade, undermining regional peace and security (Sarty, 2019). As nations endeavour to strengthen their institutions for economic development and poverty reduction, the ecological stability of global ecosystems becomes a paramount concern (Okumu et al., 2021). Despite earnest efforts, ecosystems in countries like Kenya have witnessed substantial declines (Shukla, 2018).

Turning to Africa, forest cover has experienced a stark decline, with the Democratic Republic of Congo leading in forest loss (Xiao, 2022). Sub-Saharan Africa grapples with dwindling forest resources, a trend at odds with global restoration agendas targeting a forest cover of over 50% by 2050 (Sanchez et al., 2019). To reverse this trend, nations in the global south must commit to restoration and reforestation programs, with a collective goal of boosting forest cover by at least 30% by 2030. Unfortunately, the global forest cover continues to shrink at an average annual rate of 0.13% (Ritchie & Roser, 2021; FAO, 2017).

In East Africa, nations like Tanzania have succeeded in forest preservation, whereas Uganda has witnessed a significant reduction in forest cover, and Rwanda has initiated efforts to curtail deforestation (Xiao, 2022). However, forestry security remains under-prioritized, despite its potential to drive local and regional development (Ithinji, 2020). Illegal logging, a pressing issue in the region, poses a threat to regional security (Dwyer, 2020).

In Kenya, where this study is centred, the forest restoration index remains below 15%, far from the national target. The nation's forest cover, presently at 7.4%, must rise to at least 10% to align with conservation objectives (Irungu, 2019). The degradation of forested areas is attributed to charcoal and firewood consumption, encroachment by human settlements, and land conversion for agriculture (Apollo & Mbah, 2021; Shukla et al.,

2018). The consequences are evident in the depletion of forested lands, rendering them vulnerable to environmental deterioration (Oyugi, 2018).

The Eastern Mau Forest Complex, encompassing 400,000 hectares, represents the largest closed-canopy forest in East Africa (Tarus & Nadir, 2020). The Mau Forest is a critical water tower in Kenya, playing a pivotal role in the regulation of water resources for both local and regional ecosystems, including Lake Victoria and the River Nile trans boundary basins. These waters, vital for continental freshwater sources, sustain aquatic-dependent livelihoods and support diverse ecosystems. The health of these water resources is inextricably linked to the well-being of aquatic life and livelihoods. The Mau Forest acts as a natural filtration system, regulating groundwater, controlling climate, and preventing soil degradation (Zhou et al., 2020).

However, the Mau Forest is imperilled by human encroachment, prompting concerns over its status as a critical water tower (Kogo et al., 2020; Mwaura, 2019). Calls to relocate surrounding communities due to ongoing destruction have met resistance, as these communities lack accessible land for compensation (Mwaura, 2019). Studies like that by Melnykovich *et al.* (2018) explore the connections between good governance and resilience at national, regional, communal, and individual and family levels. These investigations underscore the potential for governments and social organizations to enhance the resilience of governance structures to withstand natural disasters and man-made pressures, particularly through an environmental security-centred approach that bolsters the effectiveness of governance systems at all levels.

In all these scenarios, environmental security, governance, and resilience remain intrinsically intertwined, serving as pillars of sustainability and the protection of environmental resources. The concept of environmental security has evolved from a national to a global imperative (Wu *et al.*, 2020). Moreover, sustainability has become a paramount *objective* for contemporary societies, as evident in the United Nations Sustainable Development Goals (SDGs) (Sperling & Webber, 2019). While studies such as those by Schinagl and Shahim (2020), Broo *et al.* (2021), and Sperling and Webber (2019) emphasize how environmental security in Kenya can promote forest livelihoods,

they often overlook the critical nexus between environmental security, governance, and community resilience—a glaring gap in the context of climate-induced conflicts and disasters.

In many regions, communities heavily rely on forests for their sustenance, emphasizing that conservation and effective forest management can enhance their resilience. This study explores the role of environmental security and governance in fostering resilience within Eastern Mau forest communities. Furthermore, it delves into the socioeconomic factors contributing to environmental degradation in this area. The research also investigates how Eastern Mau forest communities can effectively implement environmental objectives and engage in sustainable co-management of natural resources.

Kenya is grappling with the challenge of forest degradation, with a forest restoration index of less than 15%. The national forest cover stands at a mere 7.4%, well below the target of 10% (Irungu, 2019). This decline is attributed to charcoal and firewood consumption, encroachments by human settlements, and the conversion of forested lands into agricultural areas (Apollo & Mbah, 2021; Shukla et al., 2021). This land-use transformation has led to the depletion of thousands of acres of forest, exacerbating land deterioration while impacting on communities' resilience within the Mau's forest (Oyugi, 2018).

Therefore, the Eastern Mau Forest Complex's unique ecological significance and its socioeconomic challenges have made it an ideal focal point for this study. The study investigated the intricate web of environmental security, governance, and resilience, and uncovered valuable insights that transcend the boundaries of this specific region. By examining how these concepts intersect and influence each other within the context of Eastern Mau, the study aimed at contributing to the broader discourse on sustainable environmental practices, resource management, and community well-being.

1.2 Problem Statement

Multiple interpretations and debates surround the concept of environmental security (Barnett, 2018; Ide *et al.*, 2021). This results from the convergence of two potent but

nebulous ideas—environment and security—and the wide variety of academic disciplines and theoretical orientations that contribute to their research. An individual's or community's perspective on environmental security can be gleaned from their grasp of the individual components. Regardless of the fact that environmental security is becoming more recognized as a crucial governance tool for creating resilience with the goal of improving community livelihoods, significant challenges remain in integrating the potentially complementary concepts of environmental governance, and resilience building (Dwyer *et al.*, 2020). In Kenya, the recent forest management initiatives, include the Forest Conservation and Management Act 2016, the Constitution of Kenya 2010, the Inter-governmental Relations Act, 2012, and the Land Act, 2012, as well as REDD+, and the Climate change Act 2016, all of which emphasize the unique role that forestry plays in both the mitigation and adaptation of environmental issues; also, they all point to the need for broader community engagement, incorporation of good governance practices, and strengthening fairness and poverty reduction as the key critical factors.

Despite these rules being in place, there is still considerable disagreement regarding how to manage The Kenyan forest resources, with numerous stakeholders citing inconsistencies in management frameworks and policies (Chisika & Yeom, 2021). For instance, rather than taking a sustainable holistic and inclusive strategy, certain legislation may exclusively address a specific area of environmental security and resilience. When compared to a well-placed policy inclusion, this is seen as incidental, which eliminates national planning and its incorporation into governance and resilience building. For the sake of this study, the Mau Complex is a key example where environmental security issues have made it impossible to preserve and protect it (Chaudhry, 2015). According to Schilling et al. (2018), the Mau Forest Complex (MFC) in Kenya suffers from a number of potentially disruptive societal impacts resultant from inadequate governance strategies. A study by Mahmud (2010), points to population imbalance, environmental insecurity, poorer agricultural output, economic stagnation, and immigration as some of the factors impacting on the Mau Complex. This accrued societal disruptive impact proliferated to environmental security issues in the Mau Complex ecosystem.

Human security has been the subject of growing academic attention as both a concept and a discourse, and this has opened up several avenues for inquiry into the ways in which environmental degradation affects social safety nets. Because of this void, researchers now have a lot of room to explore these interconnections. Very little focused research attention has been given to this key question especially in the Mau Complex. Even though there has been a lot of talk about how climate change and violence going hand in glove (Etale & Simatele, 2021), and how protecting biodiversity can lead to conflict resolution, there is little knowledge about the dangers to social instability within the Mau region as a result of the depleting water supply, for example, as reported by Abbasi *et al.* (2021). This study therefore looked into why environmental security and forest governance is an imperative for building resilience and improving forest governance amongst communities of the Eastern Mau Forest in Nakuru County.

1.3 Structure of the Thesis

The thesis unfolds across five distinct chapters. Chapter 1 lays the groundwork, offering insights into the study's background, objectives, problem statement, research questions, hypotheses, theoretical foundation, conceptual framework, and defining operational terms. Chapter 2 delves into a comprehensive literature review, aligning with the study's objectives. It explores the facets of environmental governance, security, and the interplay of governance and resilience within forest communities. The chapter further dissects the socio-ecological determinants impacting environmental security in forests and assesses the robustness of policy and legislative frameworks in buttressing environmental security in the Eastern Mau Forest. It rounds off by highlighting the pivotal roles stakeholders play in fortifying resilience and shaping environmental security dynamics in forested regions. Chapter 3 elucidates the research methodology, outlining the study area, design, sample size, sampling technique, and data analysis methods. Chapter 4 presents the study's findings in alignment with the set objectives. Conclusively, Chapter 5 synthesizes the primary findings, drawing conclusions and charting out recommendations.

1.4 Research Questions

The study was guided by the following research questions:

1. What are the general characteristics of the Mau Complex?
2. How do the current environmental security approaches impact the resilience of the Eastern Mau forest community?
3. Why do the existing household socio-economic factors threaten environmental security and governance in the Eastern Mau forest?
4. How effective is the stakeholders' role in shaping environmental security and governance processes toward resilience building in the Eastern Mau Forest?
5. Why are the existing policies and legislative frameworks underpinning environmental security and forest resource governance inadequate?

1.5 Study Objectives

1.5.1 General Objective

To assess existing environmental security and forest governance systems and their impacts on resilience building in the Eastern Mau Forest.

1.5.2 Specific Objectives

1. To examine the general, socio-economic and demographic characteristics of the Eastern Mau complex.
2. To assess the impact of environmental security approaches on resilience building for the Eastern Mau forest community.
3. To evaluate the threat of household socio-economic factors on environmental security and governance in the Eastern Mau forest.
4. To establish the effectiveness of the stakeholders' role in shaping environmental security and the governance framework toward resilience building.
5. To assess the adequacy of the existing policies and legislative frameworks in environmental security and forest resource governance.

1.6 Research Hypotheses

H₀₁: General characteristics of Eastern Mau Forest have no significant effect on environmental security, governance and resilience building.

H₀₂: There is no statistically significant relationship between environmental security approaches and the resilience of the Eastern Mau forest community.

H₀₃: There is no statistically significant relationship existing between household socio-economic factors and environmental security and governance in Eastern Mau Forest.

H₀₄: There is no statistically significant relationship between stakeholders' role in resilience building and environmental security and governance processes in the Eastern Mau forest.

H₀₅: There is no statistically significant relationship between effective policy and legislative framework in environmental security, governance, and resilience building in Eastern Mau Forest.

1.7 Theoretical Framework

1.7.1 Theory of Natural Resource Management

The theory of natural resource management served as a pivotal framework in this investigation (Cox et al., 2016). Environmental management poses significant challenges in many nations, particularly for communities residing in close proximity to natural resources with limited responsibilities. Nevertheless, recent shifts in perspectives have shed light on the pivotal roles that local communities play in creating, utilizing, and governing the assets within their immediate environments (van Noordwijk, 2019). Sukevis *et al.* (2018) defines stakeholder natural resource management as the engagement of all environmental stakeholders in safeguarding their immediate environmental surroundings to achieve local and global social and ecological objectives. This perspective is endorsed in theory and practice by numerous organizations (Sukevis et al., 2018).

The theory centres on understanding how various species, including humans, interact with their surroundings, precipitating a paradigm shift in ecology that holds implications for all of us (Child, 2019). It underscores the acknowledgment that people are an integral component of the environment, and their active involvement in the natural resource management process is a vital and commendable endeavour. Additionally, it underscores the notion that a systemic approach is best suited for ecosystem governance (Kalaitzi *et al.*, 2018). In practical terms, this shift promotes greater inclusivity in the administration of natural resources, as opposed to previous years when these diverse stakeholder groups were often disregarded.

Critics of this theory have highlighted the pervasiveness of poverty, attributed to a combination of factors such as rapid population growth, resource depletion, unequal resource access, and environmental degradation, among others. These elements have also been linked to economic disparities, which can foment resentment and escalate the likelihood of social conflict and upheaval in many developing nations (Yeboah-Assiamah, 2018). Instances of such conflicts have been documented in various developing countries rich in extractive industries, such as Congo and Sudan (Olajide *et al.*, 2019). These nations have experienced internal conflicts that have resulted in substantial environmental degradation.

This theory holds significant relevance for the study as it elucidates the role of environmental security within the context of natural resource governance involving a diverse spectrum of stakeholders. This is particularly pertinent because forests are universally recognized as valuable yet endangered natural resources (Mbaiwa *et al.*, 2019). They provide a wide array of ecosystem goods and services for both human and animal consumption and serve as sanctuaries for a diverse range of flora and fauna. The situation is further complicated in the Eastern Mau Forest due to the ambiguous leadership structure, stemming from the lack of formal documentation establishing ownership by indigenous communities (Manzano & Gutiérrez, 2019), which adds to the complexity of the issue.

Humanitarian organizations, including the United Nations, transnational non-governmental organizations like the World Wildlife Fund, and national governments, have taken a proactive role in advocating for stakeholder natural resource management in developing countries (Ahmadi *et al.*, 2019). The theory also accounts for community groups that have embraced stakeholder forest management independently of external oversight. Often, this is in response to shifts in governance, such as government land restrictions or the recognition by key stakeholders of declining resource quality.

The Theory of Natural Resource Management underscores the intricate web of relationships between environmental security, governance, and community resilience within the context of natural resource management, shedding light on the challenges and opportunities in ensuring sustainable environmental practices and improved livelihoods (Manzano & Gutiérrez, 2019).

1.7.2 A People-Centred Development Theory

According to this theory, individuals within a society enhance both their formal and personal capabilities to efficiently manage and allocate resources, fostering comprehensive and sustainable improvements at the subsistence level. Central to this concept is the idea that engagement, perceived as a multifaceted endeavour, plays a crucial role in influencing individuals with the potential for broader impact and catalysing transformative social change and empowerment (Kanter, 2019). Sustained engagement of these individuals is fundamental within this framework. The primary objective of the People-Centred Development Theory is to nurture a sense of self-reliance within a community to the extent that it becomes proficient in managing its own resources and actively participating in the formulation of policies that ensure the preservation of those resources.

Within the realm of environmental sustainability, the theory advocates for small-scale community projects in natural settings to enhance economic self-sufficiency and provide dependable income (Muthukrishna & Henrich, 2019). It also empowers communities to make choices and set their own developmental objectives, ultimately determining the quality of life for themselves and future generations. The theory further posits that

engaging in environmentally sustainable practices within the natural environment, where these resources are derived, is far more motivating for individuals in these locations. According to this argument, this setup discourages self-serving profiteering by individuals at the expense of those who benefit from the same resources.

In the context of the research, this theory has been instrumental in examining the crucial role of natural resources, encompassing human resources, water availability, and arable land, in the realm of agricultural production, as exemplified by a pilot study conducted in the Mau Complex in 2010 (Howard & Hoffman, 2018). This underscored the need for the residents of Mau to be motivated and empowered in terms of overcoming socio-cultural barriers, acquiring the necessary tools for tasks, and establishing awareness and governance structures that would facilitate agricultural expansion. The strategy ensures that with appropriate governance mechanisms in place, local populations can more actively engage in development initiatives. Consequently, these communities acquire the attributes of responsibility, cooperation, innovation, empowerment, and self-assuredness (Wang *et al.*, 2019). They hold the authority to make decisions on matters that directly affect them, and these decisions often exert a significant influence on the trajectory of social and economic progress. The theory's premise is further substantiated by the aforementioned pilot study of the Mau Complex in 2010, which highlighted the region's rich resource endowment capable of propelling agricultural development and empowering communities to evolve into potent, self-assured, innovative, responsible, and cooperative entities (Wolin, 2018).

Critics of the People-Centred Development Theory argue that its exclusive focus on the community may overlook other factors that could profoundly impact the environment and overall well-being. The theory places a strong emphasis on individuals taking on the role of ensuring collective environmental security and participating in governance activities for the betterment of community resilience and well-being. While this approach promises to enhance freedoms, thereby facilitating resource access, self-sufficiency, and community development, it may overlook potential adverse consequences such as economic and social homogeneity as the society gravitates towards ethnic identity and

cultural practices. This predisposes the community to greater vulnerability in the event of environmental disturbances (Howard & Hoffman, 2018).

The People-Centred Development Theory provides essential insights in the context of natural resource management. It underscores the significance of empowering communities to take charge of their resources and engage in governance activities for enhanced sustainability and improved livelihoods.

1.7.3 Nature Theory

In essence, the Nature Theory posits that anything is possible and can persist in its existing state. Environmental degradation and conflict are pervasive concepts in society, often exacerbated by economic and political instability. Within this framework, it is implied that human beings possess an inherent inclination towards abusive behaviour that threatens the natural environment, with the economically advantaged exercising authority over the less fortunate in society (Csevár, 2021). To delve deeper into this perspective, Csevár (2021) contends that, given the inevitability of violence, people will strive to transcend it. This perspective is rooted in the idea that, as an outcome of evolution, individuals possess the capacity to seek out safe havens to fulfil their basic needs and, upon achieving this, progress to the next stage of development, irrespective of whether legitimate or violent means are employed.

Proponents of this theory assert that Nature serves as a predictive factor for human actions and outcomes. It underscores that the occurrence of significant events hinges on a variety of other factors, notably unilateral decision-making and repressive governance, among others. However, this theory faces criticism from scholars such as Swyngedouw (2018), who contend that humans are not inherently predisposed to violence. Instead, hostilities are attributed to factors like deprivation and resource scarcity, which are further exacerbated by on-the-ground environmental conditions (Swyngedouw, 2018). Even in the presence of international diplomatic norms, such as negotiations and agreements aimed at determining the relocation of people, the application of coercion, for instance, forcibly evicting inhabitants from encroached forest areas, may incite conflict as a response to the use of oppressive tactics.

The Nature Theory contributes to the study by highlighting the complex relationship between human behaviour, environmental degradation, and governance mechanisms in the context of building resilience. It acknowledges the underlying tension between human actions, violent or otherwise, and their consequences, emphasizing the importance of understanding these dynamics within the framework of environmental security and governance. This theory provides an essential perspective for comprehending the potential interplay between human inclinations, repressive governance, and environmental factors in shaping the resilience and security of communities (Kanter, 2019).

1.7.4 Resource Curse Theory

Also referred to as the paradox of resources, the Resource Curse Theory highlights a phenomenon where certain regions endowed with abundant natural resources, such as forests, grasslands, farmland, and water, tend to lag behind in terms of financial prosperity and economic development compared to areas with less access to such resources. This theory posits that the abundance of natural resources can inadvertently contribute to societal decline due to issues like poor resource management, widespread poverty, burgeoning populations, and hindered industrialization. An inherent part of this theory is the recognition that an abundance of natural resources can lead to income disparities, structural violence, and general conflict, all stemming from inadequate resource governance. While this hypothesis may not universally apply, it has manifested as a reality in many nations and communities, including Kenya (Manzano & Gutiérrez, 2019).

The Resource Curse Theory was initially proposed by Richard Auty in 1993, with a focus on contrasting the attitudes of communities rich in water resources with those less fortunate in this regard. Over time, the theory gained widespread recognition and was incorporated into academic curricula globally (Wang *et al.*, 2019).

This theory was first critiqued by Fraizer and Kirbyshire in their 2008 research. They argued that the so-called "curse" disappears when considering it from a different perspective, specifically the extractive potential of resources as opposed to the

proportional significance of resource exports in the economy. Their findings revealed that resource richness on the ground correlated with relatively faster economic development and reduced conflicts when nations were compared using this variable (Fraser & Kirbyshire, 2017). The critical aspect is not the high level of resource exports in itself, but the high dependence on resource exports combined with detrimental policies and practices. Ineffective policies that lead to heavy reliance on natural resource exports, coupled with unequal wealth distribution, result in skewed economic growth, income disparities, and ensuing political unrest. Consequently, the economy witnesses capital flight as investors seek regions with more favourable policies and resource governance regimes. However, for extractive industries like petroleum and valuable minerals, the country's wealth persists, and resource extraction remains the dominant economic sector, even as other businesses may suffer (Fraser & Kirbyshire, 2017).

Numerous studies have highlighted a clear correlation between the duration of resource extraction, wealth, population growth, sectarian violence, and limited international economic integration and development. The Resource Curse Theory served as a framework to elucidate the dissatisfaction arising from the interaction between access to forest resources, population growth, and economic expansion, exemplified in construction, rural electrification through the use of posts from the Mau Complex, and the depletion of river basins that provide water for pastoralism and fishing, among other factors. Since the early 2000s, the decline in precipitation has been attributed to environmental degradation, notably deforestation and timber harvesting. These factors pose risks to the well-being of citizens and the allocation of government funds to programs aimed at mitigating the effects of environmental degradation in regions where resource access is seen as a misfortune (Owusu, 2018). Thus, the Resource Curse Theory informed this research, shedding light on why, despite the abundance of forest resources in the Eastern Mau Forest, local forest communities still struggle with environmental security and resilience.

1.7.5 Multi-Level Governance Theory

Multi-Level Governance (MLG) theory emerges as a pivotal framework in contemporary scholarship, facilitating nuanced exploration of the complex interactions between varying

levels of government and the broader implications for policy-making. Originating in European studies, MLG has since expanded its reach, offering insights across diverse political landscapes and policy domains (Piattoni, 2010). One defining characteristic of Multi-Level Governance theory is its focus on the dispersion of authority both vertically across different levels of government and horizontally among diverse actors (Marks & Hooghe, 2013). This decentralization of authority challenges the traditional hierarchical structures, fostering collaborative interactions between international, national, regional, and local entities.

The theory further contends that the role of non-state actors is integral in contemporary governance. Organizations, civil society groups, and private entities actively participate alongside traditional state actors, collectively shaping policy outcomes (Bache & Flinders, 2011). This increased plurality in governance actors underscores the need to reconsider conventional state-centric models and acknowledge the multifaceted nature of modern governance. The application of MLG in various studies illustrates its versatility and relevance. For instance, Schmitter (2013) explored how MLG facilitates understanding the nuanced dynamics in European Union policymaking. The research emphasized the proliferation of decision-making centers and the growing interdependence between different governance levels.

Similarly, the theory has found application in environmental policy research, where the necessity for coordinated efforts across multiple levels is particularly pronounced. Jordan et al. (2018) highlighted how MLG accommodates the diverse array of actors and scales involved in addressing complex environmental challenges, thereby fostering more comprehensive and adaptive policy solutions.

The applicability of Multi-Level Governance (MLG) theory in the research study is pivotal. The forest conservation initiatives, diverse stakeholder involvement, and livelihood implications manifest the various layers of governance and interaction that are characteristic of MLG. The Eastern Mau Forest exemplifies the interaction between different levels of governance. From local community forest associations (CFAs) to regional forestry services and national environmental agencies, each level plays a distinct role. The MLG theory helps in mapping out these varied interactions and authorities,

offering a nuanced understanding of how decisions at one level influence outcomes at another (Marks & Hooghe, 2013).

The participation of non-state actors such as CFAs, NGOs, and local communities is central to the governance of Eastern Mau Forest. MLG theory provides a framework for analysing how these actors contribute to environmental security and resilience building alongside government bodies (Bache & Flinders, 2011). This plurality of actors highlights the dynamic nature of forest governance and the importance of inclusive approaches.

Moreover, the implementation of conservation policies and innovative forest management practices in Eastern Mau Forest necessitates cooperation across multiple governance levels. MLG clarifies how policies are adapted and implemented across different levels and how local contexts influence these processes (Piattoni, 2010). It sheds light on the adaptability and responsiveness of governance structures in addressing the unique environmental challenges of the region.

Additionally, building resilience and enhancing livelihoods within local communities are integral aspects of environmental security in Eastern Mau Forest. MLG theory underscores the interplay between community engagement, economic incentives, and conservation efforts. It offers insights into how multi-level governance structures can foster community resilience and ensure the sustainable use of forest resources (Jordan *et al.*, 2018).

Furthermore, MLG theory is instrumental in exploring the interconnected decision-making that characterizes environmental governance in Eastern Mau Forest. It enables researchers to understand how decisions made at the international or national level impact local conservation efforts and vice versa, thereby providing a comprehensive view of the governance landscape (Schmitter, 2013).

Consequently, Multi-Level Governance theory serves as a crucial lens through which the intricacies of contemporary governance can be explored. By acknowledging the dispersion of authority and the vital role of diverse actors, MLG offers valuable insights for researchers examining the complexities of policy-making in a globalized world. As such, it is deeply relevant in examining the intricate web of interactions and governance

structures in Eastern Mau Forest. It offers a theoretical lens through which the complexities of environmental security, stakeholder involvement, and resilience building can be thoroughly explored and understood.

The theoretical framework of the study meticulously weaves together five seminal theories that holistically encompass the multifaceted dimensions of the research. The **Theory of Natural Resource Management** offers a foundational perspective on how resources, particularly within the Mau forest, should be prudently managed to ensure both environmental and socio-economic sustainability. The **People-Centred Development Theory** underscores the primacy of community engagement and empowerment, highlighting that sustainable solutions emerge when the community's well-being is prioritized.

The **Nature Theory** reminds us of the inherent interconnectedness of all life and asserts the need to respect and preserve the natural systems we are inextricably part of. The **Resource Curse Theory** serves as a cautionary note, pointing out the potential pitfalls of mismanaged wealth, especially in regions abundant in natural resources. This is particularly poignant for the Mau Forest, with its vast biodiversity and resource pool. Lastly, the **Multi-level Governance Theory** emphasizes the layers of stakeholder ship and the collaborative interplay necessary for efficient and sustainable resource governance.

Collectively, these theories converge to underscore the imperatives of a sustainable approach, which is resonantly echoed in the study's conceptual framework. The independent variables - Environmental security, Resource Governance, and the unique characteristics of the Eastern Mau Forest - drive the study's main thematic thrusts. These are modulated by intervening variables, such as the crafting of apt policies, bolstering of education and awareness, and ensuring robust funding mechanisms. Ultimately, these myriad elements influence the dependent variable, which is the building of resilience. This resilience is intricately manifested through various capitals - financial, human, social, and physical - underscoring the multidimensionality and interdependence of factors in the quest for sustainable forest management. In essence, the selected theories

not only provide a robust scaffold for the study but also synergistically enhance the depth and breadth of the conceptual framework.

1.8 Conceptual Framework

Perceptions of environmental security, governance, and resilience are crucial in determining how people react to negative human or natural environmental consequences. The schematic representation in Fig. 1.1 shows the independent and dependent variable models drawn from the study. Environmental security, with determinant sub-variables (environmental stress, economic stress, and demographic stress); environmental governance, the second independent variable operationalized as geographic location, innovation and capital, services and infrastructure, and policy coherence, are identified as the independent variables. The third independent variable in the conceptual framework matrix is stakeholders. The way the above variables interact through the intervening variables like appropriate policies, community awareness and funding from stakeholders can increase or undermine resilience building in terms of financial, human, social, physical and natural capitals.

Resilience serves as the dependent variable operationalized with sub-variables, financial, human, social, and natural capitals. The linkages between independent variables and the dependent variables as well as the extent of these effects are determined by the intervening variables: appropriate policies, community awareness, and funding. In totality, this operationalized and conceptualized model (Fig. 1.1), constituted this study.

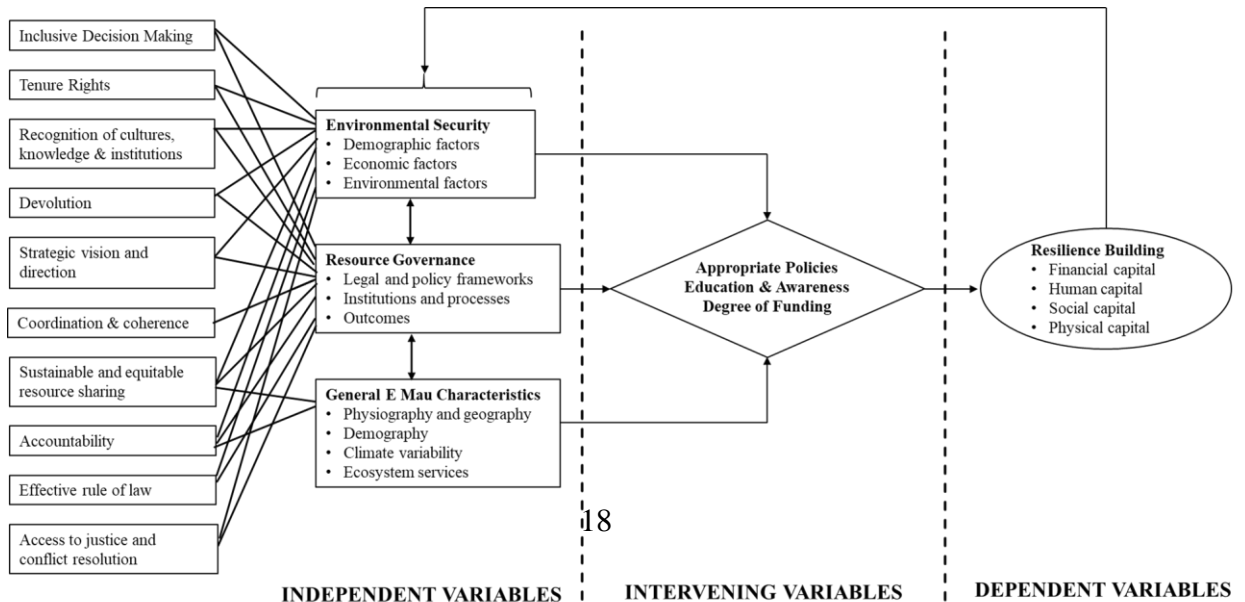


Figure 1.1. Towards Community Resilience: A Framework for Environmental Security and Sustainable Governance in the Eastern Mau Forest

Source: Researcher (2021)

1.9 Operational Definition of Key Terms

- a. ***Environmental Security*** - The concept of environmental security refers to the capacity of a population to safeguard itself from environmental threats, whether arising from natural or human-induced processes. It involves protecting the environment as well as the well-being and security of communities affected by environmental challenges (Trofymchuk *et al.*, 2020).
- b. ***Environmental Governance*** - Environmental governance encompasses the principles, policies, and practices that guide the management and stewardship of natural resources and the environment. It involves decision-making, regulatory frameworks, and institutional arrangements to ensure sustainable environmental management (Warrington & Milne, 2018).
- c. ***Resilience Building*** - Resilience building involves strategies and measures aimed at enhancing the capacity of individuals and communities to adapt to, recover from, and thrive in the face of various environmental, social, and economic challenges or shocks (Intema *et al.*, 2019).
- d. ***Stakeholder Engagement*** - Stakeholder engagement involves the active participation and inclusion of individuals, groups, organizations, and communities with an interest or influence in a particular issue or project. It aims to gather diverse perspectives and build consensus.
- e. ***Policy and Legislative Frameworks*** - Policy and legislative frameworks refer to the legal and regulatory structures, rules, and guidelines that govern specific areas, such as environmental protection, land use, and resource management.
- f. ***Social-Economic Factors*** - Social-economic factors encompass the social and economic characteristics and conditions of individuals and communities, including

- income, education, employment, and access to resources. These factors can impact environmental security and governance.
- g. ***Human Security*** - Human security relates to the protection and well-being of individuals and communities. It encompasses freedom from violence, access to basic needs, and the ability to cope with various threats and challenges.
 - h. ***Ethnographic Approaches*** - Also known as ethnography, are qualitative research methods used to study and understand the social and cultural practices, behaviours, and perspectives of specific groups or communities.

These definitions provide clarity and context for the key terms used in the study, ensuring that readers have a common understanding of the terminology employed throughout the research.

1.10 Scope of the Study

The primary aim of the research was to scrutinize environmental security and governance in resilience building in eastern Mau forest communities, Nakuru County, Kenya. In this sense, the researcher assessed the relationship between environmental security approaches and the resilience of the Eastern Mau forest community. The Eastern Mau Forest within the administrative boundaries of Nakuru County Kenya, served as the geographical scope of the enquiry from where data for the study was gathered (see Fig 3.2). Threats to resilience building like poverty, education and health levels among forest communities were investigated. The study also investigated how the forest communities recovered from environmental stressors, ability to get capital, governmental agencies assistance and civil societies' role in resilience building. As the Mau Forest has been recognized as a hub for academic study, this provided a convenient entry point on the subject of this study. The Eastern Mau area was chosen as the report's dual foci of attention for the aforementioned reasons, as well as for immediate considerations relating to effective reach.

1.11 Significance of the Study

Increasing involvement in socioeconomic growth throughout the seven blocks that make up Mau complex may be accomplished by removing obstacles that prevent participants

from gaining access to valuable resources. This research focused on the responsibilities of stakeholders, such as government agencies such as the Kenya Forest service, the Mau Forest Management Program, and other interested parties engaged in managing the Mau forests. It also contributes to the development of initiatives to assist the indigenous populations. As a consequence of the study's broad compilation of information on environmental security, governance, and resilience building, stakeholders, including governance agencies, are encouraged to focus on resolving environmental security challenges as part of the governance processes and initiatives for resource-dependent rural areas.

This work contributes in elucidating some of the primary drivers of vulnerability, ineffective governance approaches and the prevalent degradation of the Mau Forest Complex. It sheds light on the reasons behind inefficient resilience-building and describes how this affects community livelihoods and natural resource management. As a result, it suggests effective countermeasures for enhanced environmental security and governance for improved resilience outcomes. The study provides current and context-specific perspectives on some facets of environmental governance in a forest resource bionetwork for the benefit of the academic community. It provides clear conclusions and recommendations that are useful to academicians, legislators, and public authorities.

1.12 Limitations of Study

While this research was conducted diligently, several limitations were encountered that merit acknowledgment. These limitations offer valuable insights into the boundaries of the study and the potential areas for improvement in future research. Below, is an outline of the primary limitations encountered during this investigation and how they were managed.

Data Collection Constraints - One notable challenge was the collection of comprehensive data on historical events and practices related to environmental security and forest governance in the Eastern Mau Forest. The lack of well-documented records made it difficult to establish precise historical trends. This limitation was managed by relying on available secondary sources, local informants, and oral histories. Despite these

challenges, the researcher made efforts to cross-verify information through multiple sources.

Sampling Bias - The study employed purposive sampling for selecting specific administrative units and households within the Eastern Mau Forest. While this method facilitated access to knowledgeable informants, it may have introduced sampling bias (Brown, L. 2017). The researcher tried to mitigate this bias by ensuring that a diverse set of administrative units and households were included. However, some degree of bias may still persist.

Resource Limitations - Resource constraints, such as time and financial limitations, influenced the scope of the study. A broader, more extensive investigation could have provided a more in-depth understanding of the complexities within the Eastern Mau Forest (Rodriguez, P., & Lee, A. 2019). To overcome these constraints, the study focused on key variables and ensured that the research objectives were met to the best extent possible given the available resources.

Community Perceptions and Beliefs - Understanding the intricacies of local beliefs, cultural practices, and community perspectives proved challenging. These aspects are critical in comprehending the dynamics of environmental security and forest governance. While the researcher engaged with local communities and conducted interviews, there may still be aspects of local beliefs that were not fully captured. Efforts were made to employ ethnographic approaches to bridge this gap, but certain cultural nuances may remain unexplored.

Data Quality - The study depended on the accuracy and reliability of data collected from various sources. In some instances, data quality may have been compromised due to recall biases or misinterpretation of questions. The researcher addressed this limitation by conducting rigorous data validation procedures, cross-referencing responses, and triangulating information from multiple sources whenever possible (Ochieng, W. 2018).

Environmental Variability - The Eastern Mau Forest is a dynamic ecosystem subject to various environmental changes. Variability in climate, land use, and resource availability can influence the resilience-building processes of local communities (Kapoor, S. 2016).

While this variability is a part of the ecosystem, it made it challenging to establish definitive cause-and-effect relationships. The research considered this variability, emphasizing the need for adaptive and flexible strategies in the face of environmental changes.

External Factors - External factors, such as national policies and international agreements, can significantly impact local environmental security and forest governance (Garcia, M., & Alvarez, R. 2022). These factors were challenging to control in the research design. The research addressed this limitation by considering external influences in the study's analytical framework and discussing their implications on the findings.

Despite these limitations, the study's findings provide valuable insights into the intricate relationship between environmental security, forest governance, and community resilience in the Eastern Mau Forest. Future research endeavours in this area should consider these limitations and aim for more comprehensive data collection, further community engagement, and a broader investigation into the regional and global influences on local resilience-building efforts.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

This chapter embarks on a comprehensive review of existing literature, with a keen focus on aligning the discussion with the study's five primary objectives. Each section is designed to provide a structured approach to understanding the multifaceted dimensions of environmental governance, environmental security, socio-ecological factors, and the efficacy of policy and legislative frameworks in the context of resilience-building in Eastern Mau Forest. Section 2.2 delves into the intricacies of environmental governance, shedding light on the essential principles, processes, and practices that govern the management and administration of natural resources within specific regions. The objective is to establish a foundational understanding of how environmental governance operates both theoretically and in practical terms. In Section 2.3, the discourse transitions to the domain of environmental security. Here, the literature review examines the various facets of environmental security, emphasizing the critical role it plays in safeguarding ecosystems, promoting community resilience, and mitigating the impacts of environmental shocks and stressors. The objective is to underline the significance of environmental security as a fundamental component of resilience-building strategies.

Section 2.4 embarks on analyzing past research literature to identify gaps in the application of environmental security and governance within the Eastern Mau Forest context. By scrutinizing these gaps, the objective is to highlight the existing challenges and limitations that necessitate a more integrated and holistic approach to environmental management. As study proceeds to Section 2.5, the review takes an in-depth look into the socio-ecological factors and their influence on environmental security and governance within forest ecosystems. This aims to underscore the intricate interplay between human activities, societal dynamics, and environmental sustainability, emphasizing the need for context-specific solutions. Finally, in Section 2.6, the focus shifts towards assessing the efficacy of policy and legislative frameworks that underpin environmental security, governance, and resilience within forest environments. By critically evaluating these frameworks, the objective is to discern their strengths, weaknesses, and areas of

improvement, ultimately contributing to the development of more effective policies and strategies.

Through this meticulously organized literature review, the section aligns with the research objectives, providing a robust foundation for comprehending the intricate relationship between environmental governance, security, socio-ecological dynamics, and policy efficacy in the context of Eastern Mau Forest's resilience-building efforts.

2.2 The Concept of Environmental Governance

Environmental governance, as explained by the World Commission on Environment and Development (WCED) (2019), encompasses a multitude of dimensions. It encapsulates the decision-making processes, the mechanisms by which choices are executed, the requisite technical expertise essential for decision formulation, and the avenues through which communities and key stakeholders participate in these pivotal decision-making processes (Marco, 2017). To this end, the significance of expanding the conventional notion of security, typically characterized by political and military threats to national sovereignty, is underscored by the landmark Brundtland report (Agbedahin, 2019) initiated by the WCED. This report galvanized a paradigm shift, acknowledging that environmental constraints constitute an integral facet of human security (Elliot, 2006). Consequently, this expanded perspective on security necessitates a comprehensive exploration of environmental governance principles and practices.

Upon further investigation, it became apparent that the prevailing literature often lacked comprehensive assessments of the repercussions of environmental governance on community resilience, particularly within the context of forest ecosystems. While many studies acknowledge the importance of governance mechanisms, they often fall short of investigating their tangible impacts on the resilience of forest-dwelling communities. Also, while this perspective broadens our understanding of security, the literature falls short in providing comprehensive insights into how this expanded view of security translates into practical governance approaches (Agbedahin, 2019).

In 2015, by trying to resolve this gap, the United Nations initiated pivotal changes in governance structures with a focus on three primary processes: peacekeeping operations,

the UN's peace and reconciliation architecture, and adherence to UNSCR 1325 on peace and security, with an emphasis on women's involvement (Tsalis et al., 2020). These initiatives prompted governments and non-governmental organizations, both national and international, to adapt and evolve their governance approaches. This adaptation highlighted the intricate interdependencies across the realms of security, governance, and resilience. As noted by Karin (2016), this shift engendered a heightened awareness of the interconnectedness, correlations, and cascading effects of environmental protection and democratic accountability on resilience-building actions.

Crucially, the governance procedures associated with various land occupations wield significant influence over resource allocation and dispute resolution within specific regions. Governments play a pivotal role in shaping decisions concerning livelihoods, environmental interaction, and the management of natural resources (Karin, 2016). Consequently, it becomes apparent that governance, in its various forms, significantly impacts the decision-making processes surrounding resource utilization and environmental management. Therefore, it is clear, from the foregoing, that Government decisions profoundly influence people's interactions with their environment and determine resource management practices. While this insight is valuable, the literature offers limited exploration of the specific governance mechanisms that foster or hinder community resilience within forest environments (Morrison et al., 2019).

Further afield, Gustafsson and Lidskog (2018) offer a nuanced definition of environmental governance as "norms and rules that regulate decisions and behaviour structuring relationships among and between organizations." These organizations encompass administrative bodies, civil society groups, and financial institutions, all of which respond to the dynamic shifts in environmental conditions. The process of managing shared resources necessitates an intricate understanding of the interplay between governments, stakeholders, and resource users, which can encompass individuals, private sector entities, livelihood groups, and communities (Morrison et al., 2019). As such, it can be deduced, that different governance approaches assign varying degrees of significance to these relationships. However, a major weakness in the literature is that it does not sufficiently address how these norms and rules impact community resilience, especially in the context of shared resource management within

forests. Subsequently, the research looked into how our current governance systems are influenced by recent changes, and whether there are aspects that could be borrowed from the indigenous knowledge systems.

In this regard, looking at Africa, colonial institutions exerted profound and enduring influences on environmental governance across the continent. These institutions left an indelible mark, shaping governance practices that persist to this day. Scholars have meticulously examined these colonial legacies from observational, conceptual, ethical, and geographical vantage points (Kameri-Mbote & Curret, 1997), and uncovered how these institutions disrupted traditional resource management systems, which historically relied on locally negotiated access and control, in favour of centralized technocratic management. This transition has occasionally resulted in contentious interactions between the government, traditional authorities, and community groups due to misaligned objectives for resource management (Kameri-Mbote & Curret, 1997). While such collaborations have sometimes yielded positive outcomes, they have also been marred by imbalances favouring one group over another, leading to conflicts and hostilities.

The emphasis on colonial legacies and their enduring influence on environmental governance in Africa offers valuable insights. However, these studies often focus more on historical analysis rather than delving into contemporary challenges and opportunities within evolving governance frameworks. Additionally, while these studies recognize the conflict potential, they do not delve into potential solutions or alternative governance models that could enhance resilience. Consequently, there is a need for research that bridges the historical and contemporary dimensions of environmental governance in the region (Mahyuni & Syahrin, 2021).

Relatedly, the concept of co-management emerges as an intriguing approach within environmental governance, emphasizing collaboration, power-sharing, and stakeholder engagement (Mahyuni & Syahrin, 2021). While literature on this concept holds promise, there is a dearth of in-depth examinations of its practical application and efficacy, particularly in the context of forest ecosystems. In other words, the literature does not delve into the specific mechanisms through which co-management can foster resilience-building or its limitations within forest ecosystems. Therefore, exploring the dynamics of

co-management and its implications for resilience-building remains an underexplored avenue.

2.3 Environmental Security: Complex Definitions and Varied Perspectives

Environmental security, while of paramount importance, remains multifaceted and lacks a universally accepted definition, setting it apart from the more standardized concepts of governance and resilience (Busby, 2018). Environmental security's evolution can be traced to the intersection of profound considerations for physical security and mounting environmental apprehensions (Conversi, 2020). Therefore, it is essential to recognize the various perspectives on environmental security, each shedding light on different aspects of this multifaceted concept. The lack of a universally agreed-upon definition of environmental security is a significant limitation. The diverse interpretations and perspectives presented in the reviewed literature makes it challenging to establish a clear and cohesive framework for addressing environmental security issues. This conceptual ambiguity impedes effective policy development and implementation.

One perspective, often referred to as 'human-centred thinking,' views environmental changes and challenges as imminent threats to individuals and communities. For instance, Barnett (2018) defines environmental security as "the method by which environmental degradation undermines stability and security, with a specific emphasis on the unequal consequences of environmental deterioration on societal groups" (Sears, 2020). This viewpoint underscores the intricate connections between environmental degradation and societal well-being.

The 'state-centric' approach, on the other hand, delves into the correlation between environmental factors and national security. This perspective posits that environmental issues can pose severe threats to a nation's security, such as when climate change triggers violent conflicts or disrupts a country's peace and security mechanisms (Gerosideris, 2021). It even extends to situations where environmental challenges may compromise a nation's sovereignty, as exemplified by small island nations in the Pacific threatened by rising sea levels (Ide, 2020). This view aligns with the idea that environmental security concerns can impact a nation's internal and external stability. While these distinctions

offer valuable insights, adoption of the dichotomous view of environmental security in the literature, distinguishing between human-centred and state-centred approaches, may oversimplify the complex interplay between environmental challenges and security concerns. Environmental security issues often transcend these dichotomies, requiring a more nuanced understanding.

In contrast, the 'environment-centric' approach places the environment at the forefront, emphasizing hazards and dangers to the environment itself, with human consequences viewed as secondary (Bergsten et al., 2019). This perspective focuses on preserving the natural ecosystem as the vital support network for all sentient beings (Holley et al., 2018). It is closely associated with the discourse on environmental conservation and emphasizes the intrinsic value of safeguarding the environment (Bergsten et al., 2019). This approach is consistent with the broader trend of securitizing development and environmental governance globally.

While enhancing human security is often considered crucial in preventing armed conflicts and other threats (Field & Kelman, 2018), a more precise characterization of environmental security for this study is "the absence of danger or harm to the environment upon which a person or community relies and in which they reside" (Shokry et al., 2020). It is essential to note that environmentally centred security measures are often overshadowed in public and political discourse, receiving less attention from institutions focused on peace and resilience building. Among the various approaches, the state-centric perspective is the least favoured and has faced widespread criticism for reinforcing elite control, legitimizing exploitation in the developing world, portraying marginalized populations as threats, and promoting short-term thinking detrimental to resource governance.

One crucial aspect to consider is the profound impact of human populations on the environment, primarily through excessive resource consumption and inadequate resource management. Exponential population growth directly contributes to environmental stress, leading to biodiversity loss and heightened pressure on arable land (Dong et al., 2019). This unmitigated degradation, encompassing soil erosion and increased flooding, poses severe ecological challenges. Therefore, a scientific understanding of population

dynamics becomes pivotal in shaping sustainable development goals and environmental efforts, fostering a harmonious equilibrium between societal progress, economic development, and environmental sustainability, with an emphasis on sustainable consumption and production (Conversi, 2020). Additionally, the literature predominantly draws from experiences and perspectives in developed countries, potentially neglecting the unique challenges faced by developing nations. Environmental security issues can have disproportionate impacts on vulnerable populations in less-developed regions, necessitating a more inclusive and global perspective in the literature. Addressing this gap is essential for a comprehensive understanding of environmental security challenges in Eastern Mau forest.

In Sub-Saharan Africa, the rapid expansion of the population is a primary driver of agricultural land degradation, exacerbated by migration in response to land resource scarcity. The region's population growth, exceeding that of any other area globally, intensifies the demand for food, fiber, and other resources. Dong et al. (2019) demonstrated a significant link between population pressure, shorter fallow seasons, and soil nutrient depletion, indicating an unsustainable connection between shifting demographics, agricultural practices, and environmental conditions, resulting in a poverty trap (Hasnat et al., 2018). Other factors contributing to land-resource degradation in Sub-Saharan Africa include poverty, economic pressures, insecure land tenure, soil and water mismanagement, and suboptimal agricultural practices (Muchena et al., 2005).

This intricate interplay of environmental security and population dynamics prompts a critical examination of its implications, particularly in the context of the Eastern Mau forest region. Understanding the impact of environmental security in this region is essential for addressing the complex challenges it faces.

However, while the literature on population dynamics and its impact on the environment offers valuable insights into the intricate relationship between human demographics and environmental sustainability, there are noteworthy critiques and research gaps that merit consideration.

Firstly, the literature often frames population growth as a primary driver of environmental degradation, especially in the context of Sub-Saharan Africa. While population pressures undoubtedly contribute to environmental stress, this perspective may oversimplify the complex dynamics at play. Environmental degradation is influenced by a multitude of factors, including land use practices, technological advancements, and policy decisions. Focusing solely on population growth as the primary culprit may divert attention from other critical drivers of environmental decline. Moreover, the literature highlights the negative consequences of population growth on resource availability, soil fertility, and ecological balance. While these concerns are valid, there is a limited exploration of potential solutions and strategies for sustainable population management. Addressing the challenges posed by population growth requires a comprehensive approach that goes beyond mere population control and encompasses broader socio-economic and environmental policies (Bergsten et al., 2019).

Another critique is the tendency to homogenize Sub-Saharan Africa as a single entity, overlooking the vast diversity of cultures, economies, and environmental contexts within the region. Environmental challenges and population dynamics can vary significantly from one country to another, necessitating a more nuanced and context-specific analysis. Failing to consider this diversity may lead to overly generalized conclusions and policy recommendations (Garcia, M., & Alvarez, R. 2022). Furthermore, there is a need for a more comprehensive examination of the role of governance and policy frameworks in mitigating the environmental impact of population growth. While the literature acknowledges the importance of effective governance, it often lacks detailed case studies and empirical evidence of successful policy interventions. A deeper exploration of governance strategies that promote sustainable resource management and population dynamics is crucial (Kapoor, S. 2016).

Lastly, the literature predominantly concentrates on the negative consequences of population growth on the environment, leaving limited room for exploring the potential positive contributions of growing populations to environmental sustainability, especially in the context of protected forests. Future research should consider a more balanced

perspective that acknowledges the capacity of communities to adapt, innovate, and contribute positively to environmental resilience (Brown, L. 2017).

In conclusion, while the literature on population dynamics and environmental impact offers valuable insights, it is essential to address the critiques and research gaps to develop a more nuanced understanding of the complex relationship between human populations and the environment. Additionally, the multifaceted nature of environmental security is underscored by its diverse definitions and perspectives, each highlighting distinct dimensions of this critical concept. The complex relationship between human populations and the environment presents substantial challenges, especially in regions experiencing rapid demographic growth (Shammin et al., 2022). These challenges necessitate a comprehensive understanding of environmental security's dynamics and its consequences, providing the foundation for further exploration in this study, particularly within the Eastern Mau forest region.

2.4 Environmental Security, Governance, and Resilience in Forest Communities

In their research, Sunderline et al., (2005) illustrate that the effect of conflicts may directly damage the environment via degraded ecosystems, demonstrating a causal link between environmental security, governance, and resilience building in the developing world. The lack of resilience shown in inadequate coping methods, the disintegration of governance foundations and tools accountable for resource extraction and environmental preservation, or both, contribute to the crisis (Sunderline, Angelsen, & Belcher, 2005). Given these interdependencies, it implies that the procedure of bolstering the Eastern Mau forest's resistance to environmental stresses and social conflicts should normally be handled by the interplay of many sociopolitical and economic factors of governance (Smith & Vivekananda, 2007).

A case study was conducted by the authors (del Mar Delgado-Serrano et al., 2018) to examine how residents of communities close to Uganda's Lakes Kyoga and Wamala adapted to these natural disasters. As they investigated more, they learned that the community relied on connecting and spanning capital as a means of coping with adversity. Additionally, they discovered that villagers could develop skills, get access to

financing, build customer loyalty for their companies, receive remittances, manage migration, and lower the risks connected with their livelihood activities as result of their study. The local council committees were the unique institutions that significantly contributed to social capital. They lobbied on behalf of flood victims to landlords, requesting property access so they could rebuild their houses after the floods. Community-based organizations, such as fisheries management committees, have made significant contributions. However, one institution fell due to a lack of bonding capital, despite bridging and connecting the capital with government officials in the form of bridging and linking capital.

Another empirical research that emphasizes the significance of community management and action is that of Oduor (2020), who cites the example of India, where communal ownership of water supplies was supplanted by private ownership, leading to resource deterioration, to make his point. Similar to what was found in the United States, a regional comparative study of grazing in India found that conditions deteriorated in areas where community monitoring of grazing was lacking. Good governance and resilience are intrinsically intertwined, as noted by Komugabe-Dixson et al. (2019); one cannot have good resilience strategies in place without also having efficient governance structures. It's likely that countries with well-established systems of good government will also have well-established programs of resilience (Shammin et al., 2022).

At the national or regional, community, and individual/family levels, Melnykovich et al. (2018) looked at the connections between good governance and resilience. While there are many potential components to mention, it is important to highlight those that keep popping up as central themes in the literature. Scholars have recently paid a lot of attention to the topic; namely how governments and social organizations might strengthen and reorganize their governance systems to better withstand the effects of natural catastrophes and stresses of human origin. Social capital has been brought to the forefront of the discussion as an critical factor in the achievement of resilience-promoting governance systems at all levels (Jerolleman, 2020).

Zari et al. (2019) discovered the positive correlation between community resilience and environmental governance among pastoralist tribes in northern Kenya. This was

discovered via their study. A good system of environmental governance considers the roles of all of the many actors that have an effect on the environment. These players include governments, civil society, and the corporate sector. Scholars believe that in order to develop effective environmental governance that may aid us in moving towards a more sustainable future, different players need to collaborate in order to accomplish their goals.

Exploratory qualitative research on the relationship between environmental governance and community resilience was conducted by Oduor (2020) in Ghana. Pursuant to the research findings, there is statistically significant linkage between environmental governance and community resilience, and in Ghana, governance is the most important component of any development approach. As stakeholders, civic organizations and the corporate sector players promote good governance in Ghana, following the country's brief flirtation with military control, the general populace has become more supportive of democratic institutions, thus it has made strides in improved administration, culminating in a more stable and amiable political climate. The moderately amenable part to markets - the New Patriotic Party (NPP), won the elections in the year 2000, and supervised robust economic development during which the country retained relative political stability and restored its per capita GDP to the pre-independence levels, according to the World Bank (Komugabe-Dixson et al., 2019). However, the reforms were not comprehensive, as certain sectors did not see any improvement while issues persisted in other areas.

A study by Roy (2018) as part of an empirical evaluation that focused on forest communities in Uganda to determine how environmental security impacts the Sustainable Development Goals. The experts also investigated the relationship between rivalry for natural resources and violent conflict. The research focused mostly on high-value extractive resources such as oil and gas, diamonds, and other minerals that are limited in supply. A lot of the time, the conflict for non-renewable natural resources is a zero-sum game in many ways. Replenishable natural resources, on the other hand, provide more immediate potential for communal advantages via collaboration and collective action. Several factors have been studied concerning resource scarcity, degradation, and conflict, including direct and indirect effects on the environment and natural resources conflict.

According to Back et al. (2020), Mediation is known to have the impact of lowering the tension between the Sides. Keeping one's attention on the future makes it possible to forestall the further development of debates over right and evil. It prevents the level of animosity that exists between the Parties from growing. Mediation is a technique for dealing with conflict that entails seeking the aid of a third person who is impartial to help colleagues in settling their disagreements. This may be done in the context of a sports team. The aim is to diffuse the disagreements that have arisen within the neighborhood before they may deteriorate into something more damaging.

According to Melnykovich et al. (2018), the environmental governance framework directs policy interactions to guide resource management in a way that can recover or respond to change to preserve or enhance the desired condition. According to the researchers, the adaptive governance strategy is appropriate for social-ecological systems whose dynamic character is not effectively served by a static approach. Many different sizes and resources are involved in these systems, from local fishing economy to global climate impact (Gulrud et al., 2018).

Musavengane et al. (2019) explained that governments conduct environmental governance on behalf of society, sometimes in anticipation of change, but more often in reaction to specific occurrences. Regardless of the government level, environmental governance comprises two key steps: facilitation and execution. Instead of creating knowledge of adaptive techniques, eliminating obstacles, and making finances available to support these strategies, the latter requires implementing tangible operational adjustments in practice and behavior to achieve the anticipated outcomes. Adaptation to climate change may occur in two ways: as a reaction to the situation or as a preemptive measure (Lin, 2019). According to the literature on environmental governance, reactive adaptation is defined as responding to the current climate change effects with, for example, the provision of humanitarian aid in the aftermath of a disaster, the rehabilitation or relocation of critical infrastructure following storm damage, or the transfer of a population to a new location. Following the findings of the study, environmental governance aims to lessen risks of climate change before they occur, for example, by diversifying crops and altering agricultural patterns, designing and

constructing higher floor levels or suspended timber floors, and zoning land to prevent development (Ramcilovic-Suominen & Kotilainen, 2020).

According to Dawson et al. (2021), environmental governance is not only a critical aspect, but it is also a socio-ecological institution that plays a significant role in defining food, economic and social independence, including delivering vital technical support to forest communities. Consequently, recent changes have happened at a watershed level in reaction to the global food and economic crises. In addition, global lawmakers emphasize that good governance is a necessary prerequisite for liquid, power, and food security in areas where political security with the apparent lack of violence, the rule of law, participation and accountability, regulatory quality, effectiveness of governance, management of corruption, and environmental governance are all factors to consider (Shammin et al., 2022).

Espeso-Molinero and Pastor-Alfonso, (2020) used a mixed-design strategy to examine the link between environmental governance and community resilience in forest communities in the United States. It has been found that environmental security and governance may contribute to the loss of watersheds rather than natural disasters being the primary cause of food insecurity in developing economies. Consequently, governance systems characterized by disputes, a lack of institutional capacity, bad policy formulation, and a slow implementation pace may significantly damage the production and distribution of nutritious food.

Researchers such as Oduor (2020), Espeso-Molinero and Pastor-Alfonso, (2020), and Melnykovich et al. (2018) discovered a statistically significant relationship between environmental security, governance, and community resilience in forest communities. The majority of these researchers used qualitative data and secondary data, which may have an impact on the validity of their findings. Consequently, the research aimed at closing this gap by using qualitative and quantitative data to analyze the link between environmental security, governance, and resilience in forest communities inside the Mau forest.

2.5 Socio-Ecological Factors and Environmental Security and Governance in Forests

2.5.1 Contextualizing Eastern Mau Forest

Environmental security and governance lie at the heart of ecological sustainability and resilience in forest ecosystems. Ensuring the preservation and balanced utilization of forest resources necessitates an intricate understanding of the myriad socio-ecological factors at play and their dynamic interactions with governance structures and practices. The Eastern Mau Forest, a vital ecological asset in Kenya, exemplifies a terrain where such factors and governance approaches converge, offering a unique lens through which to explore their interplay.

The Eastern Mau Forest forms an integral part of the Mau Forest Complex, the largest indigenous montane forest in East Africa. This forest serves as a crucial water tower, supports a rich biodiversity, and plays a pivotal role in climate regulation. However, it is also a space of contention and challenge, marked by competing interests, resource conflicts, and pressures from anthropogenic activities. The significance of the Eastern Mau Forest extends beyond its physical boundaries, as it underpins the livelihoods of surrounding communities and contributes to broader ecological and climatic systems.

The socio-ecological fabric of the Eastern Mau Forest is characterized by a diversity of communities, indigenous knowledge systems, land-use practices, and human-nature relationships. These elements form a complex mosaic, shaping and being shaped by the ecological state of the forest. The interdependencies between human activities and forest ecosystems bring forth both opportunities for sustainable coexistence and challenges emanating from resource exploitation and environmental degradation. Addressing the multifaceted socio-ecological dynamics within the Eastern Mau Forest necessitates robust and adaptive governance mechanisms. Environmental security and governance in this context encompass the formulation and implementation of policies, conflict resolution, community engagement, and adaptive management strategies aimed at fostering ecological resilience. The governance landscape is further complicated by the multiplicity of stakeholders, ranging from local communities and governmental bodies to non-

governmental organizations and international entities, each with distinct interests, perspectives, and roles.

Therefore, exploring the interaction between socio-ecological factors and environmental security and governance in the Eastern Mau Forest is instrumental in forging pathways towards sustainable forest management and resilience building. This section of the review seeks not only to unravel the complexities inherent in such interactions but also to create better understanding of the evolving discourse on environmental governance and security for resilience building, particularly in forested landscapes.

2.5.2 Community Engagement and Participation

Community engagement and participation have been identified as pivotal elements in sustainable forest management across various ecosystems. Ostrom's seminal work (2012) established that local communities, when adequately involved, significantly contribute to maintaining ecological balance and improving forest governance. Since then, numerous studies and examples from different forest ecosystems have corroborated the centrality of community participation in forest conservation and management.

From the Brazilian Amazon to the forests of Southeast Asia, the role of communities is widely acknowledged. In the Amazon, Nepstad et al. (2016) illustrated how community engagement in monitoring and managing resources led to a decrease in deforestation rates and an increase in sustainable practices. Similarly, in Indonesia and Cambodia, research by McElwee (2014) and Clements and Milner-Gulland (2015) emphasized the value of integrating local knowledge and participatory approaches to achieve conservation objectives and resolve resource conflicts.

In Africa, several studies have underscored the positive outcomes of community engagement in forest ecosystems. In Tanzania's Duru-Haitemba and Mgori forests, Blomley et al. (2011) documented the success of community-based forest management in reducing deforestation and enhancing local livelihoods. Similarly, in Madagascar, community participation in the management of Mangabe Reserve resulted in successful conservation outcomes and community empowerment (Cinner et al., 2013).

Focusing on the Eastern Mau Forest, Wangari et al. (2012) highlighted the diverse communities surrounding the forest whose activities and participation directly impact its ecological state. While there is acknowledgment of the involvement of local communities in conservation initiatives, a gap exists in detailed examination and documentation of the extent, nature, and impact of such engagement in this specific context.

While the literature provides compelling evidence of the positive impact of community engagement, it is not without its critiques. Some scholars argue that the emphasis on local community involvement sometimes oversimplifies the complex socio-political dynamics within communities and overlooks power imbalances (Agrawal and Gibson, 2010). Furthermore, there is a tendency in some studies to romanticize indigenous practices and overlook potential unsustainable practices within communities (Fairhead and Leach, 2016).

In the context of Eastern Mau Forest, a significant gap exists in terms of comprehensive studies exploring the multifaceted nature of community engagement. More in-depth research is needed to unravel the intricate relationships, power dynamics, and varying interests within the local communities and how these elements influence conservation outcomes. Moreover, the available literature is often fragmented, focusing either on the ecological or social dimensions, with less emphasis on the interplay between the two. A holistic approach examining the synergies and tensions between community engagement for resilience building and ecological sustainability in Eastern Mau Forest remains an area ripe for exploration.

2.5.3 Indigenous Knowledge and Practices

Indigenous knowledge and practices form the bedrock of many communities' interaction with and understanding of their surrounding environments. Berkes (2018) contends that these knowledge systems, deeply embedded in the cultural fabric of indigenous communities, offer invaluable insights into sustainable resource management and biodiversity conservation. In the context of forest ecosystems, indigenous communities often possess intricate understandings of flora and fauna, ecological cycles, and sustainable harvesting methods, which have been honed and refined over generations

(Whyte, 2013). The importance of integrating such traditional ecological knowledge in contemporary conservation efforts is gaining recognition for its potential to enhance biodiversity protection and support adaptive management (Garnett et al., 2018).

However, despite the growing acknowledgment of the value of indigenous knowledge, there remain considerable gaps and challenges in its documentation, validation, and integration into formal environmental management and policy frameworks (Tengö et al., 2017). A notable gap in the literature is the underrepresentation of diverse indigenous voices and the nuances of different knowledge systems across regions and communities (Agrawal, 2009). Additionally, there is often a tension between protecting indigenous knowledge from exploitation and ensuring its accessibility for broader conservation goals, creating a dilemma in its utilization and dissemination (Coolsaet, 2016).

Addressing these gaps and tensions necessitates a nuanced and respectful approach, recognizing the rights of indigenous communities and fostering partnerships based on mutual trust and benefit. Enhancing the dialogue between indigenous knowledge holders and formal science and policy institutions is crucial to bridge the divide and ensure the co-production of knowledge for sustainable environmental governance (Turnhout et al., 2020). Future research needs to prioritize inclusive methodologies, ethical considerations, and the decolonization of knowledge production processes to truly harness the potential of indigenous wisdom in ecological conservation.

2.5.4 Land-Use Changes and Agricultural Practices

Land-use changes and shifts in agricultural practices significantly impact forest ecosystems, altering their structure, function, and the services they provide. Myers et al. (2013) underscored the profound implications of land conversions, particularly from forests to agriculture, on biodiversity loss, greenhouse gas emissions, and alterations in water cycles. In numerous forest ecosystems, the expansion of agricultural frontiers is driven by the increasing demand for food, fuel, and fibers, precipitating widespread habitat fragmentation and degradation (Lambin & Meyfroidt, 2011).

One striking manifestation of land-use changes in forest ecosystems is the transition from traditional, sustainable agricultural practices to intensive, monoculture-based agriculture.

This shift is characterized by increased use of chemical inputs, mechanization, and simplification of agricultural landscapes, which can disrupt ecological balances and reduce biodiversity (Tscharntke et al., 2012). The expansion of commodity crop plantations, such as oil palm and soy, particularly in tropical regions, exemplifies this trend, resulting in substantial environmental and social repercussions (Law et al., 2015).

The Eastern Mau Forest is not exempt from these dynamics. Here, land-use alterations and changing agricultural practices are influenced by population pressures, socio-economic factors, and policy incentives, which, in turn, impact the forest's ecological integrity and the livelihoods of dependent communities (Mutune & Nunow, 2018). The adoption of unsustainable agricultural practices in and around the forest periphery accelerates deforestation, soil erosion, and water pollution, thereby exacerbating the vulnerability of both human and natural systems in the region (Otukey & Blaschke, 2016).

However, the literature reveals a discernible gap in context-specific studies delineating the multifaceted impacts of land-use changes and agricultural transitions in the Eastern Mau Forest. While general trends and consequences are well-documented globally and regionally, nuanced, in-depth research focusing on the localized effects and adaptive capacities of the Eastern Mau ecosystem and its inhabitants is notably lacking (Baudron et al., 2021). Addressing this gap is imperative to develop tailored, effective strategies for sustainable land use and agricultural practices in this critical forest ecosystem.

2.5.5 Conflict Resolution and Resource Management in Environmental Governance

Conflict resolution and resource management have become paramount in environmental governance, particularly in areas where resources are scarce or contested. Barquet et al. (2014) elucidate that shared resources, such as water bodies and forests, often instigate conflicts among communities or nations. The implementation of sustainable management practices necessitates consensus-building and conflict mitigation strategies to align the interests of different stakeholders (Bennett et al., 2015).

In the context of environmental governance, Eriksen et al. (2015) emphasize the role of adaptive management strategies that seek to reconcile the different needs and priorities of local communities, governments, and other stakeholders. The integration of traditional

and indigenous knowledge into conflict resolution mechanisms has been highlighted as essential for fostering mutual respect and understanding among conflicting parties (Danielsen et al., 2014).

Collaborative approaches to conflict management, where stakeholders actively participate in decision-making processes, have been found to be effective in promoting sustainable resource management (Ostrom, 2014). The concept of environmental peacebuilding, introduced by Conca and Dabelko (2012), argues that cooperative management of natural resources can serve as a basis for peace and conflict resolution between adversarial groups.

While the existing literature on conflict resolution and management in environmental governance is extensive, several gaps and areas for improvement can be identified. Firstly, there is a prevalent focus on theoretical frameworks and models, with less emphasis on empirical studies illustrating the real-world application and outcomes of these frameworks. More research employing case study methodologies could address this gap and enhance the practical relevance of the theory (Barquet et al., 2014).

Additionally, the role of power dynamics and inequality in conflicts related to environmental governance has been somewhat underexplored. The literature could benefit from a more nuanced examination of how power imbalances between stakeholders influences conflict emergence and resolution (Bennett et al., 2015).

There is also a lack of comprehensive studies exploring the long-term impacts and sustainability of conflict resolution mechanisms. Evaluating the longevity and adaptability of these mechanisms is crucial for assessing their effectiveness in fostering enduring peace and sustainable resource management (Eriksen et al., 2015).

Lastly, the literature predominantly focuses on conflicts between local communities and national entities, with less attention given to transboundary conflicts and their resolution. Given the interconnectedness of ecosystems and resources, a more integrated approach to studying conflicts across borders would be beneficial (Conca & Dabelko, 2012).

2.6 Efficacy of Policy and Legislative Framework Underpinning Environmental Security, Governance, and Resilience in Eastern Mau Forest

Global and regional policy frameworks play a significant role in shaping environmental governance and security. Internationally, the Sustainable Development Goals (SDGs), particularly SDG 13 on Climate Action and SDG 15 on Life on Land, provide a comprehensive framework for addressing environmental challenges and fostering sustainability (United Nations, 2015). These goals aim to integrate environmental concerns with socio-economic development, highlighting the interconnectedness of global equality and environmental quality (Grant & Langer, 2021). The 1997 Kyoto Protocol, despite its vulnerabilities, has been a pivotal international instrument, emphasizing the need for nation-states to prioritize environmental security over political agendas (Jackson et al., 2021).

Regionally, frameworks such as the African Forest Law Enforcement and Governance (AFLEG) initiative address illegal logging and promote sustainable forest management in Africa (African Development Bank, 2018). The African Union's Agenda 2063, moreover, emphasizes inclusive growth and sustainable development, underscoring the significance of environmental security for the continent's socio-economic progress (African Union, 2015). The ASEAN Agreement on Transboundary Haze Pollution is another exemplar of regional collaboration in Southeast Asia, aiming to prevent, monitor, and mitigate transboundary haze pollution resulting from land and forest fires (ASEAN, 2002).

Locally, in the quest for environmental security and governance, evaluating the effectiveness of existing policy frameworks and their implementation is pivotal. The Eastern Mau Forest region operates under a myriad of policies and legislations, notably highlighted by the Kenya National Forest Program 2016-2030, which indicates the presence of 21 major policies and legislations affecting forest protection in Kenya (Ministry of Environment and Natural Resources, 2016). Additional affiliated strategies include the Kenya Vision 2030 and the Kenya Green Economy Government Strategic Plan (2015), aiming to provide comprehensive approaches to forest management across the country.

Despite these extensive frameworks, studies have pointed towards the vulnerability of Kenya's forest communities to poor governance and inefficient policies (Kissinger et al., 2012; Were, Kennedy, & Singh, 2013). The existing consequences of forest land degradation and impacts on livelihoods have been associated with inadequate resource governance, highlighting a critical need for the evaluation and improvement of policy implementation. The research by Yehua, Han, Liao, & Huang (2015) substantiates these findings, underscoring the significant effects of this policy and legal structure on land-use patterns and the long-term viability of rural livelihoods.

While the frameworks set in place are extensive, the effective implementation and outcomes of such policies present a significant research gap, particularly in the context of the Eastern Mau Forest. The review of literature reveals a paucity of in-depth, context-specific studies analysing the impact and effectiveness of these policy frameworks within this region. Addressing this gap will necessitate an assessment of the policy and legal frameworks fostering environmental security, governance, and resilience specifically in the Mau Forest, providing insights necessary for enhancing environmental governance and community resilience.

Gender inclusivity in governance also emerges as a pivotal aspect of effective environmental protection, with research evidencing enhanced forestry protection when women are involved in maintenance and decision-making procedures at the local level (Cucari et al., 2018). This highlights the need for a governance approach that not only meets the fundamental requirements of women but actively involves them in decision-making and leadership roles, breaking societal boundaries and promoting more effective community-based environmental protection.

The complexity and multidimensionality of governance in protected areas present unprecedented pressures on institutions and policymakers (Lutz-Ley et al., 2021). Achieving "good governance" necessitates a thorough understanding and development of tools to evaluate performance and address potential pitfalls in protected area governance. Research by Valatin et al. (2022) and Grant and Langer (2021) further emphasizes the interconnectedness of environmental quality with global equality, suggesting the

integration of environmental justice's theoretical foundations into new sustainable development strategies.

However, the effectiveness of international environmental law remains ambiguous and highly vulnerable to the political priorities of nation-states, impacting the distribution of security in global governance (Behnassi et al., 2021; Jackson et al., 2021). This vulnerability is exemplified by the outcomes of the 1997 Kyoto Protocol and the impact of international trade agreements and intellectual property legal frameworks on food security in the Global South. Addressing these vulnerabilities requires a reevaluation of international law and its implications for environmental security and governance.

The studies conducted by Laforteza et al. (2018) and Jackson et al. (2021) highlight the role of socioeconomic factors in environmental safety and the overall success of environmental governance regulations. However, a critical gap in the literature is the absence of context-specific research and methodologies for assessing water-related security and policy efficiency in regions such as the Mau Forest.

The existing literature provides comprehensive insights into the multifaceted nature of policy frameworks and their implementation at both global and regional levels. The acknowledgment of the interconnectedness of environmental quality with global equality (Grant & Langer, 2021) and the exploration of the vulnerabilities of international environmental law (Jackson et al., 2021) provide critical perspectives on the complexities of environmental governance.

However, several gaps are evident in the literature. While the literature discusses the implications of global and regional frameworks, there is a notable lack of in-depth, context-specific studies that analyze the actual impact and effectiveness of these policy frameworks within specific regions, such as the Eastern Mau Forest. This is crucial, as the unique socio-economic and environmental context of each region demands tailored approaches and evaluations.

Secondly, the literature largely addresses policy frameworks and their intended outcomes but falls short in examining the practical challenges and nuances of implementation on the ground. The on-paper success of policy frameworks does not necessarily translate

into on-ground effectiveness, necessitating studies that bridge this gap between theory and practice.

Further, there is a scarcity of research focusing on the role of gender in the formulation and implementation of environmental policies at both global and regional levels. Given the evidence of the positive impact of gender-inclusive governance (Cucari et al., 2018), this gap highlights a missed opportunity for enhancing the effectiveness of resilience building initiatives.

Lastly, the literature does not sufficiently address the adaptability and flexibility of policy frameworks in response to emerging environmental challenges and changes. The dynamic nature of environmental issues necessitates adaptive policy frameworks, and further research is needed to explore how existing policies are evolving to meet new challenges.

2.7 Stakeholders' Roles in Resilience Building and Shaping of the Environmental Governance and Security Processes in Forests

Sonnsjö and Bremberg (2016) undertook a pivotal study examining how stakeholders, especially in underdeveloped nations, strive to integrate ecological sustainability at both policy and operational levels of governance. Their research underscored the persistent gaps and omissions in incorporating environmental security threats into conflict resolution, governmental policies, and early alert systems. They highlighted the detrimental impact of these omissions on resilience building and environmental security, particularly in regions like Kenya where integrating conflict elements into resource governance is not mandatory (Were et al., 2013).

This lack of integration results in organizational inefficiencies and hinders adaptation, mitigation, and collaborative efforts (Sonnsjo & Bremberg, 2016). Conca and Wallace (2013) further emphasized the necessity for enhanced cooperation across policy areas and between stakeholders to breakdown organizational silos and efficiently integrate global protection and governance for adaptability building.

2.7.1 Grassroots Engagement and Governance Transparency

Hovardas (2021) contributes to the discourse by highlighting the significance of grassroots engagement and transparent governance systems. Through qualitative research methods, Hovardas uncovered the challenges associated with inadequate local knowledge, livelihood restrictions, and insufficient information sharing, which impede stakeholder cooperation. The study advocated for an increase in grassroots public forums and the active participation of government officials in local projects to foster stakeholders' active participation and input in building urban resilience.

2.7.2 Corporate Networks and Environmental Governance

Cleaver and Whaley (2018) delved into the interplay between corporate networks, firm characteristics, and climate change mitigation efforts, using data from companies in Malaysia. Their findings illustrated the substantial impact of corporate networks on climate change mitigation efforts, highlighting the role of normative pressures in shaping corporate behaviour. This aligns with the assertions of Joshi et al. (2021) and Okpara et al. (2018), who emphasized the potential for structured interactions with stakeholders to promote socially responsible operations and environmental outcomes.

2.7.3 Adoption of Environmental Management Standards

Gulsrud et al. (2018) offered insights into the adoption of Environmental Management Standards (EMS) such as ISO 14001 across the United States and Europe. Their comparative analysis revealed a more conducive environment for EMS adoption in Europe, attributed to positive relationships between industry and regulatory agencies, in contrast to the United States. The disparities in regulatory environments and stakeholder demands between the two regions underscore the variations in environmental governance and security mechanisms globally.

2.7.4 Stakeholder Theory and Environmental Management

Lee and Baggio (2021), along with Delabre et al. (2020), focused on the utilization of stakeholder theory in environmental management. They emphasized the influence of

stakeholders in shaping corporate environmental practices and the potential financial rewards for environmentally responsible businesses. Larson and Sarmiento Barletti (2020) echoed these sentiments, noting that businesses adhering to good environmental practices can enhance their reputation, attract qualified employees, and potentially improve financial performance.

The literature, while extensive, reveals a geographical limitation with a predominant focus on regions outside of Africa, particularly Kenya. This indicates a research gap in understanding the roles of stakeholders in shaping resilience and environmental governance within forest environments in Africa. Addressing this gap can provide a comprehensive perspective on stakeholder roles in environmental governance and security processes, particularly in diverse ecological settings.

Relatedly, while the literature addresses a range of stakeholders, including corporations, governmental bodies, and local communities, there is a gap in exploring the roles of non-traditional and marginalized stakeholders, such as indigenous communities and small-scale enterprises, in shaping environmental governance and security. Sonnsjo and Bremberg (2016) highlighted the omission of environmental security in governance policies, but the literature could benefit from further exploration of how integration can be achieved and the impact of such integration on resilience building.

In addition, the literature discusses various theoretical frameworks and policy recommendations, but there is a lack of empirical studies illustrating the practical implementation and outcomes of these frameworks and policies. Therefore, the literature would benefit from more longitudinal studies evaluating the long-term impacts and sustainability of stakeholder involvement in resilience building and environmental governance. Addressing these research gaps would provide a more comprehensive and nuanced understanding of stakeholders' roles in resilience building and shaping environmental governance and security processes in forest environments.

2.8 Summary of the Research Gaps

The given literature underscores the evolving and multifaceted notion of "environmental security", a term that has garnered considerable attention but lacks a universally agreed

definition, as noted by Kameyama & Yuri (2021). Pivotal studies by researchers such as Sunderlin et al. (2005), del Mar Delgado-Serrano et al. (2018), and Melnykovych et al. (2018) emphasized the significance of environmental security methods for the sustenance of communities residing in forested areas. Their investigations explored the multifarious linkages between factors influencing community resilience on varying scales - national, local, and household. However, a critique of their methodology reveals a constrained perspective, focusing predominantly on environmental aspects and overlooking crucial socio-cultural and economic dimensions.

Despite the excess of existing literature on environmental security, community resilience, and governance, particularly around the Mau forest complex, several prominent gaps remain. Firstly, there is a discernible need for *Addition of Theoretical Value*. The literature must address the nuanced relationship between environmental security and governance and the subsequent value addition to the theoretical framework. This involves reconciling the traditional notions of security, primarily associated with national defense, with the contemporary understanding of environmental securitization and its implications for resilience building and resource governance (Buzan, 1983).

Secondly, the literature highlights the critical *Roles of Non-State Players* in the discourse on environmental security and governance. A holistic and effective approach to environmental security necessitates the active involvement of a diverse array of stakeholders, including local governments, international organizations, the business sector, and citizens. This collective participation is indispensable for fostering positive resilience outcomes and addressing pressing issues related to environmental security and resource governance.

The third identified gap pertains to the evident *Underrepresentation and Research Imbalance*. The majority of the existing literature on environmental security emanates from European and North American scholars, focusing primarily on regions such as Europe, Africa, the Americas, and the Middle East. Notwithstanding the severe environmental threats faced by Africa, there is a conspicuous underrepresentation of African experts and a scarcity of case studies from the continent. The literature recognizes the intricate linkages between environmental security and the distinct

geographical, geopolitical, and cultural contexts of different regions, thereby necessitating a diversified and region-specific approach to understanding and addressing environmental security and vulnerability.

Lastly, the literature also points to the existence of *Regional Imbalance*. Much like the aforementioned gap, there is a predominance of literature from European and North American authors, concentrating on specific regions while leaving others, such as Asia, underrepresented. This imbalance underscores the situational dependence of the definition of security and its close association with the varied cultural and geopolitical contexts of different countries or actors. Recognizing this variance is crucial, as what constitutes “climate security” may differ significantly across regions. Consequently, researchers have advocated for the formulation of policies and legislative frameworks that are contextual, catering to the specific needs and characteristics of the communities they are intended for, as emphasized in studies by Katrina et al. (2015), Valatin et al. (2022), and Yehua et al. (2015).

The identified areas of research gaps are cross-cutting across various study themes, encompassing theoretical value, stakeholder roles, representation imbalance, and regional discrepancies. Addressing these gaps is imperative for advancing our understanding and management of environmental security, community resilience, and governance, particularly in diverse and vulnerable regions. Further summary of the analysis is provided in the table below.

Source: Field Survey (2021)

Table 2.3: Summary of Key Research Gaps

Previous Researchers	Focus of Research Findings	Corresponding Research Gaps	Current Study Focus
Sonnsjo and Bremberg (2016)	Integration of ecological sustainability in underdeveloped nations' governance	- Lack of integration of environmental security in governance policies - Geographical limitation focusing	Integration of environmental security and governance in various geographical

		primarily on specific areas	contexts, especially in forest environments
Were et al. (2013)	Absence of obligatory integrated institutional approach in Kenya	- Marginalization of essential entities - Emergence of organizational silos	Exploration of integrated approaches and breaking down of organizational silos in diverse settings
Conca and Wallace (2013)	Need for enhanced cooperation across policy areas and stakeholders	- Limited practical examples of enhanced cooperation and its outcomes	Implementation and outcomes of enhanced cooperation across diverse stakeholders
Hovardas (2021)	Importance of grassroots public forums and transparent governance systems	- Barriers to stakeholder cooperation such as inadequate local knowledge and information sharing	Strategies to overcome barriers to stakeholder cooperation and enhance local participation
Cleaver and Whaley (2018)	Impact of corporate networks on climate change mitigation efforts in Malaysia	- Limited exploration of the influence of corporate networks in different sectors and geographical contexts	Influence of corporate networks on environmental governance in various sectors and regions
Gulrud et al. (2018)	Adoption of ISO 14001 in the United States and Europe	- Comparison limited to U.S. and Europe - Lack of exploration of reasons behind the low demand for ISO 14001 in the U.S.	Expansion of comparison to other regions and in-depth exploration of factors influencing adoption of ISO 14001
Lee and Baggio (2021)	Significance of institutional theory in	- Need for more empirical studies	Practical implementation and

	understanding sustainability	illustrating practical implementation and outcomes of institutional theory	outcomes of institutional theory in environmental governance
Delabre et al. (2020), De Luca et al. (2021)	Role of businesses in addressing social problems and meeting stakeholder expectations	<ul style="list-style-type: none"> - Lack of exploration of non-traditional and marginalized stakeholders - Need for longitudinal studies on the impact of responsible practices 	Exploration of diverse stakeholder roles and long-term impacts of responsible environmental practices

This table summarizes the research gaps identified in the literature review, providing a concise overview of areas where further research is required to enhance the understanding of stakeholders' roles in environmental governance and resilience building. The current study focus aims to address these gaps by exploring diverse geographical contexts, stakeholder roles, and practical implementations.

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The research was carried out in the Eastern Mau Forest, located in Nakuru at a longitude $35^{\circ}58'00''$ E and latitude $00^{\circ}32'00''$ S with elevations ranging from 1,200 to 2,600 meters. Mau Forest Complex occupies approximately 270 km^2 in total. The area under study is a significant portion of the Mau Forest Complex's drainage basin and is a source of a number of crucial rivers and watercourses that contribute to the hydrological processes of lakes Nakuru, Baringo, Victoria, and Natron. In contrast to the bimodal trend that prevails over the majority of the nation, the region receives a trimodal distribution of rainfall. This includes the long showers of April to June, the short rain of September, and the moderate showers from November to December; the total yearly rainfall averages 1200 mm.. Previous topographical and geologic investigations have shown that the region is mostly composed of tertiary and secondary volcano materials.

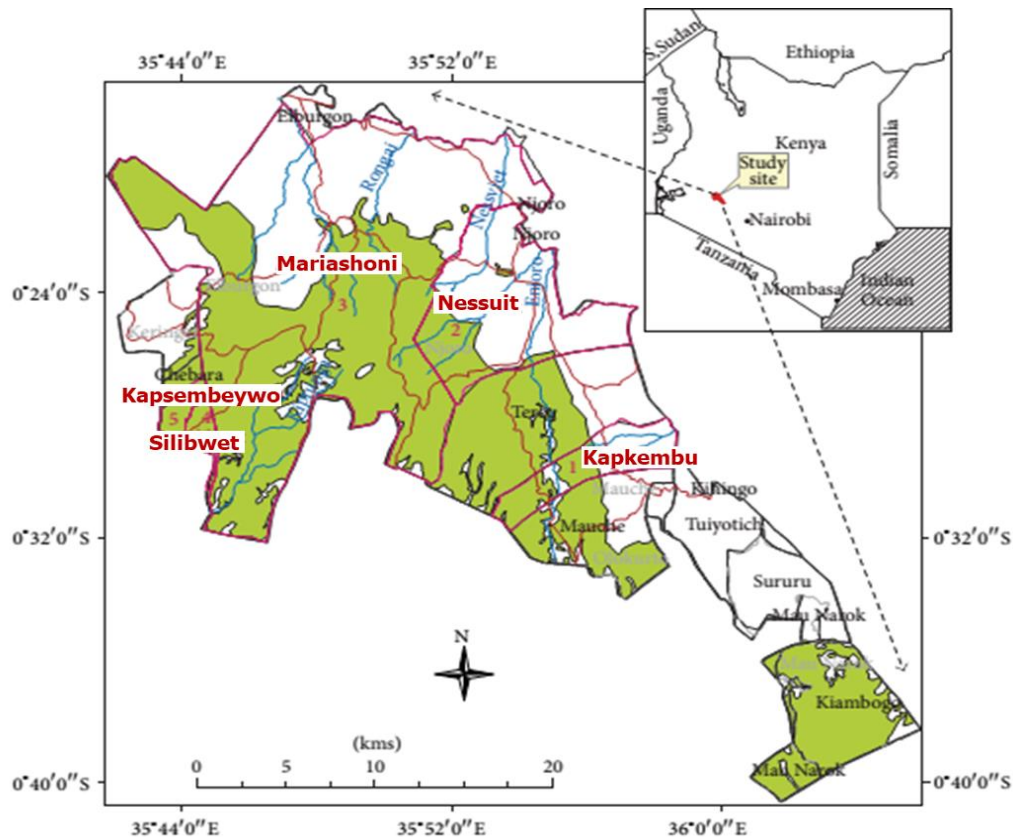


Figure 3.1: Study Area Map
Source: Dumbi (2018)

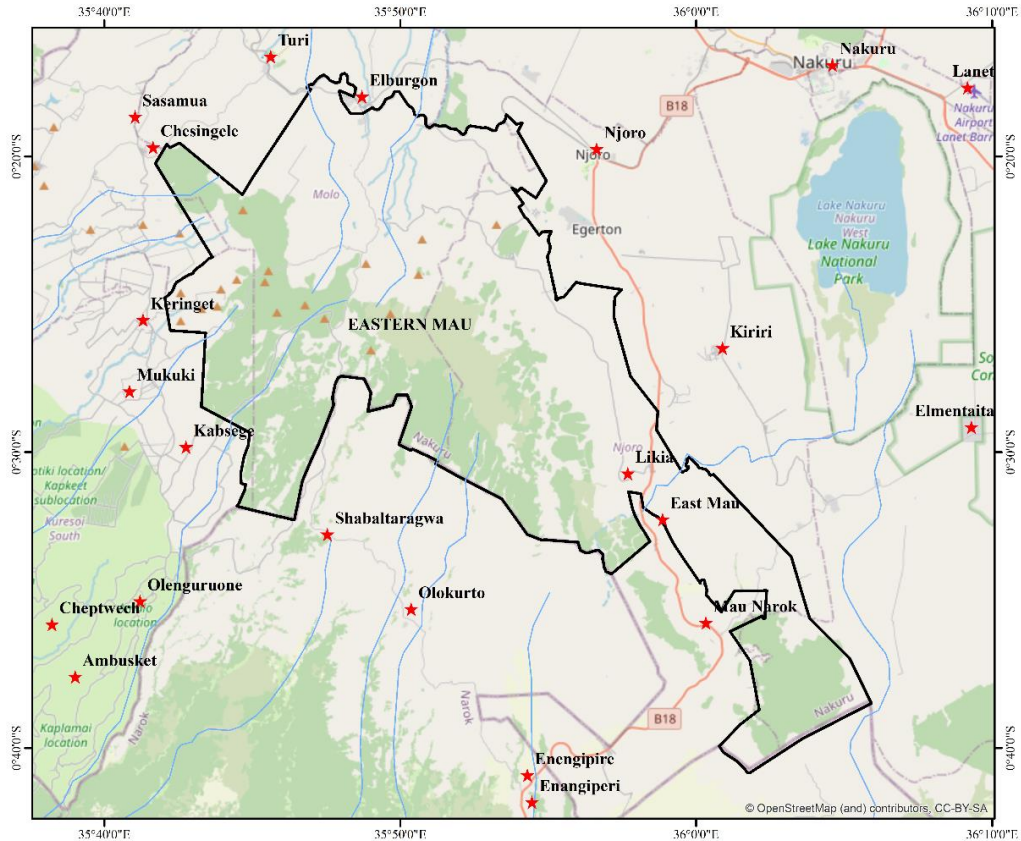


Figure 3.2: Map of Study Area Showing Vegetation Cover
Source: Field Survey (2021)

In socioeconomic endeavours, the people who live in the Mau forest have evolved a wide variety of ways to make a living, including farming, maintaining animals, selling forest products, engaging in local commerce, and sending money home (Makindi, 2019). Farming and the raising of animals are the most popular forms of income-producing activities.

3.2 Research Design

This study employed a mixed-method research design, which integrates both quantitative and qualitative research approaches. The mixed-method design is particularly effective for addressing the multifaceted nature of environmental security and governance in resilience building, as it offers a more comprehensive understanding of the phenomena under investigation (Creswell & Plano Clark, 2017).

3.2.1 Quantitative Research

The quantitative component of this study involved structured surveys administered to a diverse range of stakeholders, including local communities, members of Community Forest Associations (CFAs), and governmental and non-governmental organizations involved in forest conservation efforts in the Eastern Mau Forest. The survey encompassed questions on forest conservation techniques, perceived benefits and challenges, livelihood implications, and community resilience. Statistical analyses, including descriptive statistics and inferential statistics, were employed to examine relationships, compare groups, and test hypotheses (Conversi, 2020). The findings from the quantitative phase helped in quantifying the attitudes, opinions, behaviors, and other defined variables and generalize results from a larger sample population.

3.2.3 Qualitative Research

The qualitative component was essential in exploring in-depth insights, perceptions, and experiences of the participants, thereby providing context and meaning to the quantitative data. Semi-structured interviews, focus group discussions, and field observations were the primary data collection methods in this phase. Participants included key informants from the local communities, representatives from CFAs, and experts in environmental security and forest conservation. Thematic analysis was employed to analyze the qualitative data, identifying patterns, themes, and nuances in the responses, and offering a richer, more nuanced perspective on the community's interaction with the Eastern Mau Forest and the impact of conservation efforts (Agbedahin, 2019).

3.3 Determination of Sample Size

A stratified random sampling technique was used for the quantitative phase to ensure representation from different stakeholder groups. For the qualitative phase, purposive sampling was employed to select participants who had rich, relevant information about the research topic, ensuring a depth of response and insights (Marks & Hooghe, 2013).

Determining the appropriate sample size was instrumental in ensuring the accuracy and reliability of the study's findings. The initial step involved identifying the total

population of homes around the Eastern Mau Forest, as they constituted the primary unit of analysis. Subsequently, a sample of administrative units were purposively selected using the age of settlements and demographic makeup of the population as the primary criteria. The sample households were then randomly selected from these administrative units. This stratified random sampling technique facilitated the inclusion of varied demographic groups, thereby enriching the diversity of the sample. By establishing the Confidence Interval (CI) and the Coefficient of Variation, the study calculated the permissible range of deviation from the population mean, ensuring that the results remained representative and indicative of the broader population (Greenland et al., 2013).

The application of the statistical formula outlined below, enabled the calculation of the sample size (n) and the margin of error (E). These calculations were crucial in striking a balance between the breadth of data and the feasibility of the research process, thus optimizing the allocation of resources and time (Cohen, J. 1988).

$$X = \left(\frac{c}{100}\right)^2 r(100 - r)$$

$$n = Nx / ((N - 1)E^2 + X)$$

$$E = \frac{\sqrt{(N - n)X}}{N(N - 1)}$$

In this sense,

$$X = \left(\frac{0.05}{100}\right)^2 0.5(100 - 0.5) = 0.0000124375$$

$$n = 2,162,202 (0.0000124375 / ((2,162,202 - 1)0.5^2 + 0.0000124375))$$

$$n = 384$$

Where n is the size of the sample, N is the size of the population, r is the proportion of predicted responses, and a safe percentage of 50% is used except if the investigator is confident of a larger response. *c* is the Confidence level of 95% taken at a *Z* score of 0.05, *Z* (*c*/100) = The critical value for the confidence level. According to the 2019 population census by the Kenya National Bureau of Statistics (KNBS), the total population of the sample frame was calculated to be 2,162,202 individuals drawn from 17

different county administrative units. Putting these variables into the equation yields a population estimate of 384 based on the sample size being calculated.

Table 3.1: Sample Sizes and Sampling Procedures

Type of respondents	No. of respondents
Households	384-Random sampling, Systematic sampling
Key Informants (Government, NGO, and County administrative units)	17-Purposive sampling, snowballing sampling
FGDs (men, women youth)	3(8 participants) =24 – Purposive sampling

Source: Field Survey (2021)

3.3.1 Administration of Questionnaires

The study employed systematic sampling to distribute the questionnaires to the selected administrative units in order to ensure engagement of a representative subset of households. The starting point was determination of the sampling interval, which was calculated by dividing the total number of households in the sampling units by the number of questionnaires to be distributed as follows (Babbie, E. 2010):

$$\begin{aligned}
 \text{Sampling Interval} &= \text{Total households} / \text{Number of questionnaires} \\
 &= 43,257 / 384 \approx 112.51 \text{ (rounded to the nearest whole number)} \\
 &= 113
 \end{aligned}$$

Thereafter, the study commenced by selecting a random starting point within the first sampling unit. A random number generator was used as the randomization method to choose a starting household number.

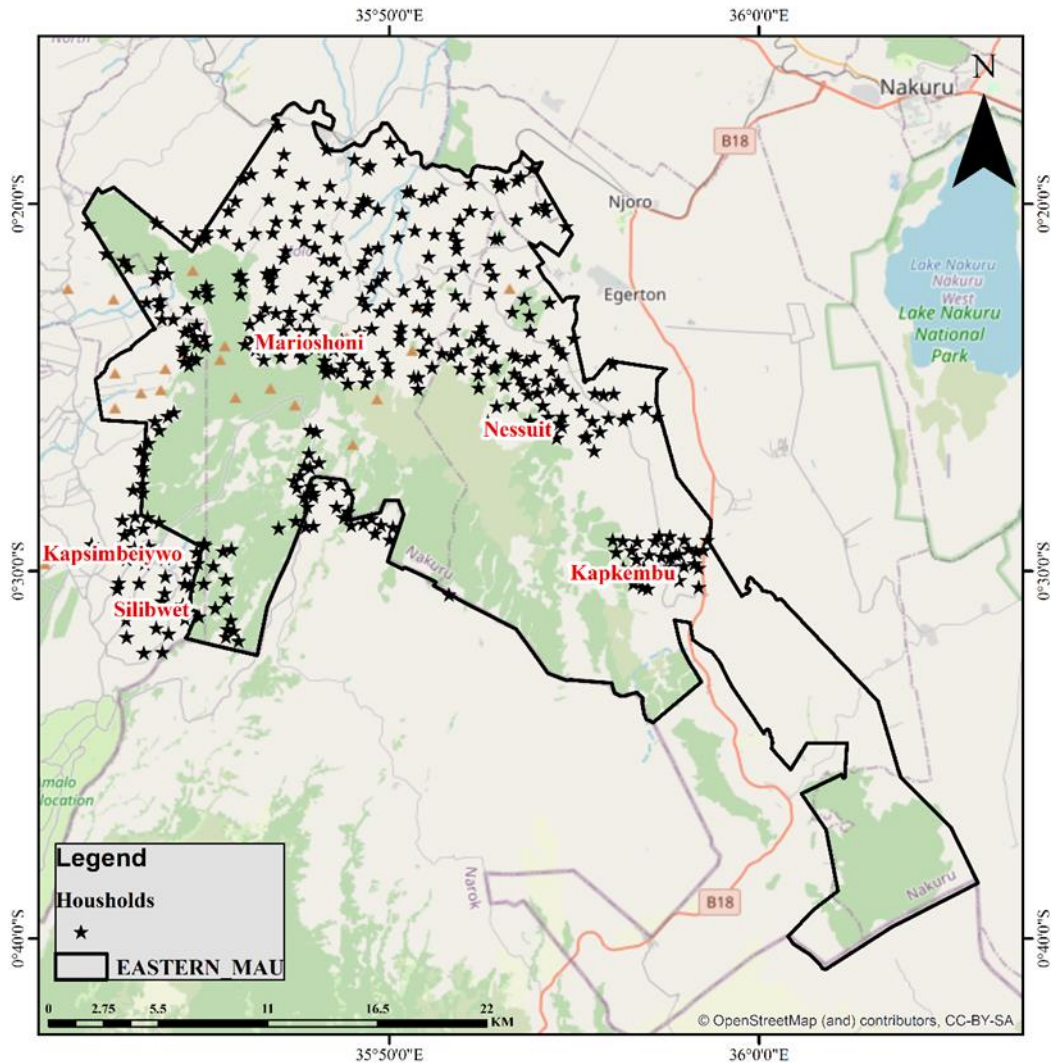


Figure 3.3: Map of Study Area Showing 384 Randomly Selected Sampling Points
Source: Field Survey (2021)

Once the random starting point was in place, the researcher selected every 113th household in every sampling unit after that, in a systematic manner, until the desired sample size was reached. For instance, after selecting a random start household #17, the researcher selected households #17, #130, #243, #356, and so on until all the 384 questionnaires were distributed.

This approach ensured that the study covered a representative subset of households from each of the five purposively selected sampling units while maintaining a degree of

randomness in the selection process. It helps prevent bias and provides a reasonable approximation of the population characteristics the study was interested in.

3.4 Sampling procedures and Data Analysis

3.4.1 Objective 1: To determine the general characteristics of the Eastern Mau Forest

For the first objective, the research unfolded through a meticulous blend of a comprehensive desktop review and an adept strategy of secondary data mining. This approach was instrumental in unravelling the layered aspects of the Eastern Mau Complex, enabling a multifaceted insight into its demographic, geological, historical, ecological, and climatic characteristics.

3.4.1.1 Desktop Review

A pivotal step in the research was a thorough analysis of the demographic characteristics of communities around the Eastern Mau Complex. Leveraging data from the 2019 Population and Housing Census conducted by the Kenya National Bureau of Statistics (KNBS), the study elucidated various demographic dynamics such as population size, age distribution, and household composition. This demographic dissection was instrumental in crafting a detailed portrait of the human aspect surrounding the forest complex.

Additionally, the study delved into topographical surveys orchestrated by various government agencies and geological research institutions. These detailed surveys unveiled a wealth of information about the geological features, terrain, and landscape of the Eastern Mau Complex, providing intricate details on soil types, elevation, and geological formations. The desktop review also encompassed an examination of historical records, including archival documents, photographs, and local historical narratives, shedding light on the historical development, land use evolution, and conservation chronicles of the Eastern Mau Complex.

3.4.1.2 Secondary Data Mining

Venturing into the ecological realm, the study accessed invaluable data from the Kenya Wildlife Service and Kenya Forest Service. This data offered a glimpse into the rich biodiversity of the Eastern Mau Forest, illuminating aspects such as forest cover, tree and animal species composition, and ongoing conservation endeavours. The meteorological facet was not left behind, with climate data from the Kenya Meteorological Department and IGAD being instrumental in dissecting climate patterns, temperature variations, rainfall tendencies, and overall climate trends that wield influence over the region's environmental tapestry.

3.4.1.3 Analysis and GIS Integration

The data acquired from the diverse records and sources underwent a rigorous analytical process. Qualitative analysis techniques were employed to interpret textual information gleaned from historical records, while a quantitative lens was applied to numerical datasets sourced from KNBS, Kenya Forest Service, and climate data repositories. To add a spatial dimension to the analysis, Geographic Information System (GIS) tools were seamlessly integrated, enabling the visualization and intricate analysis of spatial data, including land use alterations, land cover transitions, and geological intricacies.

The combination of desktop review and secondary data mining, complemented by advanced analytical tools and GIS integration, furnished a comprehensive understanding of the Eastern Mau Forest's general characteristics. This methodological synergy facilitated a nuanced exploration of the demographic, geological, ecological, and climatic attributes of the area, laying a solid foundation for the subsequent objectives of the study.

3.4.2 Objective 2: To assess the impact of environmental security approaches on resilience building

For the second objective, which was to assess the impact of environmental security approaches on resilience building in Eastern Mau forest, a purposive sampling strategy was implemented. This sampling method allowed for the selection of participants who had experienced or were knowledgeable about the environmental security approaches

implemented in the region. This included community members, local government officials, representatives of Community Forest Associations (CFAs), and other stakeholders involved in environmental conservation and security.

Given the nature of the objective, it was essential to include participants with varying levels of exposure and involvement in environmental security initiatives. This allowed for a diverse range of perspectives and experiences to be captured, enhancing the depth and richness of the data collected (Palinkas et al., 2015).

The selection criteria for participants were clearly defined, ensuring that the sample was representative of the different stakeholder groups and the community at large. Informed consent was obtained from all participants, with an emphasis on the voluntary nature of participation and the confidentiality of their responses.

3.4.2.1 Analysis

The analysis for this objective incorporated both quantitative and qualitative methods to gain a comprehensive understanding of the impact of environmental security approaches on resilience building. Quantitative data were analysed using inferential statistics, specifically, impact evaluation techniques such as Difference-in-Differences (DID) and Propensity Score Matching (PSM), to ascertain the causal impact of environmental security approaches on resilience building (Angrist & Pischke, 2015). Employing Difference-in-Differences (DID) and Propensity Score Matching (PSM) methodologies. techniques were pivotal in mitigating biases, isolating causal effects, and providing a robust analysis of the interventions under scrutiny.

DID served as a cornerstone for analysing the causal impact of environmental security initiatives. By forming a treatment group of households within the Eastern Mau Forest exposed to these initiatives, and a control group from neighbouring areas not exposed, the study could compare changes in outcomes over time between these groups. Data regarding resilience-building indicators, including household income, community cohesion, access to forest resources, and perceived security, were meticulously collected from both groups before and after the implementation of the security approaches. The DID estimation was then executed, comparing the average change in the outcome

variable for both groups, isolating and highlighting the causal effect of the interventions on resilience building.

To address the challenge of selection bias and ensure the comparability between the treatment and control groups, PSM was incorporated into the study. Propensity scores, representing the likelihood of households being exposed to environmental security approaches, were calculated based on observable characteristics such as household size, income, education level, and historical engagement in forest conservation. Various matching algorithms were explored, and after identifying suitable pairs, balance checks were performed to ensure a similar distribution of covariates between the matched groups. This meticulous matching process paved the way for a credible estimation of the average treatment effect on the treated (ATT), shedding light on the causal impact of the environmental security strategies.

3.4.2.2 Integration of DID and PSM

The integration of DID and PSM in the study was not merely a methodological preference but a strategic approach to enhance the robustness of the causal inference. DID addressed time-invariant unobserved heterogeneity, while PSM focused on controlling for observable differences between the treatment and control groups. This symbiotic relationship between DID and PSM offered a comprehensive and nuanced assessment, enabling the study to draw more reliable conclusions about the impact of environmental security approaches on resilience building in the Eastern Mau Forest.

Qualitative data, gathered through interviews and focus groups, were subjected to thematic analysis. This involved coding the data, identifying recurring themes, and interpreting the findings to understand the nuances of how environmental security approaches influenced resilience building in the community (Nowell et al., 2017).

The integration of quantitative and qualitative findings provided a holistic view of the impact of environmental security approaches, shedding light on both the measurable outcomes and the lived experiences of the community members and stakeholders in Eastern Mau forest.

3.4.3 Objective 3: To examine of the threat of household socio-economic factors on environmental security & governance in Eastern Mau forest

In order to examine the threat of household socio-economic factors on environmental security & governance in Eastern Mau forest, a stratified random sampling method was employed. This approach facilitated the categorization of the population into distinct subgroups or strata based on specific characteristics, ensuring representation across various socio-economic factors. The strata included different income levels, education levels, occupations, and household sizes among the community members residing in and around the Eastern Mau forest region.

A sample frame listing all households in the region was developed with the assistance of Kenya National Bureau of Statistics (KNBS) census data of 2019, local administrative records and Community Forest Associations (CFAs). From each stratum, households were randomly selected to participate in the study. This procedure ensured that the diversity of socio-economic factors within the community was adequately represented, thereby enhancing the external validity of the findings (Creswell & Creswell, 2017). The census data provided a broad demographic context, while the survey data offered specific insights into the socio-economic dynamics and their impact on environmental issues within the community. The research aimed to identify threats posed by socio-economic factors and provide valuable information for policy and governance interventions.

The sample size was determined using a confidence level of 95% and a margin of error of 5%, resulting in a sufficiently large and diverse sample to make inferences about the population. Participants were informed about the purpose of the study, the confidentiality of their responses, and their right to withdraw from the study at any time.

The collected data were subjected to both descriptive and inferential statistical analyses using statistical software (e.g., SPSS). Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize and describe the main features of the collected data, providing a simple summary about the sample and the measures.

Inferential statistical analyses, such as regression analysis, were employed to examine the relationships between household socio-economic factors and their impact on environmental security & governance. Specifically, the analysis aimed to identify which socio-economic factors posed a significant threat to environmental security and governance in the region. The results of the regression analysis were used to test hypotheses and draw conclusions about the population (Field, 2013).

Additionally, the qualitative insights gathered through open-ended questions, interviews, and focus group discussions were analysed through thematic analysis. This involved identifying, analysing, and reporting patterns or themes within the data, providing in-depth insights into how household socio-economic factors influence environmental security and governance in Eastern Mau forest (Braun & Clarke, 2012).

3.4.4 Objective 4: To examine the effectiveness of stakeholders' role in shaping environmental security & the governance framework toward resilience building

To delve into the intricacies of stakeholder effectiveness in shaping environmental security and the governance framework, the research deployed a meticulously crafted sampling procedure. This encompassed the strategic selection of key stakeholders and resource persons who hold active roles in environmental security and governance within the Eastern Mau Forest community, employing a blend of purposive and purposive random sampling methods.

3.4.4.1 Non-Random Sampling

The study hinged on purposive sampling for the initial selection of key stakeholders and resource persons, ensuring the inclusion of individuals who wield critical influence and play pivotal roles in environmental security and governance. A diverse list of resource persons was compiled, representing a spectrum of sectors and organizations. This assortment included government representatives, NGO officials, private sector actors, and community leaders, each bringing a unique perspective to the table.

Rigorous selection criteria were instituted, aiming to identify individuals with substantial experience, expertise, or influence in matters intertwined with environmental security and governance in the Eastern Mau Forest.

Within the structured framework of purposive sampling, the study potentially employed purposive random sampling to select specific subsets of resource persons. This method amalgamated purposeful selection with an element of randomness, ensuring a diverse representation of sectors and backgrounds.

3.4.4.2 Data Collection

A multifaceted approach to data collection was adopted, involving in-depth interviews, focus group discussions, and documentary analysis. Key informant interviews delved into the roles, perspectives, and contributions of the selected resource persons, while focus group discussions facilitated open conversations and collective insights. Additionally, an analysis of relevant documents, reports, and records complemented the qualitative data, offering a more rounded view of stakeholder engagement and contributions.

3.4.4.3 Data Analysis

The research employed qualitative analysis on the collected data, involving thematic coding and content analysis to identify recurring patterns and themes. This comprehensive approach aimed to unravel the depth of stakeholders' effectiveness and their contributory dynamics in shaping environmental security and the governance framework towards resilience building in the Eastern Mau Forest community.

The meticulous sampling procedure and diverse data collection methods adopted in the study provided a comprehensive understanding of the effectiveness of stakeholders' roles. By analyzing their perspectives, experiences, and documented activities, the study offered valuable insights into the dynamics of stakeholder engagement and their impact on environmental security and governance within the Eastern Mau Forest.

3.4.5 Objective 5: To assess the adequacy of existing policies & legislative frameworks in environmental security & forest resource governance

3.4.5.1 Review of Policies and Legislative Frameworks

To accomplish the fifth objective, the research embarked on an extensive review of the existing policies and legislative frameworks steering environmental security and forest resource governance. This critical assessment entailed examining both national and regional legislations, policies, guidelines, and strategic plans that have a bearing on the environmental and forest resource management in the Eastern Mau Forest. The objective was to scrutinize their comprehensiveness, effectiveness, and alignment with contemporary environmental challenges and community needs.

The study investigated several policy documents and legislations. One such document was the Kenya Forest Act (2016), which governs the management and conservation of forest resources. The Act's provisions, including those on community forest associations and participatory forest management, were scrutinized to gauge their effectiveness in fostering sustainable forest governance. Additionally, the Environmental Management and Coordination Act (EMCA) of 1999 was evaluated, focusing on its mandates on environmental conservation and the regulatory mechanisms in place to ensure compliance.

3.4.5.2 Alignment and Relevance

A critical aspect of the policy analysis was determining the alignment and relevance of these legislations with the unique challenges and needs of the Eastern Mau Forest. For instance, the alignment of the Forest Act with the community's conservation needs was assessed by examining the extent of community participation in forest management as stipulated by the Act. The research also evaluated whether the EMCA's provisions on environmental conservation were congruent with the prevailing environmental challenges such as deforestation and climate change impacts in the region.

3.4.5.3 Evaluation of Enforcement Mechanisms

The enforcement mechanisms within the legislations were thoroughly assessed. For example, the effectiveness of the penalties and sanctions outlined in the Forest Act for illegal logging and other forest-related offenses were evaluated. The study also examined the role of forest rangers and the collaboration between community forest associations and government agencies in enforcing the Act.

3.4.5.4 Community Inclusion in Policy Formulation and Implementation

The level of community inclusion as stipulated by the policies was a key area of focus. The study analysed how the Forest Act facilitated or hindered community involvement in forest management. It also explored whether the EMCA provided mechanisms for community participation in environmental conservation initiatives and how these provisions impacted the community's role in safeguarding the Eastern Mau Forest.

3.4.5.5 Addressing Emerging Environmental Threats

The research evaluated how well the policies and legislative frameworks addressed emerging environmental threats such as climate change, biodiversity loss, and increased human activities. It assessed the provisions within the Climate Change Act (2016) of Kenya and its strategies for adaptation and mitigation, particularly focusing on how these strategies are integrated into forest resource governance in the Eastern Mau region.

The expansive policy analysis, comprising the evaluation of policy documents, alignment and relevance check, scrutiny of enforcement mechanisms, community inclusion assessment, and addressing emerging environmental threats, provided a comprehensive perspective on the adequacy and gaps in the existing policies and legislative frameworks. This in-depth analysis, supplemented with specific examples, enriched the understanding of how these policies and legislations are shaping environmental security and governance in the Eastern Mau Forest.

3.5 Data Collection Procedure

This study employed use of questionnaires, focused group discussions (FGDs), key informant interviews, and observations when conducting fieldwork. These research tools were employed to obtain primary data. To obtain the secondary data, the study utilized use of secondary data that involved document analysis and extraction of data relevant to the study. Administration of questionnaires was carried out among the household heads around the Mau Complex. The key informant interview targeted professionals and experts from the environmental ministry and lands, the conservations units and other government parastatals like KWS, KWTA and KFS.

The use of questionnaires has been suggested due to their importance in allowing the researcher to collect data objectively (Hair, 2016). Following the development of a preliminary version of the questionnaire, a set of pretests was carried out, following which the final version of the questionnaires was drafted and validated to ensure that they had all of the necessary information. -In addition, the researcher used self-administration to present the study questions to the chosen respondents. Considering the schedules and limited time the respondents had, the researcher employed a strategy called "drop and pick later," giving the respondents three days to finish answering the study questions (Smith, 2015). Thus, the data collection instruments in the study are important because they help collect data that can be analysed and interpreted to address the research questions and problems, providing recommendations and conclusions. In this study, the questionnaire instruments used consisted of close-ended questions which would enable better quantitative analysis.

The questionnaires were based on the study's key objectives. The use of questionnaires has been suggested due to their importance in allowing the researcher to collect data objectively and use descriptive statistics and correlation analysis (Hair, 2016). The questionnaires were designed to comprise five key sections with the first being for demographic data, the second part environmental security approaches, the third measures household socio-economic factors, the fourth part assessing the effectiveness of existing policies and legislative frameworks, and the fifth part investigating stakeholders' role in

resilience building and shaping environmental security and the governance framework towards resilience building.

Researchers interviewed Key Informants (Government, NGO, and County administrative units). Based on this interview, the researcher was assessing the Key Informants' (Government, NGO, and County administrative units) outlooks on investigating stakeholders' role in resilience building and shaping environmental security and the governance framework towards resilience building. In order to meet the study's goals, the interview guidelines were developed based on the research thematic areas. There were also 3 focus group discussions one for men the other for women and lastly for youth ages (18-35). The research employed 4 research assistants in total. In each FGD there were 8 participants giving an overall total of 24 participants. Purposive sampling was used to select the members of FGDs and people who were knowledgeable with issues under investigation were recruited. Triangulation was enhanced by FGDs which helped reduce research bias that comes from using a single method, or investigator. It also helps validity by approaching the same topic with different tools, which gives a researcher a complete picture of the research problem.

3.5.1 Pretesting for Validity and Reliability

In the research project, pretesting was an essential step undertaken to enhance the validity and reliability of the measurement instruments employed in the study. This process involved selecting a representative subset of respondents who were not part of the main study, specifically targeting East Mau Forest residents. The rationale for choosing this group was their direct involvement in forest management strategies and governance, aligning with the study's investigative focus.

The pre-test was conducted with a target sample size comprising 10% of the eventual respondents of the main study, a common practice in research design (Mugenda & Mugenda, 2003). Fourteen respondents from East Mau Forest residents participated in the pre-test. This sample size was thoughtfully selected to balance the need for thorough evaluation with the manageable logistics of the pretesting process.

Pretesting, as suggested by Bajpai (2011), served a crucial purpose in assessing whether the research questions developed by the researcher effectively addressed the research problem. The primary objective was to evaluate the clarity and appropriateness of the questions, ensuring that respondents' understanding aligned with the expected outcomes. In line with the perspective of Bryman and Bell (2011), pretesting can be seen as a small-scale study aimed at refining and developing research instruments. The insights gained from the pre-test respondents played a vital role in improving the quality of the final questionnaire.

During the pre-test, respondents' interactions with the survey instruments were closely observed. Any ambiguities or difficulties in comprehending the questions were noted and analysed. This process helped pinpoint areas in the research instruments that required refinement and adjustment. Question wording was modified for greater clarity, response options were fine-tuned, and any redundant or confusing items were eliminated.

In the research study, one of the critical aspects of the research methodology involved the assessment of the validity and reliability of the measurements used to gather data. According to Lewis and Thornhill (2016) reliability and validity testing are done to test the degree of internal consistency of the research instruments. To accomplish this, the study incorporated the use of the Cronbach's Alpha test statistical tool, to ensure the quality and consistency of the research instruments.

In the context of this research, Cronbach's Alpha was used to evaluate the reliability of survey questions and scales designed to collect data on various aspects of environmental security, resilience building, and governance within the Eastern Mau forest community.

Application of Cronbach's Alpha test in the study followed a systematic procedure outlined below:

- a. **Selection of Items** - Initially, a set of survey items or questions relevant to the research objectives was chosen. These items were grouped into scales or constructs representing different aspects of environmental security, resilience, or governance.

- b. **Data Collection** - Data was collected from the study participants using the selected survey instruments. The participants, comprising community members, stakeholders, and other relevant individuals, responded to the survey items.
- c. **Data Analysis** - After data collection, Cronbach's Alpha was computed for each scale or construct independently. This involved a mathematical calculation that assessed the internal consistency among the items within each scale.

$$\alpha = \frac{N}{N - 1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma_T^2} \right)$$

Where:

α (Cronbach's Alpha) is the reliability coefficient.

N is the number of items or questions in the scale.

k is the number of items.

σ is the variance of the scores on each item.

T is the variance of the total scores on all items.

The study assessed the internal consistency and reliability of three variables namely: Environmental Security, Resilience Building, and Governance. Each variable was represented by a set of items or questions, and the number of items in each variable was specified in the table.

Table 3.2: Reliability Tests

Variable	No. of items	Cronbach's Alpha
Environmental Security	10	0.87
Resilience Building	8	0.79
Governance	12	0.91

Source: Field Survey, (2021)

The Cronbach's Alpha value for the *Environmental Security* variable is 0.87. This value exceeds the commonly accepted threshold of 0.70, indicating strong internal consistency among the items within this variable. It suggests that the items within the Environmental Security scale are measuring the same underlying construct reliably.

For the *Resilience Building* variable, the Cronbach's Alpha value is 0.79. Similar to the Environmental Security variable, this value surpasses the 0.70 threshold, signifying good internal consistency among the items within the Resilience Building scale. The items in this scale are reliably measuring the intended construct of resilience.

The *Governance* variable demonstrates an even higher Cronbach's Alpha value of 0.91. This value significantly exceeds the 0.70 threshold, indicating very strong internal consistency among the items within the Governance scale. It suggests that the items in the Governance variable are exceptionally reliable in measuring the construct of governance.

The Cronbach's Alpha test results for these three variables in the study demonstrate that all of them have satisfactorily passed the test for internal consistency and reliability. This means that the survey items or questions within each variable are consistent in measuring the respective constructs of Environmental Security, Resilience Building, and Governance.

These high Cronbach's Alpha values provide confidence in the quality of the data collected for these variables. As such, the study could rely on these measurements to draw meaningful conclusions and make informed decisions based on the research findings Sürücü & Maslakçi (2020). Additionally, the results suggest that the survey instruments used to gather data on these constructs are well-designed and capable of producing reliable results, enhancing the credibility of the study's outcomes and insights into the Eastern Mau forest community's environmental security, governance dynamics, and resilience-building efforts.

3.6 Data Analysis

The research study employed a comprehensive data analysis approach to extract meaningful insights from both quantitative and qualitative data. This section outlines the data analysis methods and tools used to address the research objectives.

To analyse the quantitative data collected through the survey design, the research utilized Statistical Package for the Social Sciences (SPSS) Version 25 software. SPSS is a powerful tool known for its capability to conduct various statistical analyses, including ANOVA, cluster analysis, component analysis, and correspondence analysis. These analyses are well-suited for examining trends in living conditions, risk assessments, environmental insecurity, resource depletion, population movements, and socioeconomic and institutional markers (Trochim, 2000).

To gather accurate and comprehensive information on household income, a combination of primary and secondary data sources was utilized. Primary data collection involved conducting structured surveys and interviews with household heads or primary income earners within the selected sample. During these surveys, respondents were asked to provide details about various sources of income, including but not limited to:

- a. **Wages and Salaries** - This category encompassed income earned from formal employment, including monthly salaries, bonuses, and any additional compensation.
- b. **Self-Employment and Entrepreneurship** - Income generated from entrepreneurial activities, self-employment, or small businesses was documented, including profits from agricultural endeavours or other sources.
- c. **Investments and Financial Assets** - Information regarding income from investments, such as dividends, interest, and capital gains, was collected.
- d. **Social Transfers** - Any financial assistance received from social welfare programs, pensions, or government subsidies was noted.

- e. **Other Sources** - Respondents were encouraged to report any miscellaneous sources of income, including rent from property, remittances from family members, or any other financial inflows.

The total household income (THI) was computed by summing the income from all reported sources. The formula for calculating THI is as follows (De Vaus, D. A. 2014):

$$THI = \sum_{i=1}^n I_i$$

Where:

THI represents the total household income.

n is the number of income sources reported by the household.

I_i denotes the income from each respective source.

The formula allowed for a straightforward summation of all income streams, providing a comprehensive view of the household's economic resources. It is essential to note that this calculation provides a snapshot of income at a specific point in time, which can be extrapolated to annual or monthly figures as required for the study's analysis.

The primary statistical tools used for the analyses of income inequalities and changes in socioeconomic components within the Eastern Mau forest community were the Tukey B and one-way Analysis of Variance (ANOVA) tests. These statistical methods are powerful tools for comparing means and identifying significant differences among multiple groups.

The one-way ANOVA test was employed to examine variations in socioeconomic components within the Eastern Mau forest community. This test allowed the researcher to assess whether there were statistically significant differences in these components among various groups. The formula for the one-way ANOVA F-statistic is as follows:

$$F = \frac{MSB}{MSW}$$

Where:

F represents the F-statistic.

MSB denotes the mean square between groups.

MSW denotes the mean square within groups.

The F-statistic was then compared to a critical value or p-value to determine statistical significance. If the F-statistic exceeded the critical value or if the p-value was less than the chosen significance level (usually 0.05 or 5%), it indicated that at least one group significantly differs from the others in terms of the assessed socioeconomic component.

The Tukey B test, also known as the Tukey-Kramer test, is a post hoc test applied after conducting the ANOVA test. Its purpose was to compare the means of multiple groups and identify specific groups that exhibit significant differences in income. This test was particularly valuable when dealing with multiple groups and provided detailed insights into income disparities. The formula for the Tukey B test statistic is not presented here due to its complexity but was calculated using SPSS statistical software, by selecting the "Post Hoc" options and selecting "Tukey" for multiple comparisons.

Both the one-way ANOVA and Tukey B test were crucial in assessing income disparities and socioeconomic changes within the Eastern Mau forest community. The one-way ANOVA helped identify whether significant differences existed among various socioeconomic components, shedding light on the overall socioeconomic landscape. On the other hand, the Tukey B test was instrumental in pinpointing specific income disparities among different groups within the community.

The significance level chosen for these tests was 0.05 or 5%. This significance level served as the threshold to determine whether the results were statistically significant. If the calculated p-value was less than 0.05, it would indicate that there were statistically significant differences or inequalities in income or socioeconomic components.

By employing these parametric tests and adhering to rigorous statistical assumptions, the research enhanced the credibility and validity of its findings. The

one-way ANOVA and Tukey B tests played pivotal roles in analysing income inequalities and socioeconomic changes, allowing for a comprehensive assessment of the Eastern Mau forest community's socioeconomic landscape. These tests provided statistically valid insights that contributed to the study's robust findings and conclusions.

In this study, the qualitative data obtained from open-ended questions, interviews, and focused group discussions provided a deeper and nuanced understanding of the research questions. These qualitative insights shed light on the perceptions, beliefs, experiences, and cultural narratives of the respondents, which quantitative data alone could not capture (Braun & Clarke, 2013).

After the collection of qualitative data, the process of transcription was initiated. All verbal and non-verbal data from interviews and group discussions were transcribed verbatim to retain the authenticity of the respondents' expressions and to ensure that the subtleties and nuances in their narratives were maintained (Saldaña, 2015). Once the transcriptions were completed, they were read multiple times to gain a thorough familiarity with the data, setting the stage for coding.

The primary method employed for qualitative data analysis was coding. In the initial phase, open coding was applied, wherein raw data were divided into segments and labelled based on their thematic essence (Charmaz, 2014). This involved breaking down the transcriptions line by line, identifying preliminary patterns, and creating initial codes. Subsequently, axial coding was used, which involved grouping these initial codes into broader categories, creating a more organized and structured dataset. Themes and sub-themes began to emerge as codes were further refined, collapsed, or expanded based on recurring patterns and interconnectedness.

Throughout the coding process, constant comparison was employed. This iterative method ensured that data segments were consistently compared with each other and with existing codes to refine categories and align them with the emerging themes (Glaser & Strauss, 2017). Furthermore, memo-writing was regularly practiced during the coding phase. Memos captured analytical thoughts, relationships between codes, and potential

interpretations, serving as a bridge between coding and the development of a coherent narrative (Saldaña, 2015).

The use of qualitative data analysis software further facilitated the organization and categorization of codes, ensuring accuracy and efficiency. Additionally, to validate the findings, member-checking was performed. Respondents were provided with summaries of the analyzed data to confirm that the interpretations resonated with their experiences and views, thereby enhancing the credibility of the findings (Creswell & Poth, 2018). The systematic approach to qualitative data analysis, grounded in established methodologies, ensured that the voices, perspectives, and lived experiences of the respondents were rigorously and authentically represented in the study's findings.

In presenting the findings of this study, meticulous attention was given to ensure that the data acquired and analysed are conveyed in a comprehensive and intelligible manner. This is pivotal for a coherent understanding and interpretation of the results, especially in the context of environmental security and resilience in the Eastern Mau Forest community.

Initially, descriptive statistics were utilized to offer an elementary understanding of the data collected. These statistics provide a summary about the main aspects of the data, ensuring the simplification of large amounts of data in a sensible way. Measures like mean, median, mode, and standard deviation were calculated to provide insight into the central tendency and dispersion of the responses (Field, 2013).

Graphical tools such as bar charts, histograms, pie charts, and line graphs were employed to visually depict the data. This visual representation not only facilitates a quicker interpretation of the data but also highlights patterns, trends, and outliers that might be less discernible in textual or tabular presentations (Creswell, 2014).

For qualitative data, a narrative analysis approach was adopted. This involves organizing the data into a structured format and weaving together individual narratives to bring forth predominant themes and patterns. Through narrative analysis, the personal experiences and perspectives of the Eastern Mau Forest community were captured and highlighted, providing depth and context to the quantitative findings (Riessman, 2008).

To assess relationships between different variables, cross-tabulation was performed, supported by inferential statistics. This deeper layer of analysis was necessary to deduce potential correlations or significant differences between key variables and to determine the strength and direction of such relationships (Pallant, 2016).

To ensure the trustworthiness of the findings, the data was subjected to reliability and validity checks. Cronbach's alpha, for instance, was used to ascertain the internal consistency of the instruments, and expert reviews were sought to validate the alignment of the findings with the objectives of the study (Tavakol & Dennick, 2011).

In sum, the presentation of findings was framed to be as transparent, comprehensive, and digestible as possible. The synthesis of quantitative and qualitative data aimed to provide a holistic understanding of the study's focal areas, corroborating the empirical results with existing literature and theories in the field.

Use of the multiple regression model in the research project played an important role in understanding the multifaceted dynamics of environmental security and governance in the Eastern Mau forest community, and in examining complex relationships between various independent variables and the dependent variables of interest. It allowed for the quantitative assessment of the relationships between various factors and the key outcomes of interest, ultimately contributing to evidence-based proposals for decision-making and policy formulation for the betterment of resilience building.

Additionally, the research study was designed to address multiple objectives, including the assessment of the impact of environmental security approaches, the examination of household socio-economic factors, and the evaluation of stakeholders' effectiveness in shaping environmental security and governance, among others. Multiple regression was chosen as a modeling technique to address research questions that involved more than one independent variable, allowing for the exploration of the combined effects of various factors on key outcomes.

In applying the multiple regression framework, the primary components of interest included:

Dependent Variables; These represented the outcomes or variables of interest that the research aimed to explain or predict. In the research, dependent variables were measures related to resilience-building indicators such as; Financial capital, Human capital, Social capital, Physical Capital, and Natural capital.

Independent Variables; These were factors, attributes, or predictors that were hypothesized to influence the dependent variables outlined above. Independent variables encompassed a wide range of factors, such as socio-economic characteristics, policy variables, environmental indicators, and stakeholder engagement measures.

The multiple regression models in this research were carefully specified based on the research objectives and the theoretical framework guiding the study. The study identified a set of independent variables believed to have a significant impact on the chosen dependent variables, and incorporated these into the model as predictors.

Multiple regression analysis was conducted to assess the relationships between the dependent variable and the chosen independent variables. The analysis aimed to quantify the strength and direction of these relationships. The coefficients generated by the multiple regression models were interpreted to understand the impact of each independent variable on the dependent variable while controlling for other variables in the model.

Table 3.3: Model Summary

Model	R	R Square	Adjusted R Square	Std. The error in the Estimate
1	.816 ^a	.666	.660	.16873

a. Predictors: (Constant), Governance, social-economic factors, existing policy and legislative framework, and stakeholders' role

Source: Field Survey (2021)

The model presented a correlation value of .816^a, showing a robust linear connection between variables (independent and dependent), as shown in Table 3.3. The Table shows R-square values of .666 with adjusted errors to .16873. This indicates that predictor variables contribute to about 81.6% of changes in Resilience building and environmental security and governance processes.

Table 3.4: ANOVA^a

Models	Sums of Squares	Df	Mean Square	F	Sig.
Regression	12.697	4	3.174	111.490	.000 ^b
Residual	6.377	224	.028		
Totals	19.074	228			

a. Independent Variables: Environmental security, and governance building

b. Dependent Variable: Resilience

b. Predictors: (Constant), Financial, human, social, natural capitals, and physical capital.

Source: Field Survey (2021)

Results outlined in the Table 3.4 demonstrate that there is significance of the model due to an F-test value of 111.490 at a significance value of 0.000 p-value-0.05), indicating that the null hypothesis was rejected and a conclusion was reached that there is a significant relationship between the combined variables and Resilience building and environmental security and governance processes.

Table 3.5: Coefficients^a

Models	Unstandardized Coefficients		Standardized Coefficients		Sig.
	B	Standard Error	Beta	T	

1	(Constant)	1.178	.054	21.899	.000
	Governance	-.176	.020	-.479	-8.632 .000
	Social-economic and political factors	.238	.015	1.013	16.091 .000
	Existing policy and legislative framework	.076	.034	.128	2.203 .029
	Stakeholders' role	-.313	.039	-.525	-8.094 .000

a. Dependent Variable: Resilience building and environmental security and governance processes

Source: Field Survey (2021)

From Table 3.5, the following regression equation was established:

Resilience building =

$$1.178 - .176 \text{ Governance} + .238 \text{ Social - economic and political factors} + .076 \text{ Existing policy and legislative framework} - .313 \text{ Stakeholders' role}$$

When other factors (Governance, social-economic and political factors, existing policy and legislative framework, and stakeholder's role) are at zero, the Resilience building will be 1.178. Holding (social-economic and political factors, existing policy and legislative framework, and stakeholder's role) constant, a unit increase in Governance would lead to a 0.176 decrease in resilience building. Holding other factors (Governance, existing policy, legislative framework, and stakeholder's role) constant, a unit increase in social-economic and political factors would lead 0.238 increase in resilience building. Holding (Governance, social-economic and political factors, and stakeholder's role) constant, a unit increase in existing policy and legislative framework would lead to a 0.76 decrease in resilience building. Furthermore, (Governance, social-economic and political factors, and existing policy and legislative framework) constant, a unit rise in stakeholder's role would result in a 0.313 reduction in Resilience building.

The findings show that all variables (Governance, social-economic, and political factors, existing policy and legislative framework, and stakeholder's role) have sig-values (.000, .000, .029, and 0.000) < p-value (0.05), leading to a conclusion that there is a significant relationship between environmental security and forest governance systems and they impact on resilience building in the Eastern Mau forest.

The research evaluated the overall fit of the multiple regression models to assess how well they explained the variance in the dependent variable. Common measures of model fit, such as R-squared, were used to gauge the models' explanatory power.

3.7 Logistical and Ethical Considerations

In the process of working with human subjects, the research tried to adhere to the three most important ethical standards, which are the principles of respect, beneficence, justice, and equity. The research endeavoured to maintain respect for the individuals who participated in the study by ensuring that adequate information and guarantees were provided to them on their involvement. The research committed to ensuring that the greatest possible degree of impartiality was maintained throughout all of the conversations and analyses that are conducted during the study. The reference system was utilized to provide proper credit where credit is due to authors of works that were used in any capacity throughout the investigation. After the Kenyatta University Graduate School had finished their evaluation, permission was granted for application of a research permit, which was secured by applying to the National Commission for Science, Technology, and Innovation (NACOSTI).

CHAPTER FOUR: RESULTS AND DISCUSSION

4.0 Introduction

The chapter provides an assessment of data obtained from questionnaires that were given to the people of the Mau forest, as well as the discoveries that resulted from that study. The information that was provided by the respondents was evaluated, and the essential variables that were included within it were retrieved by the researcher. The observations were examined, and outcomes were presented using descriptions, tables, pie charts and graphs.

4.1 Objective 1: To Examine the General Characteristics of the Eastern Mau Forest

The initial objective of this study centred on elucidating the fundamental characteristics of the Mau Complex, with the findings thereof detailed in the ensuing section. Employing a questionnaire as a primary tool, the research aimed to systematically unearth and assemble the foundational information pertaining to the respondents. The data gleaned from this phase proved indispensable to the research endeavour, as it facilitated the establishment of essential baselines for subsequent evaluations and aided in understanding the underlying rationale behind the diverse responses, thereby providing a more nuanced perspective to the analysis. This served to lay the foundational framework upon which further interpretations of the research were constructed.

4.1.1 Demographic Composition by Gender

A majority of the respondents, representing 70.74% of the sampled residents, were male, while females constituted 29.26%. This study incorporated participants from both genders to assess the impact of governance on resilience in the Mau Forest, aligning with the gender distribution in Kenya, which, according to the Kenya National Bureau of Statistics (2019), has 98.76 men for every 100 women, a slight increase from 98.70 men per 100 women recorded in 2015.

Inclusion of both sexes was pivotal as numerous studies, including that by Agarwal (2018), have underscored the significant role gender plays in determining individuals' adaptability to their environment. Agarwal posits that there is growing evidence supporting the correlation between gender equality and enhanced environmental outcomes. Women's leadership in addressing climate change is multifaceted, spanning from altering emerging trends to advancing rainwater harvesting and conservation agriculture initiatives. Their contributions are evident in organizing disaster resilience and emergency preparedness and adopting energy consumption patterns that minimize household carbon footprints. Women leaders globally are actively engaged in enhancing household living standards and safeguarding the environment from further degradation.

4.1.2 Demographic Composition by Age

Also, the study established the age range distribution of respondents and findings plotted in Figure 4.2.

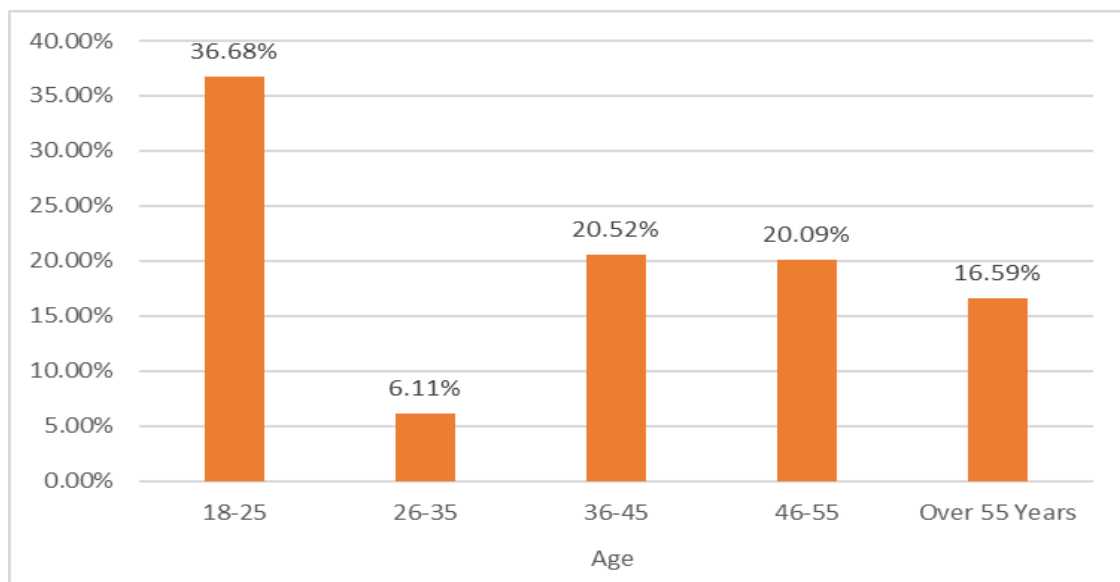


Figure 4.1: Age of Respondents

Source: Field Survey (2021)

The results in figure 4.1 presents participants' age whereby the majority (36.68%) were aged between 18 and 25 years, 20.52% were between 36 and 45 years, 20.09% stated that they were between 46 and 55 years, and 16.59% were aged over 55 years. The findings

show that the Mau residents are distributed in age, thus possibly impacting environmental governance and community resilience as will be demonstrated in subsequent results.

4.1.3 General Physiographic Characteristics affecting Resilience Building in East Mau Forest

Environmental security encapsulates the symbiotic relationship between the preservation of ecosystems and the protection of human populations from ecological degradation and its associated repercussions. In this context, it was imperative to evaluate the measures and strategies implemented to safeguard both the environment and the communities residing within and around the Eastern Mau Forest.

The Eastern Mau Forest is a biodiversity hotspot, playing a pivotal role in regulating climate, preserving soil integrity, and sustaining a plethora of flora and fauna. It also serves as a vital resource for the neighbouring communities, offering essential goods and services such as clean water, food, and fuel. Consequently, striking a balance between ecological conservation and community resilience becomes a paramount objective. This section of the study sought to unravel the intricacies of the environmental security measures in place and their influence on fortifying the resilience of the Eastern Mau forest community. It aims to investigate the efficacy of various environmental security strategies, identify potential gaps, and explore the adaptability and responsiveness of the community to these approaches.

The exploration of this objective is anchored in the belief that fostering environmental security is foundational to cultivating resilient communities capable of adapting to changes, mitigating vulnerabilities, and contributing to the sustainable stewardship of their natural environment. By dissecting the relationship between environmental security approaches and resilience building, this section illuminates pathways for enhancing the wellbeing of both the Eastern Mau Forest and its inhabitants. The following were environmental issues noted in Eastern Mau from the study:

4.1.3.1 Climate Change

4.1.3.1.1 Rainfall

Assessing the rainfall data is pivotal in understanding the implications of climate change on the Eastern Mau forest community. Rainfall patterns directly influence the availability of water resources, biodiversity sustenance, and agricultural productivity, thereby shaping the resilience and adaptability of the community. Fluctuations in rainfall can trigger ecological imbalances, affect food security, and alter the socio-economic dynamics of the community. By analyzing historical rainfall data, we aim to identify trends and variations, assess their impacts on the forest ecosystem and the community, and establish a foundation for developing adaptive environmental security strategies.

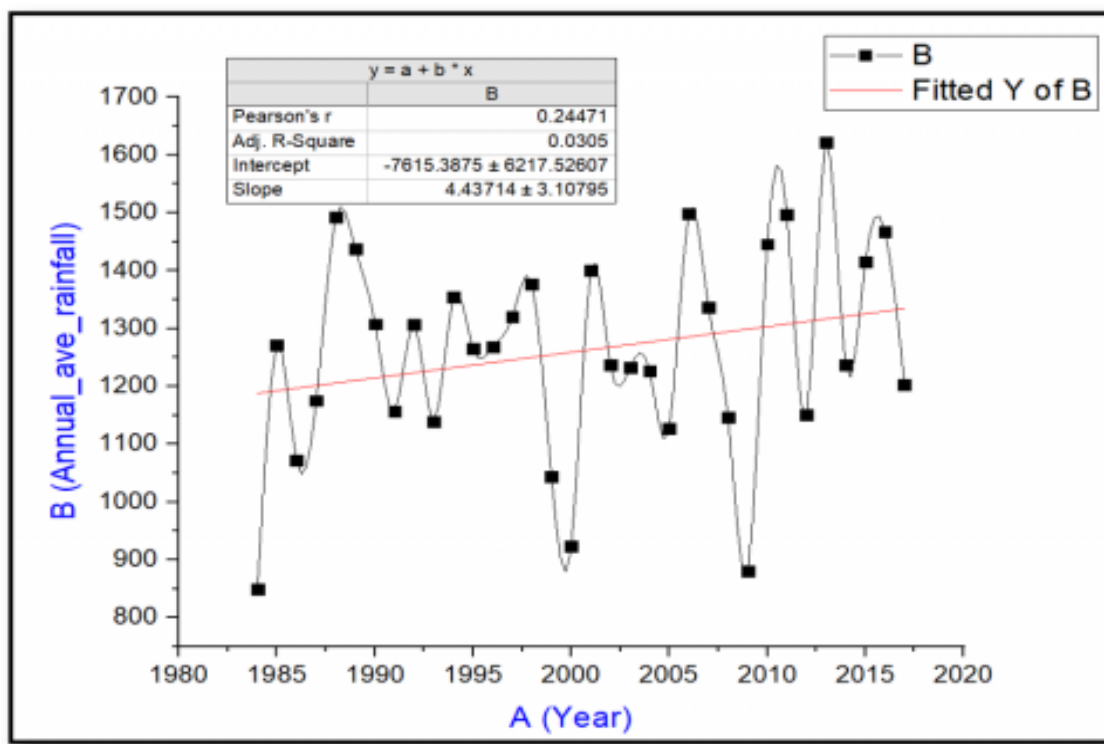


Figure 4.2: Annual Average Precipitation (mm)
Source: Meteorological Department (KMD), (2021)

The analysis of the monthly and annual means of gridded rainfall data, spanning from 1984 to 2020, reveals a nuanced picture of rainfall patterns in the study area (Figure 4.2). The highest annual rainfall recorded was in 2013, at approximately 1622 millimetres, while the lowest figures were observed in 1984 and 2009, at around 850 mm and 880 mm, respectively. Despite the decrease in forest cover over the years, a slight upward

pattern in rainfall was noted. However, the adjusted R-Square value of 0.0305 indicates limited significance to this trend.

Although initial observations suggested a potential increase in rainfall, the Mann-Kendal (MK) test yielded a low tau value of 0.135, indicating that the increment in average rainfall over the years did not exhibit a strong trend. This is supported by a high two-sided p-value of 0.27264, implying the absence of a significant pattern and suggesting that the variations in rainfall are essentially random. This was calculated from the dataset using the following formula:

$$S = \sum_{i=1}^{n-1} \sum_{j=i+1}^n \text{sgn}(x_j - x_i)$$

Where:

n is the total number of data points or observations in the time series.

X_i and X_j are data points in the time series, where i and j are the indices of the observations, and $j > i$.

S is the test statistic, which is the sum of the signs of the differences between all pairs of data points. It indicates the trend in the data series.

$\text{sign}(X)$ is a function that returns 1 if $X > 0$, 0 if $X = 0$, and -1 if $X < 0$. It is used to determine the sign of the difference between each pair of data points ($X_j - X_i$).

$\text{Var}(S)$ is the variance of the test statistic S . It is used to calculate the standard deviation of S .

σS is the standard deviation of the test statistic S . It is calculated as the square root of the variance of S and is used to normalize S to obtain the tau value.

Z is the normalized test statistic, which is approximately equal to the tau value. It indicates the strength and direction of the trend. A positive value would have indicated an

increasing trend, a negative value indicates a decreasing trend, and a value close to zero indicates no significant trend.

τ (Tau) is the Kendall rank correlation coefficient, which measures the strength and direction of the trend in the time series. It was calculated as the normalized test statistic Z .

The Mann-Kendall (MK) test was employed as it is a robust non-parametric statistical test widely used to detect trends in time series data, especially in environmental and climatological research. Given the variability and unpredictability inherent in rainfall patterns, the MK test was deemed suitable for identifying any significant trends or shifts in the rainfall data over the study period. This test does not assume a specific distribution of the data, making it advantageous for analysing environmental datasets that often exhibit non-normal distributions. By utilizing the MK test, the study aimed to discern whether the observed fluctuations in rainfall represented a random variation or were indicative of an underlying trend, thereby contributing to a more nuanced understanding of climate dynamics in the Eastern Mau forest community.

The findings from this section resonate with those of Jebiwott et al. (2021) in the Marsabit Forest Ecosystem Reserve, where the MK-test also indicated no significant trend in rainfall patterns, signifying the region's susceptibility to unpredictable shifts in rainfall. Similarly, a study by Gebrechorkos et al. (2019) in Eastern Kenya found variations in rainfall patterns, with periods of La Nina and El Nino affecting the local climate, aligning with the observed fluctuations in the study.

These results provide a consistent narrative with previous research, highlighting the inherent variability and unpredictability in rainfall patterns across different regions in Kenya. The absence of a definitive trend in rainfall, as depicted in both the current study and earlier research, underscores the complexity of climate dynamics and the challenges posed to environmental security and community resilience.

The findings from the Eastern Mau forest community, juxtaposed with the results from similar studies, underscore the intricate nature of rainfall patterns and their implications for environmental security. The observed fluctuations and randomness in rainfall,

consistent with Jebiwott et al. (2021) and Gebrechorkos et al. (2019), reinforce the need for adaptive strategies to build resilience in the face of uncertain climate conditions. While the studies reviewed did not indicate a consistent trend of decreasing or increasing annual or seasonal rainfall, they highlighted the variability and unpredictability that characterize rainfall patterns. This unpredictability necessitates a proactive approach in environmental management and community engagement to mitigate potential adverse effects on biodiversity, water resources, and agricultural productivity.

The nuanced understanding gleaned from analyzing rainfall data, coupled with insights from the reviewed literature, offers a foundation for developing informed and adaptive environmental security approaches to enhance the resilience of the Eastern Mau forest community. The absence of a consistent rainfall trend underscores the importance of continual monitoring and research to inform adaptive management strategies and policy interventions, fostering a harmonious balance between ecological conservation and community wellbeing.

4.1.3.1.2 Temperature

Analysing temperature data is vital to understand the shifts and variations in temperature within the Eastern Mau forest community, which can subsequently influence the environmental security and resilience of the community. Assessing temperature trends enables the identification of patterns of climate change, such as global warming, which have significant impacts on ecosystems, biodiversity, and human livelihoods. By scrutinizing temperature fluctuations, the study aims to shed light on the potential impacts on the forest's microclimate, which in turn, affects the adaptive capacities and vulnerabilities of the local community and ecosystem to climatic changes.

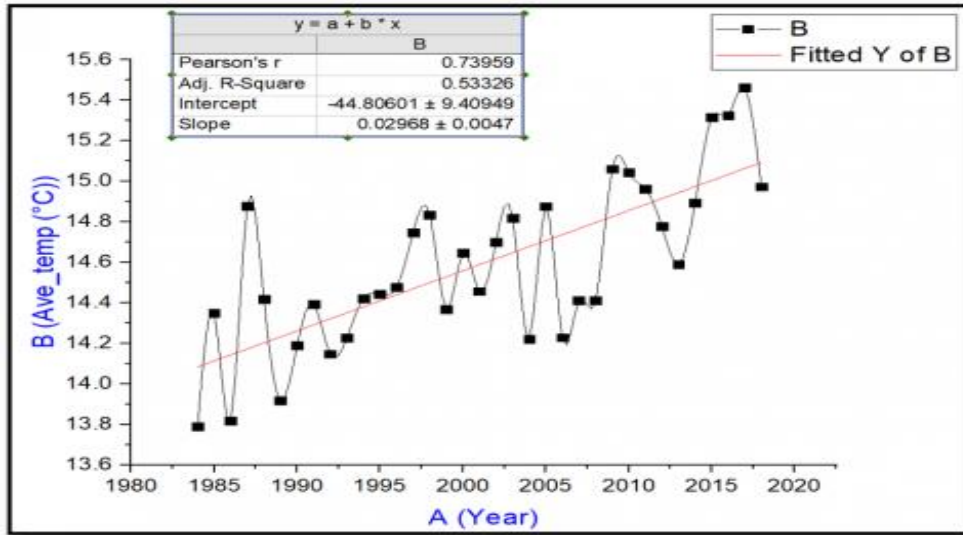


Figure 4.3: Annual Average Temperature
 Source: Meteorological Department (KMD), (2021)

The analysis focused on the annual averages of minimum and maximum temperatures from 1984 to 2020 to assess trends in temperature changes, as illustrated in Figure 4.3. Over this period, the average annual temperature increased by nearly 2 degrees Celsius. The trendline, through simple regression analysis, reveals significant temperature increases over the past 30 years. This observation was supported by Key Informant Interviews, indicating noticeable climatic fluctuations in East MAU, marked by unpredictable rainfall patterns, protracted droughts, and extended cold seasons. Participants concurred that extended droughts had become more frequent, with irregular weather patterns being a recurrent theme. Instances of powerful, yet short-lived rainfall, resulting in flooding, and unpredictable weather affecting farming activities were also reported.

These findings align with Kayombo et al. (2020), who associated the loss of forest cover with higher and drier local temperatures in Marsabit, suggesting that the temperature increases observed in the Mau complex were not exclusively due to changes in forest cover, but also reflective of broader regional temperature trends. Another regional study by Wolff et al. (2021), spanning Kenya, Tanzania, and Ethiopia, found tendencies for increases in minimum and maximum temperatures of more than +1.2°C and +1°C,

respectively, particularly during the long rains period of March, April, and May, although the increase in precipitation was not statistically significant.

These studies, when viewed collectively, underscore the complexity of climatic fluctuations and their multifaceted impacts on environmental security and community resilience. The observed temperature trends in the Eastern Mau region are consistent with broader regional patterns, emphasizing the importance of understanding local climatic variations within the larger context of regional and global climate change. Such insights are instrumental in formulating adaptive strategies and enhancing the resilience of both the ecosystem and the community residing within it.

4.1.3.2 Energy

4.1.3.2.1 Main Source of Energy

Main Sources of Energy data is fundamental as it sheds light on the energy consumption patterns of the Eastern Mau forest community. Understanding these patterns is essential for assessing the community's impact on the environment and forest resources, given the potential ecological repercussions of different energy sources. The reliance on particular types of energy can lead to resource depletion, deforestation, and environmental degradation, thereby affecting the resilience and sustainability of both the community and the ecosystem. This analysis also informs the development of appropriate energy policies and interventions aimed at promoting sustainable energy use and mitigating environmental impacts. Participants were asked to indicate the main energy source among communities around the Mau forest. The results were as presented below;

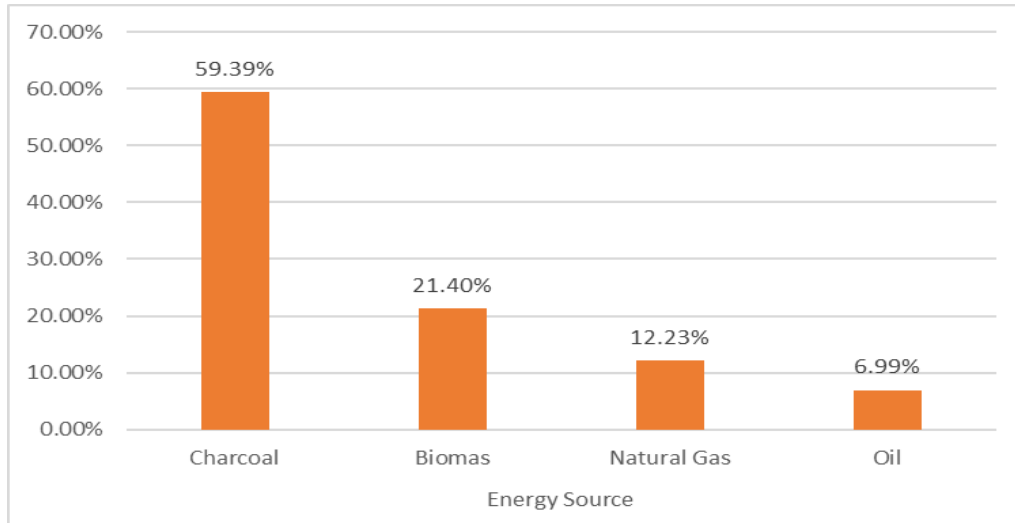


Figure 4.4: Energy Sources

Source: Field Survey (2021)

The results, as outlined in Figure 4.4, reveal that the majority (59.39%) of participants identified charcoal as their main energy source, followed by 21.4% using biomass, 12.23% natural gas, and 6.99% oil. These findings align with the conclusion reached by Sears (2020), which stated that charcoal is the primary source of energy for 82 percent of families in urban areas of Kenya. Although it is a vital source of income and energy for many households, the production, trading, and utilization of charcoal are often dominated by unsustainable practices.

Ascuí et al. (2018) observed that communities residing in forests have integrated these ecosystems into their homes and primary sources of income. The forests serve as habitats and resources, with trees being cut down for construction, charcoal, and wood fuel, subsequently sold to nearby urban centers. This reliance on forest resources has sparked considerable opposition, particularly concerning resettlement and compensation for residents. The current scenario suggests that only a small fraction of families residing in the forest possess legal title documentation for their dwellings.

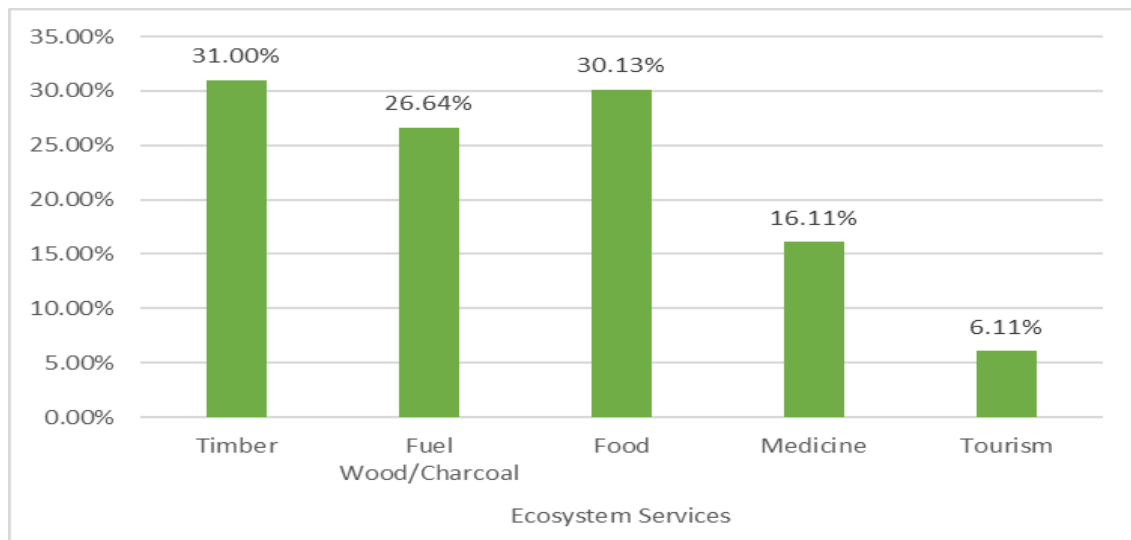
Projecting into the future, a "business as usual" scenario anticipates that the energy required for cooking in 2040 would be three times the current demand, with firewood remaining the predominant fuel source. This increased dependence on forest resources would intensify pressures on the ecosystem, accelerating deforestation.

These findings underline the crucial interplay between energy consumption patterns, environmental sustainability, and community resilience. The prevalent use of charcoal and forest resources for energy reflects broader national trends, highlighting the need for sustainable energy solutions and forest conservation measures to balance community needs with environmental preservation. The comparison with existing literature underscores the challenges and opportunities in fostering sustainable energy practices and enhancing resilience in forest communities.

4.1.3.2.2 Ecosystem Services

Analysing the Ecosystem Services data provides insights into the array of benefits that communities derive from the Mau Forest. Understanding the various ecosystem services and their significance is crucial for assessing the sustainability of human-forest interactions and informing conservation strategies. The knowledge of how communities utilize the forest for different services aids in identifying the dependencies and pressures on the ecosystem. This, in turn, supports the development of policies and interventions that balance the ecological integrity of the forest with the livelihood needs of the local populations.

Respondents were requested to outline some of the services that they obtain from the



forest (Figure 4.5)

Figure 4.5: Ecosystem Services

Source: Field Survey (2021)

Figure 4.6 indicates that a majority (31%) of participants rely on the forest primarily for timber production, 30.13% for food (including wild fruits, vegetables, and game meat), and 6.11% for medicine and tourism. This reveals a significant dependence of local populations on the Mau Forest for sustenance and various resources. As Barua et al. (2020) highlighted, the local populations primarily rely on forest resources, notably fuelwood and food items, which contribute significantly to household revenue. Ahammad et al. (2021) further noted that approximately 3 million Kenyans depend on natural forests for essential needs such as shelter, using resources like building poles and lumber. Additionally, the study uncovered that around 30.13% of communities in the Mau region benefit from non-timber forest products, which are crucial for income and food production, including honey, mushrooms, fruits, and vegetables (Ferraro et al., 2020). Forests are also pivotal for socio-cultural values and supplying ecological services to agriculture and other productive sectors, playing a significant role in family incomes in Kenya (Maua et al., 2020).

Forest ecosystems offer diverse products and services essential for the socio-economic development of dependent communities. Participatory Forest Management (PFM) aims to contribute to the socio-economic development of forest-dependent populations (Sears et al., 2018), reduce environmental degradation (Dhyani & Dhyani, 2020), and alleviate poverty (Kumar & Saikia, 2020). However, the study revealed a diminished value of the ecosystem for communities near protected regions, due to prohibitions on resource use imposed by the Forest Management Agreement (FMA). This was attributed to the biologically diverse value of the National Park and river catchment duties, among other legislative responsibilities (Wambugu et al., 2018). Kandel et al. (2018) emphasized the pivotal role of woodlands in the rural economy and the urgent need for making forest ecosystems economically more beneficial to residents, necessitating a comprehensive assessment of all ecosystem services.

Furthermore, the study established that 6.11% of respondents sourced medicinal/herbal products from the forests, aligning with Ferraro et al. (2020), who emphasized the

monetary value of forest’s medicinal products. A similar proportion of respondents benefited from tourism products from the forests, highlighting the potential for enhancing this sector through the promotion of ecotourism. These findings underscore the multifaceted value of the Mau Forest to the local communities and the importance of sustainable management to preserve both the ecological balance and the livelihoods dependent on the forest.

4.2 Objective 2: Impact of Environmental Security Approaches on Resilience Building

4.2.1. Enhancing Infrastructure for Environmental Resilience

The study evaluated Eastern Mau Infrastructure with a score of 1 to 5, 1 being Non-existent and 5 showing availability and good working order of the infrastructure. (Table 4.1).

Table 4.1: Improving Infrastructure

	Non-existent	Poor	Average	Good	excellent	Mean	Standard deviation
Road networks	34.1%	47.6%	5.7%	3.1%	9.6%	2.0655	1.17730
Bridges	19.2%	44.5%	26.6%	9.6%	0.0%	2.2664	.88047
Piped water	14.0%	46.7%	27.9%	8.3%	3.1%	2.3974	.93386
Boreholes	20.5%	50.2%	19.7%	7.9%	1.7%	2.2009	.91469
Electricity supply (Grid)	23.1%	60.3%	9.6%	3.9%	3.1%	2.0349	.87289
Average						2.1930	0.9558

Source: Field Survey (2021)

Majority (47.6%,44.5%, and 46.7%) of household respondents noted that Mau forest has poor road networks, bridges, and piped water, respectively. About 50.2% and 60.3% of household respondents indicated that there is poor borehole for water supply and

electricity supply (Grid), respectively. Moreover, the findings reveal an average mean of 2.1930 and SD 0.9558, implying that most participants noted poor infrastructure in the Mau complex. Studies (Albertazzi *et al.*, 2018; Githumbi *et al.*, 2021), have observed that transport infrastructure, such as the maintenance of infrastructure, homes, reservoirs, and other large-scale development, is a major factor for forest deforestation and degradation. Also, urbanization, which entails the rise and extension of metropolitan areas, is a key contributor to forest degradation. The towns of Elburgon and Molo are putting stress on the East Mau and Molo woods, which are under threat (Waithiru, 2009; Cherotich, 2022).

4.2.2 Strategies for Resolving Environmental Conflicts

The study sought to assess the recent cause of conflicts and their severity, wherein 5 indicates violent clashes with casualties and people migrating 4 indicates severe clashes with minimal casualties and property devastation 3 indicates moderate conflicts with incidents and minimal destruction of property, 2 indicates minimal conflicts with few non-lethal injuries, and 1 indicates the least severe conflicts with no harm and loss of property (Table 4.2).

Table 4.2: Recent Causes of Conflicts

Focal areas	1	2	3	4	5	Means	S.D.
Politics	24.5%	20.1%	11.4%	28.8%	15.3%	2.9039	1.44168
Ethnicity	15.7%	15.7%	18.8%	30.1%	19.7%	3.2227	1.35343
Religion	17.9%	21.0%	13.1%	34.9%	13.1%	3.0437	1.34354
Scarcity of water	25.3%	10.5%	27.1%	17.5%	19.7%	2.9563	1.44423
Scarcity of pastureland	22.3%	22.7%	6.1%	27.9%	21.0%	3.0262	1.49831
Horizontal inequalities (disparities across cultural groups with regard to access to resources).	18.3%	9.2%	24.5%	19.7%	28.4%	3.3057	1.43973
Failure of the social contract (a failure on the part of the regional or national government to	20.5%	8.7%	7.9%	30.1%	32.8%	3.4585	1.52300

provide a service)

Insecurity (*Burglary, theft, muggings, etc.*) 21.4% 17.5% 15.7% 32.3% 13.1% 2.9825 1.37319

Average 3.1124 1.4271

Source: Field Survey (2021)

Results shown in the Table 4.18 indicates that 28.8%, 30.1%, and 34.9% of participants indicated that politics, ethnicities, and religion are the main cause of conflicts, respectively, with the impact being severe with minimal fatalities and destruction of property. Also, 25.3% and 22.3% noted that scarcity of water and pastureland is the main cause of conflicts, with the impact being violent clashes with fatalities and migration of people. The findings show that 28.4% and 32.8% of sampled residents indicated that horizontal inequalities (disparities across culturally identified groups with regard to their access to economic and political resources) and Failure of the social contract (a failure on the part of the regional or national government to provide a service) are the cause of conflicts respectively with the impact being violent clashes with fatalities and migration of people. Lastly, 32.3% of respondents thought that Insecurity (Burglary, theft, muggings, etc.) is the cause of conflicts, with the impact being severe with minimal fatalities and destruction of property.

Respondents were asked to outline the most common avenues for conflict resolution within their areas, the outcome is as shown in the Figure 4.6.

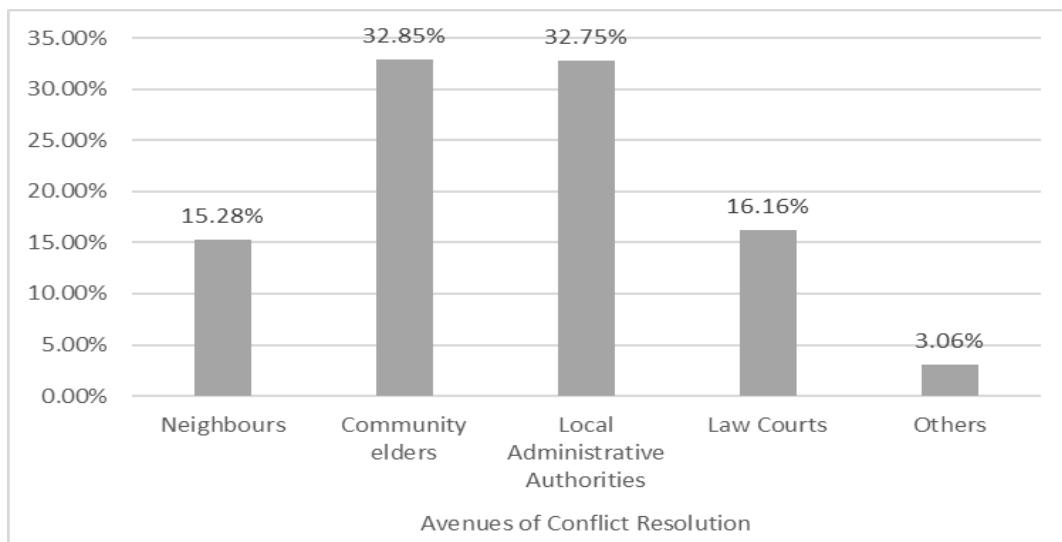


Figure 4.6: Avenues for Conflict Resolution

Source: Field Survey (2021)

A major percentage of respondents (32.75%) indicated that their initial recourse for conflict resolution are the village and local level leadership including local administrative authorities (32.75%). Local law courts scored at (16/16%), and intervention from neighbours, presumably friends and/or relatives scored at (15.26%), other avenues including church leadership and face to face confrontations lumped as others scored at (3.06%) as avenues for conflict resolution (Figure 4.6).

Additionally, stemming from the conflict resolution avenues, respondents were requested to rate conflict-management approaches according to preference. This was key for verifying voracity of the earlier choices on avenues. the following outcomes were noted (Figure 4.7)

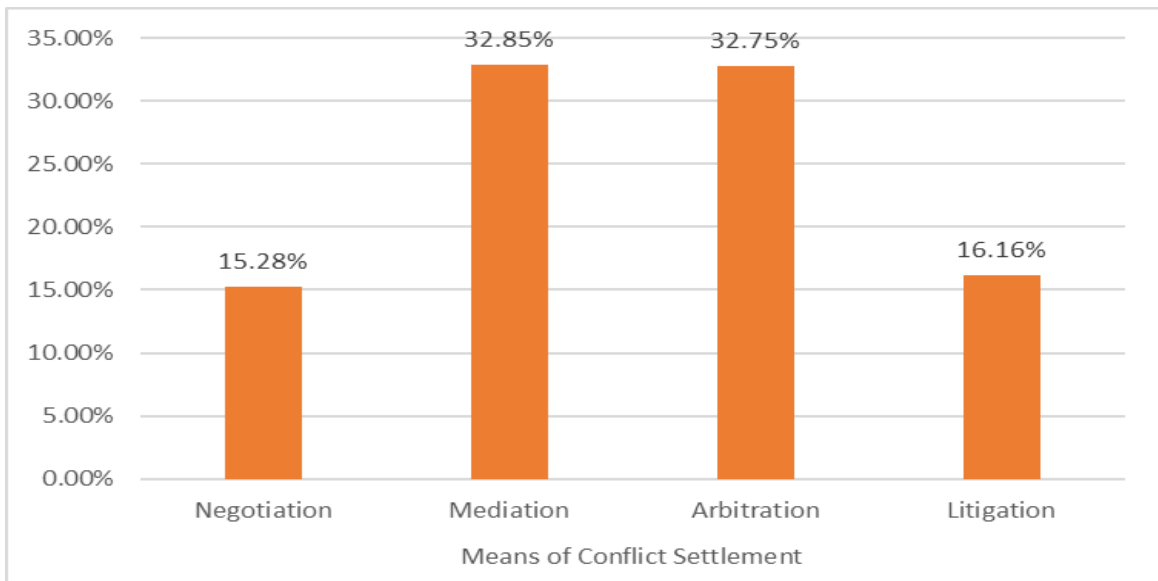


Figure 4.7: Conflict Management approaches

Source: Field Survey (2021)

The majority (50.91%) indicated that mediation is the most common method with (20%) indicating negotiation as their preferred approach. Litigation was panned at (16.36%) and (12.73%) indicated that they preferred arbitration (Figure 4.8). The findings imply that

mediation is one of the most important approaches of conflict resolution mainly due to its major advantage of cost-effectiveness.

4.2.3 Frameworks for Sustainable Environmental Management

Respondents were asked to indicate if Mau forest management has adopted environmental governance approaches (Figure 4.9)

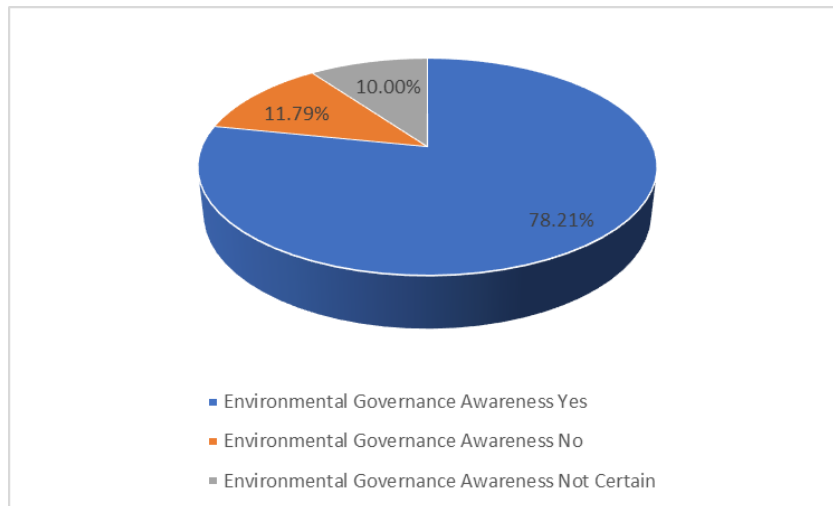


Figure 4.8: Environmental Governance Approaches Awareness

Source: Field Survey (2021)

Figure 4.8 presents responses on the environmental governance approaches in the Eastern Majority (78.21%) noted that the Mau forest management had adopted various environmental governance approaches while 11.79% said No and 10% were not certain. The results clearly indicate that efforts towards conservation of Mau Forest have been enhanced with the majority indicating a positive. For instance, the reforestations programs in parts of the Mau Forest Complex (Chaudhry, 2019).

Table 4.3: Level of Participation

	Frequency	Percent
Very high	57	24.9%
High	31	13.5%
Moderate	54	23.6%
Low	87	38.0%

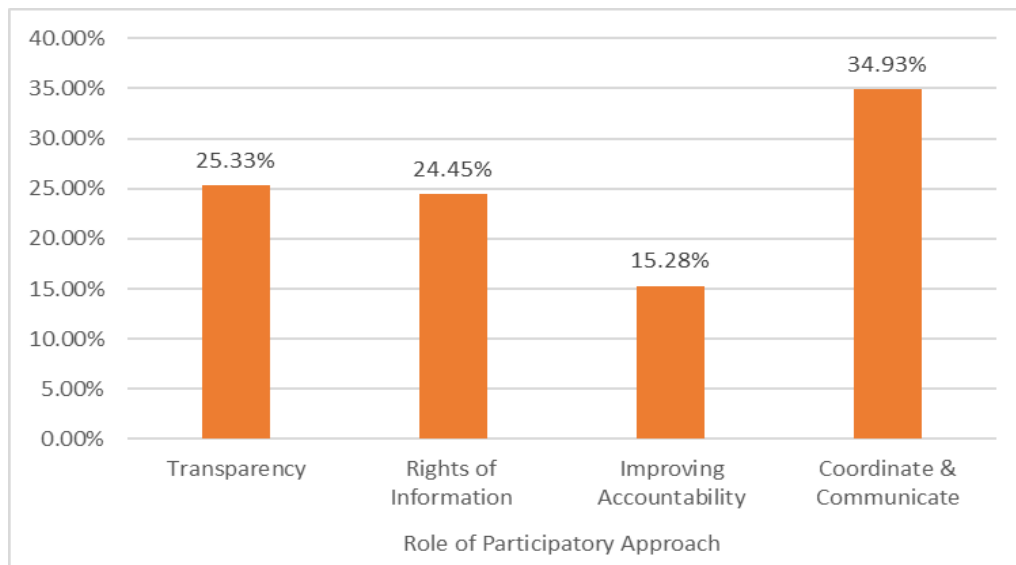
Total	229	100.0%
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Source: Field Survey 2021

Results from questionnaires as tabulated - Table 4.3, reveals that 38.0% of those sampled indicate that the level of community participation was low (24.9%) indicated that it was very high (23.6%) moderate, and 13.5% indicated a high level. The findings imply that the adoption of participatory environmental governance approaches was high. This participatory approach is important in resilience building as it adopts the community voices in resource conservation as stakeholders.

4.2.4 Community Involvement in Environmental Solutions

Respondents were requested to state what they thought were the critical roles or importance of community participation in environmental security and community



resilience. Results are as shown in Figure 4.9.

Figure 4.9: Use of Environmental Participatory Approach

Source: Field Survey 2021

The majority (34.93%) of respondents indicated that the participatory environmental approach played an imperative role in coordinating and communicating issues affecting the Mau forest, 25.33% helped enhance transparency, 24.45% rights to information, and 15.28% helped in improving accountability. As Janicke and Jorgens (2020) remarked, participation in environmental policy concerns, in addition to the other new policy tools mentioned here, is very demanding in its own right. This is also true of the other new policy instruments. It presumes the existence of an enabling condition (SRU 2002: 86-122). A framework of incentives and a network of rights and information is required for citizens functioning as an online bonus for environmental policy. This involves providing individuals and environmental organizations with the right to information, access to justice, and participation, as well as openness about the environmental credentials of items now available on the market. The desire to engage also requires a certain level of environmental disclosure in the media that is at least sufficiently truthful and problem-oriented.

The respondents’ rated statements on participatory planning were sought to establish how it is linked to forest security on a Likert scale ranging from 1 indicating nil engagement to 5 indicating very high engagement (Table 4.4).

Table 4.4: Participatory Planning in Forest Governance

Statement/Question	1	2	3	4	5
Has KFS improved the ability of various stakeholders to take up leadership roles?	0.0%	0.0%	26.0%	44.4%	29.5%
Do you participate in formulating management plans for the administration of forest resources?	0.0%	0.0%	11.4%	44.4%	44.2%
Are the various special interest groups represented in decision-making processes concerning the governance of the forests?	5.4%	0.0%	18.1%	57.7%	18.8%
Does KFS include various interested parties and agencies in identifying potential forest protection conflicts jointly?	3.4%	0.0%	12.1%	69.1%	15.4%

Does KFS include several parties, including agencies and stakeholders, in collaborative efforts to resolve conflicts related to forest protection?	2.7%	5.4%	0.0%	61.1%	30.9%
Does KFS include various stakeholders and agencies in a collaborative effort toward executing scheduled activities?	.7%	0.0%	7.4%	64.4%	27.5%

Source: Field Survey (2021)

According to the results, presented in the Table 4.20, the capacity of stakeholders to participate in forest management activities was carried out to a High Extent in the Mau forest. This conclusion was supported by 44.4% of respondents, followed by a high extent rate of 29.5%. In addition, the results indicated that workers engage in creating management plans in the governance of forests to a High Extent 44.4% of the time, while 44.2% of the respondents supported the statement to a High Extent 44.4% of the time. A respondent corroborated this in an interview who said the following in response to the question:

.... “The participation of the lower team members in the planning process should be kept to a minimum in participative planning. In particular, there is an insufficient amount of involvement on the part of supervisors and supervisees in creating management ideas and plans, as well as the decision-making and execution programs. This is because external stakeholders who may not have appropriate background knowledge are engaged to perform things in certain cases, which has a detrimental influence on the supply of services.” KII

Furthermore, it was found that the special interest organizations, which include women, youngsters, and individuals living with disabilities, were involved in decision- making on forest governance to a high extent, at a rate of 57.7%, and to a moderate extent, at a rate of 18.1%. A high level of involvement followed this at 57.7%. A respondent to the interview provided the following information, which lends credence to the rating:

“In terms of involvement, there is consensus in certain regions for the administration of the forests in a collaborative fashion. Additionally, throughout

the implementation phase, participation is encouraged, although only to a limited level, in the development of conservation committees.” KII

However, the participation of several stakeholders and agencies in the collaborative identification of prospective forest protection conflicts and other imminent hazards to conservation received a greater level of approval, reaching 69.1% of the total vote after it came to a rating of a very significant extent, at 15.4%.

This was corroborated by key informant interviewers who said the following in response to the following questions:

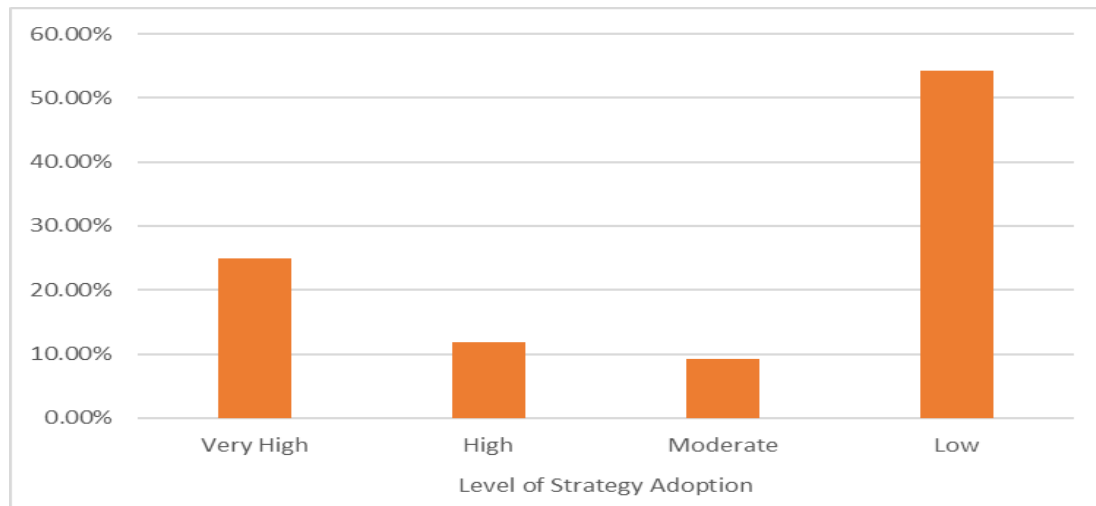
“The participation of stakeholders in management is essential because it broadens the range of ideas and makes it simpler to put those opinions into action. In addition, the participants have the impression that they are appreciated and that the administration of the woods considers their points of view.” KII

“Plans for the sustainable management of individual forests developed via participatory forest management are not comprehensive and do not include defined management activities. If there are no such action plans, then it would be very difficult to realize the goals that have been set at the business level... It is recommended that such specifics be integrated into the plans to get the best results.” KII

Based on these results, forest administration seems to have some influence, although a little, on human resilience. According to the research findings, increasing the amount of participatory planning is an essential step to achieving the level of forest preservation that is sought while also guaranteeing that those who benefit from the forest may continue to make a living off it. This notion originates from the belief that including all relevant parties in the planning process would make it easier for those parties to support the forest protection governance structure and its associated actions.

4.2.5 Goal-driven Strategies for Environmental Resilience

Target-oriented Approach was the second environmental governance approach adopted; respondents were asked to outline the level of adoption and its role in the Resilience



Building of the Eastern Mau Forest Community.

Figure 4.10: Level of Target-oriented Approach Adoption

Source: Field Survey (2021)

From Figure 4.10, majority (54.15%) of participants noted that target-oriented approach adoption was low, 24.69% noted very high, 11.79% was high, and 9.17% said moderate. This result means that target-oriented approach adoption was low. Based on the secondary data, a significant portion of this such study, which is relevant to the development of community resilience and, often, resilience in general, has concentrated mostly on the role that various social elements play in shaping potential or real collective action for change and resilience (Shokry et al., 2020). Such research has emphasized, for instance, the importance of local knowledge transfer, direct understanding, social learning, and people–place connections, which shape perceptions and behaviors concerning a higher risk of severe climatic conditions events (Busby, 2018); or the importance of safety nets and variables such as trust and ambitions for overcoming threats to food security. Similarly, such work has emphasized the significance of overcoming dangers to food security (Sears, 2020).

Adopting a Target-oriented Approach helps to emphasize community actors in generating and activating resources for the community so that it may flourish in the face of change (Shokry et al., 2020). A change of this kind, for instance, could be more particular and, although unforeseen, immediately recognized. Some examples of this kind of change are fires and floods. Other changes may be more varied or unexpected.

Approach with a Target-oriented Approach Adoption in the context of managing natural resources and adoption plays an essential part. In many regions of Kenya, many women remain highly vulnerable to climate change's unpredictable effects. This is large because their social responsibilities and duties, which have been socially constructed, primarily include their roles as leading service providers of food, water, and fuel for their families. Although subsistence farming forms the primary income source for most community members of Mau forest, these individuals do not take part in the decision-making process regarding natural resources like land.

During drought, women and girls must travel significant distances to get food, water, and firewood. Additionally, they are obligated to take care of family members that are at risk of climate-instigate hazards. This results in their less time for schooling, activities that generate cash, and involvement in the decision-making processes of community organizations, which further contributes to unequal gender relations.

From the Key Informants, Target-oriented Approach Adoption has helped in the following:

“Target-oriented Approach Adoption aids in improving the effective engagement of marginalized groups, including women, in decision-making over administration of the environment and other natural resources by boosting people's rights to, ownership of, and exploitation of such sources. “The adoption of a target-oriented approach has assisted in the provision of additional resources toward the creation of different incentives to promote clean and renewable energy (clean cooking technologies), intending to reduce deforestation for the production of wood fuel and charcoal. This would not only help preserve the environment, but it would

also make it easier for women and girls to avoid being subjected to violence and pollution within their homes while traveling great distances to collect firewood.”

To put it another way, the Target-Oriented Approach cannot reduce both risks and repercussions to zero at once. A Target-Oriented Approach ensures that individuals and businesses will be able to cope in the event of a catastrophe without suffering debilitating long-term impacts and will be able to recover rapidly. Physical harm and financial damage may be mitigated by preparedness, such as by improving hydromet data, early detection systems, and disaster management systems. For instance, boarding windows before a hurricane can minimize damage by up to fifty percent. It has been shown on several occasions that the provision of equal coverage to early-warning systems around the globe results in advantages that significantly outweigh the associated expenses by a ratio of at least four to ten.

Moreover, ensuring people have access to social security and other forms of financial inclusivity, such as being able to borrow money in a crisis, are crucial strategies to assist businesses and individuals in getting back to work. Target-Oriented Approaches are especially efficient, which can be quickly scaled up to include more people and provide larger support after a tragedy. However, because they rely on distribution and finance processes that must be established before a crisis happens, they cannot be implemented immediately after a catastrophe.

4.2.6 Innovative Tactics for Strengthening Household Resilience

According to the findings of the study, pace of technological development can significantly contribute to the more rapid accomplishment of the SDGs by 2030 through many different mechanisms. These mechanisms include: getting better wage growth (through increased efficiency and lower costs of goods and services); empowering the faster and wider implementation of new solutions to financial, cultural, and environmental hurdles that function as stringent regulations on advancement; continuing to support more encompassing forms of involvement in social institutions. UNCTAD gives examples that are specific to a broad variety of uses of emerging technologies that

are already displaying the ability to speed up the process of attaining the Goals for Sustainable Development.

The Table 4.5 presents participants' views on the impact of innovation or technology on their resilience. The results indicate that all means are more than 3.4, meaning that most respondents agreed with the statements on technology with a standard deviation of less than 2. On the use of contemporary agricultural methods results in large increases in crop yields, most participants agreed that with the mean of 3.5839 and SD 0.60517. The findings further revealed most a majority agreed that applying fertilizer results in considerable improvements in both the fertility of the soil and crop production, with the mean and SD of 3.4295 and .69023, respectively. Additionally, participants agreed when seeds certified as being of high quality are planted, the resulting crops are of higher quality and produce more when harvested. Applying chemical pesticides effectively prevents crop damage caused by insects and other pests with means of 3.2349 and 3.3356, respectively. Moreover, participants noted that the use of effective preservation methods might improve the quality of their food last for longer, accessibility of information on market circumstances, such as pricing and demand, is facilitated by mobile phones, Advertising on online marketplaces gives businesses instantaneous access to potential customers, the effective distribution of food is made possible by modern modes of transportation (vehicles, motorcycles) and their farm will experience less food deterioration and waste if it has quick access to the market with means of 3.4765, 3.5503, 3.1074, 3.1611 and 3.2148 respectively.

Table 4.5: Impact of Technology Adoption on Household Resilience

Impact of technology on household resilience	SD	Mean
The use of contemporary agricultural methods results in large increases in crop yields.	3.5839	.60517
Application of fertilizer results in considerable improvements in both the fertility of the soil and crop production.	3.4295	.69023
When seeds that have been certified as being of high quality are planted, the resulting crops are of higher quality and produce more when they are harvested.	3.2349	1.09291
Applying chemical pesticides is an effective method for preventing crop damage caused by insects and other pests.	3.3356	.96989
Using effective preservation methods may improve the quality of your food last longer.	3.4765	.82678
The accessibility of information on market circumstances, such as pricing and demand, is facilitated by mobile phones.	3.5503	.69200
Advertising on online marketplaces gives businesses instantaneous access to potential customers.	3.1074	1.19764
The effective distribution of food is made possible by modern modes of transportation (vehicles, motorcycles).	3.1611	1.21403
Your farm will experience less food deterioration and waste if it has quick access to the market.	3.2148	1.19438

Source: Field Survey (2021)

4.2.7 Evaluating the Effectiveness of Environmental Security Measures on Community Resilience in the Eastern Mau Forest

Assessing the overall efficacy of environmental security approaches, especially in terms of their impact on community resilience, remains paramount in shaping sustainable policies and interventions. The results from the study's second objective – focusing on the impact of such approaches on the resilience building of the Mau East Forest community –

offer crucial insights into the dynamic interplay between conservation strategies and community perceptions.

Participants were prompted to evaluate the transformation of Mau East Forest over the past two decades, an essential timeline considering the rapid environmental changes in contemporary history. As illustrated in Figure 4.11, a significant portion of the respondents (42.36%) felt that the Mau East forest is heavily degraded. Meanwhile, 34.06% believed that considerable changes have occurred, with 23.58% opining that the forest is in a better condition than before.

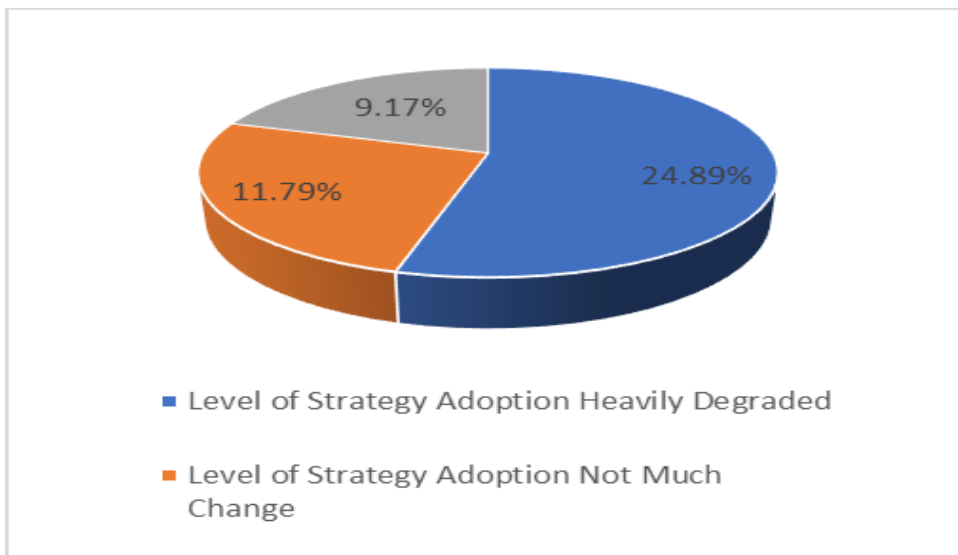


Figure 4.11: Current Status of Eastern Mau Forest
Source: Field Survey (2021)

The literature on environmental resilience consistently emphasizes the intricate balance between conservational practices and their tangible outcomes (Smith & Lindenmayer, 2021). Interestingly, the finding that almost a quarter of respondents perceive the forest as being in a better condition aligns with studies suggesting that strategic environmental security approaches can yield positive results (Harrison & Paavola, 2018). However, the stark contrast in opinions, with 42.36% viewing the forest as heavily degraded, signals the varying impacts of environmental interventions and potentially reflects the heterogeneous experiences of community members.

The variance in perceptions can also hint at underlying challenges. For instance, many degraded landscapes across the globe have resulted from a gap between policy formulation and its pragmatic execution (Turner et al., 2019). Furthermore, while some areas might indeed benefit from resilient strategies, other segments of the same region might be overlooked or may face unique challenges.

In conclusion, while a sizable portion of the Eastern Mau Forest community acknowledges positive changes in forest conditions, it's evident that a more substantial segment perceives degradation. These mixed perceptions underscore the need for more comprehensive, inclusive, and adaptive environmental security approaches that cater to the nuances of the region and its inhabitants. It also emphasizes the importance of ongoing evaluations to recalibrate strategies for optimal impact.

The second objective of the study - to assess the impact of environmental security approaches on resilience building of the Mau East Forest community bore the following results.

4.3 Objective 3: Impact of Household Socioeconomic Factors on Environmental Security, Governance and resilience building

Environmental security and governance were established to be affected by a range of household socioeconomic factors which are identified in the study results. Consequently, measuring resilience building in the context of environmental security and governance in the Eastern Mau forest community involved assessing the community's capacity to withstand and recover from environmental challenges and disruptions while maintaining or enhancing its well-being and socioeconomic sustainability. Being a multidimensional concept that is challenging to quantify, the study utilized the following mix of approaches and indicators to measure resilience building in the context environmental security and governance in Eastern Mau Forest. Data on the following indicators were analyzed in order to measure resilience in the area of study:

- a. ***Ecosystem Health Indicators:*** Data procured from KFS and KWS illuminated the diversity of flora and fauna in the Eastern Mau forest, serving as a key barometer for ecosystem health and resilience. The dynamics of species diversity over time

offered insights into the ecosystem's fluctuating resilience. Concurrently, meticulous observation of alterations in forest cover, underscored by GIS mapping depicting two decades of land use trends, elucidated the forest's recuperative abilities post deforestation and disturbances. Moreover, the assessment of water quality within the forest's rivers and streams was indicative of the vitality and resilience of the aquatic ecosystems to pollution and degradation.

- b. **Community Well-being Indicators:** The study scrutinized the diversity of income and livelihoods amongst local communities as a primary gauge of resilience, with

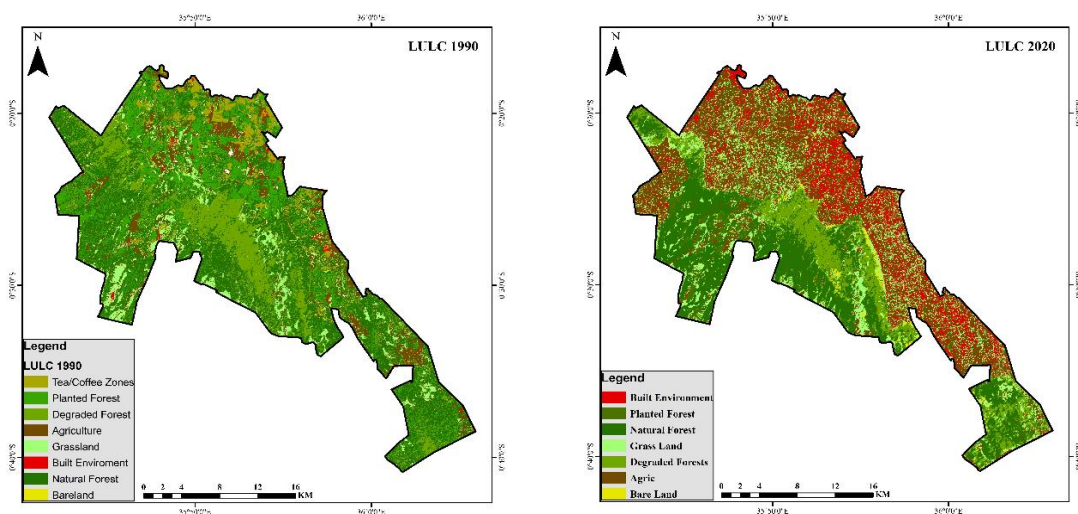


Figure 4.12: Land use trends within E Mau Forest between 1990 – 2020
Source: Field Survey (2021)

varied income sources bolstering community endurance against economic adversities. Further, persistent monitoring of food security parameters, including access to food, dietary diversity, and crop yields, mirrored the community's resilience to food-associated challenges. Additionally, an evaluation of access to fundamental services such as healthcare, education, and clean water served as a reflection of the community's resilience to health and socio-economic adversities.

- c. **Environmental Governance and Policy Indicators:** The study assessed the efficacy of environmental policy implementation in the Eastern Mau Forest as a pivotal measure of governance systems' resilience in navigating environmental challenges. Concurrently, the degree of community involvement in decision-

making processes concerning environmental management emerged as an indicative measure of robust governance frameworks and community resilience.

- d. ***Social and Cultural Factors:*** The analysis focused on the strength of social networks, community cohesion, and mutual support systems, positioning them as critical contributors to enhanced resilience, particularly in enabling communal collaboration during crises. Indigenous knowledge, traditional practices, and adaptive strategies were also acknowledged as pivotal indicators, contributing to resilience building by aiding communities in adapting to environmental shifts.
- e. ***Economic Resilience Indicators:*** The diversity of income sources within households was analysed to demonstrate economic resilience. Additionally, the study considered the accumulation of savings and assets, which act as financial safeguards against economic shocks, as an essential metric for resilience building.
- f. ***Environmental and Climate Indicators:*** The research monitored community adaptations to climatic variations, such as the embrace of climate-resilient agricultural practices, to provide insights into resilience building. The study also formulated composite resilience indexes, amalgamating various indicators from diverse dimensions like financial, social, physical, natural, and human capital. The impact of these diverse factors on community resilience was explored and explained, revealing the varying degrees to which each contributes to building resilient communities.

Findings based on the above indicators is summarized in Table 4.6.

Table 4.6: Factors Affecting Community Resilience

Factors/results	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD
Socioeconomic potential of Mau Forest, encourage the development of social amenities that facilitates resilience building.	4.8%	62.0%	10.0%	7.4%	15.7%	3.3275	1.18920
High level of cooperation among people engaged in forest conservation efforts.	10.9%	65.1%	7.0%	6.1%	10.9%	3.5895	1.11492
Use more modern stoves.	9.2%	15.7%	18.8%	10.5%	45.9%	2.3188	1.41689
The forest conservation techniques on environmental security.	12.7%	63.3%	13.1%	6.6%	4.4%	3.7336	.91946
Improved livelihoods resultant from Mau Forest conservation program.	17.0%	60.7%	13.1%	7.0%	2.2%	3.8341	.86778
Your skills and abilities in forest conservation initiatives.	5.7%	20.1%	9.6%	14.8%	49.8%	2.1703	1.37388
Forest conservation operations in the Mau Forest and sustainable household income initiatives for the local people.	16.6%	67.7%	9.2%	3.9%	2.6%	3.9170	.80411
Forest conservation operations and investments on local community infrastructural development projects.	10.0%	69.9%	12.2%	4.8%	3.1%	3.7904	.80552
Establishment of Community Forest Associations, increasing environmental security, cooperation, and cohesiveness.	20.5%	68.1%	5.7%	3.9%	1.7%	4.0175	.76068
Gaining access to forest products due to conservation activities.	19.2%	62.9%	3.1%	8.7%	6.1%	3.8035	1.04327
Average						3.45022	1.029571

Source: Field Survey (2021)

As depicted in Table 4.6, of the 229 respondents surveyed, 4.8 percent strongly concurred with the notion of leveraging the socio-economic potential of the Eastern Mau forest to foster the development of social amenities and services. Meanwhile, 62.0 percent agreed, 10.0 percent remained indifferent, 7.4 percent disagreed, and 15.7 percent strongly disagreed. The line item attained a higher mean score (3.3275) and SD (1.18920) compared to the mean composite score (3.45022 and SD 1.029571), suggesting that the untapped socio-economic value in the Mau forest is a compelling incentive for investments, thereby enhancing livelihoods and mitigating vulnerability. This perspective was corroborated by qualitative data from a KFS respondent, Mr. Justus Koech, a KFS Forester, who remarked: “The socio-economic potential of Mau forest is vastly untapped, and many key decision-makers in the country remain unaware of this potential. The rich flora, fauna, and scenic beauty can be developed to generate substantial foreign income through tourism and research.”

A significant 60 percent of respondents concurred that robust teamwork and cooperation are prevalent among groups dedicated to forest conservation, with 10.9 percent strongly agreeing. Meanwhile, 30 percent were indifferent, 6.1 percent disagreed, 10.9 percent strongly disagreed, and the remaining 30 percent were uncertain. The line item boasted a mean of 3.5895 with SD 1.11492, surpassing the mean composite score 3.45022 and SD 1.029571. This indicated the presence of fruitful collaboration among members, contributing to a decline in conflicts as CFA members unitedly advocated for an effective Mau forest conservation program. This collaborative effort was underscored by the success of the Mau forest program.

Furthermore, the study uncovered that a substantial portion of respondents (45.9 percent) expressed strong reservations regarding the utilization of energy-saving stoves in their homes. An additional 10.5 percent opposed, 15.7 percent agreed, 9.2 percent strongly agreed, while 18.8 percent remained indifferent. The line item had a mean of 2.3188 with SD 1.41689, which was below the mean composite score 3.45022 with SD 1.029571. Consequently, the reluctance of CFA members to adopt improved stoves escalated the likelihood of community encroachment into forest areas and increased the risk of illicit

logging for firewood. This led to further forest degradation, posing a challenge to the successful conservation of the Mau forest.

In a survey on the significance of forest conservation techniques for enhancing environmental security, 12.7 percent of the respondents strongly agreed that innovative techniques are guaranteed to succeed, while 13.1 percent agreed but remained undecided. Conversely, 6.6 percent disagreed, and 4.4 percent strongly disagreed, expressing scepticism towards untested approaches. The line item's mean score of 3.7336, with a standard deviation of .91946, surpassed the mean composite score of 3.45022 and SD 1.029571. This suggests that disseminating performance evaluations of community forest initiatives empowers members to refine future endeavours and embed conservation programs at the heart of these plans.

According to 60.7 percent of the respondents, efforts to conserve the Mau Forest have enhanced the community's livelihood, with 17.0 percent strongly agreeing. However, 13.1 percent were indifferent, 7.0 percent disagreed, and 2.2 percent were strongly opposed. The line item had a mean of 3.8341 with a SD of .86778, exceeding the composite mean 3.556 with SD 1.256. This indicates a perceived improvement in the well-being of CFAs due to their involvement in forest conservation activities. Revenues generated from trading in NTFPs and the establishment of CBOs have been utilized to uplift living standards, fostering increased engagement in forest conservation. The findings align with studies such as Soe et al. (2019), demonstrating that communities dependent on forests for livelihoods tend to support sustainable forest management practices.

However, the survey revealed that 49.8 percent of the respondents strongly felt they lacked the necessary skills to contribute to forest conservation efforts, with 14.8 percent disagreeing, 5.7 percent strongly agreeing, 20.1 percent agreeing, and 9.6 percent indifferent. The line item recorded a mean of 2.1703 with a SD of 1.37388, which was below the composite score of 3.45022 and SD 1.029571. This highlights the challenges faced by CFA members in implementing conservation initiatives, indicating a need for capacity-building through training and financial incentives to enhance their participation and efficacy in conservation projects.

The study unveiled that 67.7% of respondents acknowledged that forest conservation efforts in the Mau Forest contributed to a rise in family income. Specifically, 16.6% strongly concurred, while 9.2% remained indifferent. However, a noteworthy 15.5% expressed disagreement, and a further 3.9% strongly dissented. The mean line item score of 3.9170 and SD .80411 surpassed the composite mean of 3.45022 and SD 1.029571, signifying that communities garnered numerous products from the forest, enhancing income through trade, and hence fostering a conservation ethos.

These results resonate with Okumu and Muchapondwa's (2020) examination of cooperative forest management in India and the variables influencing community perception. Similarly, Kimengsi et al.'s (2022) meta-analysis across 17 developing nations demonstrated the importance of forest resources, such as firewood and animal fodder, in contributing to household incomes. Echoing this, Magessa et al. (2020) revealed that, for communities in Northern Ethiopia, income from natural forest resources played a pivotal role, second only to crop revenue.

Further corroboration comes from Nerfa et al. (2020), highlighting that individuals in Burkina Faso actively engaged in forest management derived tangible benefits. Kibria et al. (2022) observed a parallel in the Oromia region, where the extent of engagement in forest management was proportionate to the benefits received, including access to animal fodder.

Moreover, a substantial 69.9% of respondents endorsed the idea that investing in community infrastructure and forest conservation would bolster their resilience, with 10.0% expressing strong agreement regarding the positive impact of conservation on local development. A minority exhibited neutrality (4.8%), disagreement (12.2%), or strong disagreement (3.1%). The line item's mean score of 3.7904 and SD .80552 exceeded the composite mean score of 3.556 and SD 1.256, illustrating the community's substantial gains from conservation-led infrastructural development, such as enhanced road networks and educational facilities.

These findings align with those of Torres-Rojo et al. (2019), indicating heightened awareness among families in PFM zones about the forest's significance to their

livelihoods and the reinvestment of nature-based profits for holistic life improvement. Such families appreciated the income from diverse activities like butterfly farming and honey harvesting, which facilitated education, food acquisition, and agricultural development.

The survey revealed that a substantial 68.1% of respondents concurred that the formation of CFAs, with an aim to bolster environmental security, cohesion, and cohesiveness, significantly contributes to resilience building. Among them, 20.5% strongly agreed, while 1.7% and 3.9% were strongly opposed and opposed, respectively. A small portion, 5.7%, remained indifferent. The mean line item of 4.0175 and SD 76068 surpassed the mean composite score of 3.45022 and SD of 1.029571, indicating that enhanced safety, social support, and unity among CFAs foster a positive environment conducive to effective participatory processes. This is aligned with research by Pasaribu et al. (2020), which highlighted disparities in perspectives on information accessibility, leadership, and control among participants, emphasizing the need to accommodate diverse viewpoints in community involvement initiatives.

Furthermore, 62% of respondents believed that conservation initiatives enabled access to a broader array of forest products. A notable 19.2% strongly agreed, while 8.7% and 6.1% were strongly opposed and disagreed, respectively. A minimal 3.1% showed indifference. With the mean line item of 3.8035 and SD 1.04327 exceeding the mean composite score of 3.45022 and SD 1.029571, it's evident that conservation efforts in the Mau Forest have facilitated access to diverse resources such as fodder, mushrooms, and medicinal herbs, thereby reinforcing the forest's preservation and long-term sustainability.

These insights are corroborated by earlier research (Duguma et al., 2018), which asserted that accruing greater economic benefits motivates communities to actively manage forest resources. This study's findings also indicate a positive correlation between the extent of economic benefits and the level of participation in conservation activities. Consequently, families deriving more benefits from the Mau Forest are more inclined to engage in

conservation efforts, furthering the protection and sustainable management of this vital ecosystem.

4.3.1 Significance of Participants' Marital Status in Environmental Governance and Resilience

Establishing the marital status of the participants was essential to the study for several reasons. Firstly, marital status could potentially influence the level of involvement and interest individuals have in environmental governance and resilience, given that married individuals often have familial responsibilities and, thus, may have a vested interest in the sustainability of their environment for the wellbeing of their families. Secondly, understanding the marital status helps in identifying the household structures prevalent in the area, which is crucial in assessing how families, as basic social units, interact with and are affected by environmental changes and governance structures. Lastly, marital status may influence the social networks and community involvement of individuals, which are vital aspects in community resilience and adaptive capacity to environmental

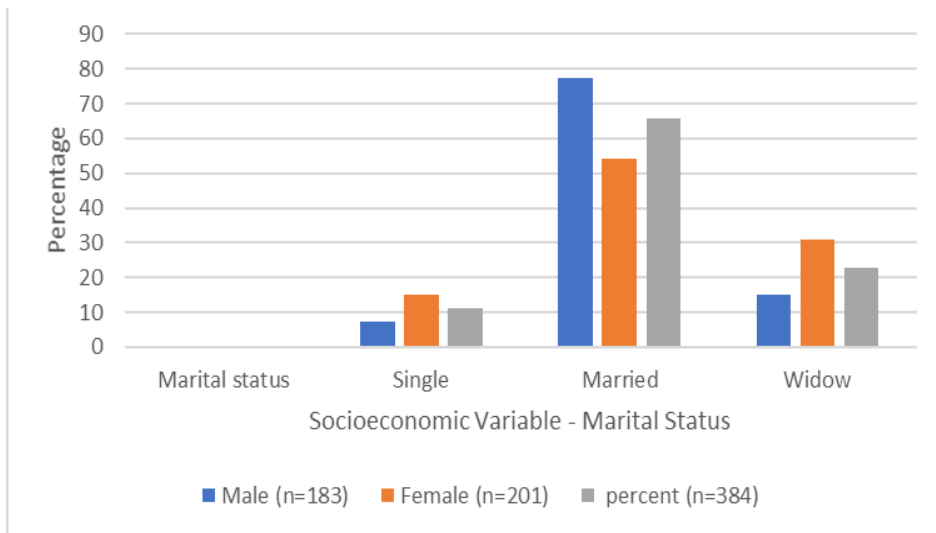


Figure 4.13: Marital Status

Source: Field Survey (2021)

changes.

In light of the aforementioned, the data represented in Figure 4.13 reveals the marital status of the participants. A considerable majority, 79.04%, indicated they were married,

while the remaining 20.96% identified as single. This outcome suggests that the predominant population residing in the Mau Forest Complex is married. Consequently, aspects of environmental governance and resilience bear significant implications for their well-being and health (Belinda et al., 2018).

As aforementioned, understanding the marital status of respondents is essential as it offers insights into the household structure and social dynamics within the community, which are integral to comprehending how environmental governance impacts resilience. Marital status can influence decision-making processes, resource allocation, and coping mechanisms within households, making it a pertinent aspect of the study.

The finding that a large proportion of respondents are married aligns with the conceptualization that married individuals, and by extension, families, form the foundational social unit in many communities. This is consistent with the research conducted by Belinda et al. (2018), which emphasized the criticality of environmental governance and resilience for the health and well-being of individuals residing in forested areas.

Comparing this with relevant literature, the high percentage of married individuals in the Mau Forest Complex could be reflective of socio-cultural norms and values that prioritize marriage, similar to various communities globally. Additionally, earlier research has indicated that marital status influences adaptability and resilience, with married couples often having access to shared resources and support networks, thereby enhancing their capacity to respond to environmental challenges (Agarwal, 2018).

However, it is crucial to delve deeper into the dynamics of the single population within the community, as their resilience strategies and experiences might differ from their married counterparts, thereby offering diverse perspectives on environmental governance. Previous studies have highlighted the varied adaptive capacities of single and married individuals, emphasizing the need for inclusive governance approaches that cater to the diverse needs of the community (Sunderlin et al., 2005).

These findings both support and extend the existing body of knowledge by elucidating the interplay between marital status, environmental governance, and resilience within the

specific context of the Mau Forest Complex. While there is alignment with previous research on the significance of marital status in environmental resilience, the study also sheds light on potential anomalies, such as the distinct experiences of the single parent or orphaned families, warranting further exploration and analysis.

4.3.2 Impact of Household Size on Resource Consumption and Community Resilience

Studying the household population is crucial as it provides insights into the demographic composition of the community residing in the Mau Forest Complex. Understanding household size is integral to evaluating the pressure exerted on natural resources and gauging the community's adaptability and resilience. Larger households may face different challenges and employ varied strategies in response to environmental changes compared to smaller households. The household population is a key determinant in assessing resource needs, allocation, consumption patterns, and the impact of environmental governance on community resilience.

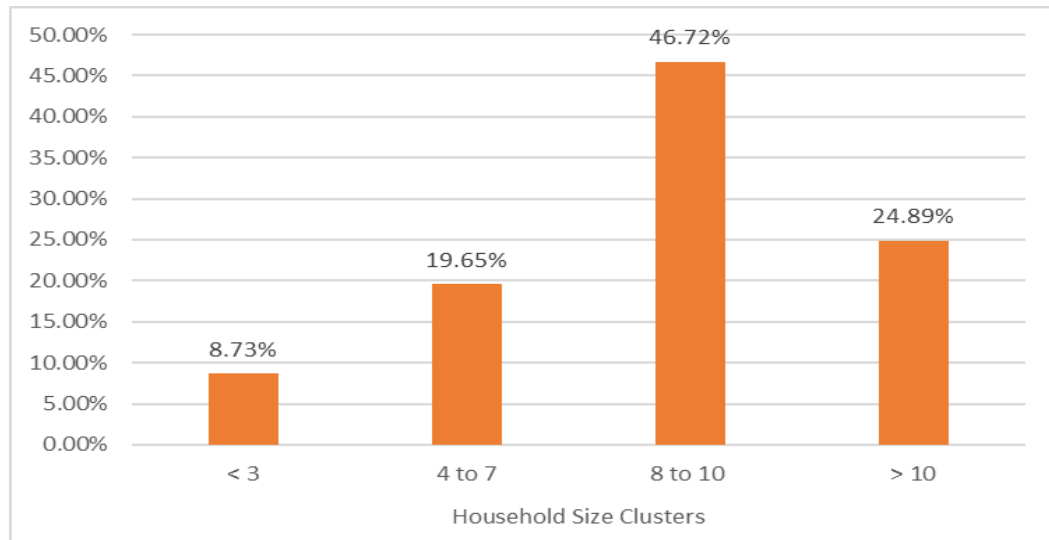


Figure 4.14: Household Size Clusters

Source: Field Survey (2021)

The majority of participants, 46.72%, reported having between 8 and 10 people per household. Additionally, 24.89% indicated a household size of more than 10 persons,

while 8.73% stated that their households comprised between 0 and 3 persons (Figure 4.14).

These results suggest a prevalence of relatively large households in the Mau Forest Complex. This is aligned with findings from several recent studies, which highlight the correlation between household size and resilience in various environmental settings. For instance, a study by Sunderlin et al. (2005) underlined the importance of household size in determining the adaptive capacity of communities to environmental changes. Larger households, often characterized by extended family structures, tend to have diverse resource bases and shared responsibilities, enhancing their resilience.

Similarly, research by del Mar Delgado-Serrano et al. (2018) emphasized that larger households might have more diversified livelihood strategies, enabling them to cope better with environmental uncertainties. The study suggested that the collective efforts and varied skill sets within large households contribute to better environmental outcomes and community resilience.

However, Melnykovich et al. (2018) offered a nuanced perspective, noting that while larger households may demonstrate higher adaptive capacity, they also face increased resource pressures and potential conflicts, necessitating effective environmental governance.

The current findings support the broader literature, underscoring the significance of household size in environmental resilience and governance. However, the proportion of smaller households (0-3 persons) in the Mau Forest Complex is noteworthy and presents a potential anomaly. Smaller households, representing 8.73% of the participants, may have distinct adaptive strategies and resource needs, potentially differing from the general trends observed in larger households. Further exploration into the experiences and resilience of these smaller households is essential to develop a comprehensive understanding of the community dynamics and inform inclusive environmental governance strategies.

4.3.3 Immigration Among Eastern Mau Forest Communities

4.3.3.1 Place of Origin Prior to Relocation to Mau Forest

Understanding the place of respondents' origin prior to relocation to the Mau Forest is key as it sheds light on the diversity of the population, their varied experiences, and potential impacts on the environment and community dynamics. It helps to analyze the influence of their original habitats on their perceptions, behaviors, and adaptations to the new environment. It also aids in assessing how their diverse backgrounds contribute to the community's resilience and response to governance initiatives.

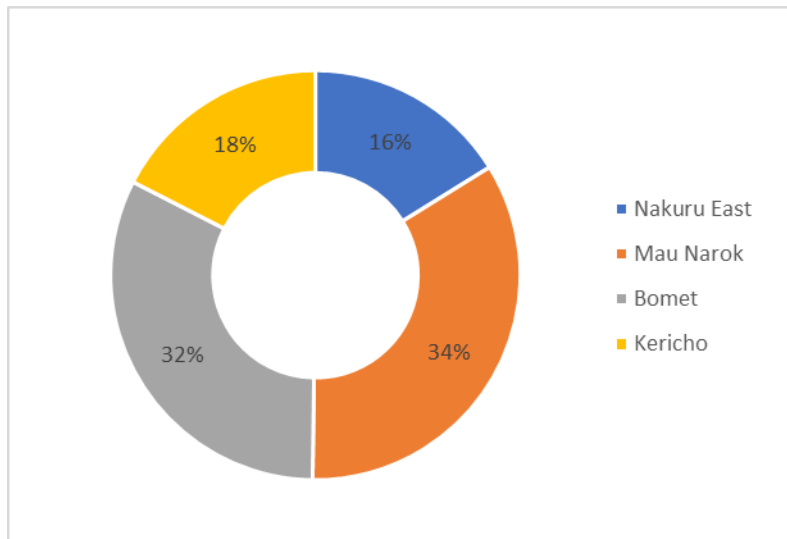


Figure 4.15: Respondents Place of Origin

Source: Field Survey (2021)

The majority of respondents (34.06%) indicated that they originated from Mau Narok before relocating to the forest. Additionally, 32.31% came from Bomet, 17.47% from Kericho, and 16.16% from Nakuru East.

The findings reveal a diverse origin of the Mau Forest's inhabitants, which contributes to a heterogeneity of experiences, perceptions, and adaptive capacities within the community. A study by Melnykovich et al. (2018) supports this observation, highlighting that diversity in origin can result in varied environmental practices and attitudes, influencing the community's overall approach to environmental governance and

resilience. Research by del Mar Delgado-Serrano et al. (2018) further elucidates that individuals from different origins bring unique knowledge, skills, and perspectives, which can enrich community-based environmental strategies and adaptive capacities. This diversity can be leveraged to foster innovative solutions and collaborative efforts for sustainable environmental management.

However, a study by Sunderlin et al. (2015) presents a contrasting view, noting that diversity in origin can also pose challenges in terms of community cohesion and collective action, especially when there are differences in environmental values and practices among the inhabitants. The current findings align with the broader literature, showcasing the diversity of origin as both an asset and a potential challenge for community resilience and environmental governance in the Mau Forest. It underscores the need for inclusive and adaptive governance strategies that recognize and integrate the diverse experiences and knowledge of the inhabitants, fostering collaboration and mutual learning.

While the diverse origins of the Mau Forest inhabitants contribute to a rich tapestry of knowledge and practices, it also necessitates careful consideration and integration in the development and implementation of environmental governance initiatives. Balancing the benefits and challenges of this diversity is key to enhancing community resilience and achieving sustainable environmental outcomes in the Mau Forest.

4.3.3.2 Reasons for Migration to the Study Area

Studying the reasons for migration to the Mau Forest area is significant as it helps identify the driving forces behind population movements and their subsequent impacts on the region. Understanding the motivations behind migration offers insights into the population's socio-economic dynamics, settlement patterns, and the pressure exerted on the local environment and resources. It also aids in assessing the varying needs and aspirations of the inhabitants, which is essential for developing targeted and effective governance and resilience strategies.

The majority of respondents (12.2%) indicated that their migration to the Mau Forest was primarily motivated by business ventures. Approximately 10% settled in the forest in

search of agricultural land, 10.5% followed their relocating parents, 8.7% moved to live with relatives, and 7.4% were fleeing from conflicts at home. Table 4.4 highlights that the Mau region has experienced a notable population increase in recent years, impacting the forest adversely due to these migrations.

The findings reveal that economic opportunities, familial ties, and conflict avoidance are primary motivators for migration to the Mau Forest. This aligns with the study by Ceccaldi et al. (2020), which posits that migration can lead to settlement expansion and population increase, posing significant environmental risks. A study by McLeman and Smit (2012) supports these findings, indicating that economic prospects, land availability, and social connections are common drivers of migration, especially in regions with environmental significance. The impact of such migration on local ecosystems can be multifaceted, affecting resource availability, land use patterns, and environmental conservation efforts.

Table 4.7: Reasons for Migration to Study Area

	Frequency	Percent
Parents Moved	24	10.5%
To live with relatives	20	8.7%
Schooling	19	8.3%
Marriage	13	5.7%
Family quarrel	17	7.4%
Divorce	10	4.4%
Work elsewhere	19	8.3%
Job transfer	6	2.6%
Look for work	16	7.0%
New job	16	7.0%
Business	28	12.2%
Searching for land assets	23	10.0%

Recovery from illness	7	3.1%
Other	11	4.8%
Total	229	100.0%

Source: Field Survey (2021)

Additionally, research by Black et al. (2011) underscores that migration resulting from conflict or familial reasons can lead to unplanned and rapid settlement growth, further straining environmental resources and governance structures. The study emphasizes the need for comprehensive planning and adaptive governance to address the diverse needs of the migrating population while ensuring environmental sustainability.

Contrastingly, Beniston et al. (2018) argue that while migration can pose environmental challenges, it also brings in human capital, innovative ideas, and potential for community development, which can contribute to adaptive capacities and resilience-building. The current findings echo the broader literature, highlighting the complexities of migration and its varied implications on environmental governance and resilience in the Mau Forest. Addressing the challenges and leveraging the opportunities presented by migration is pivotal for fostering sustainable development and environmental conservation in the region.

4.3.3.3 Duration of Residence in Research Area

Studying the Duration of Residence in the Research Area is imperative as it offers insights into the respondents' familiarity and engagement with the local environment and governance structures. The length of residence can influence residents' perceptions, experiences, and interactions with environmental changes, governance initiatives, and community resilience strategies. Understanding how long residents have lived in an area can help in assessing their awareness, knowledge, and attitudes towards environmental degradation and the effectiveness of governance interventions over time.

Table 4.8: Period of Residence in Research Area

	Frequency	Percent
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0 to 3 years	36	15.7%
4 to 6 years	57	24.9%
7 to 10 years	69	30.1%
Above 11 years	67	29.3%
Total	229	100.0%

Source: Field Survey (2021)

Most participants (30.1%) have resided in the Mau Forest for between 7 and 10 years, while 29.3% have lived there for more than 11 years, as depicted in Table 4.8. Additionally, approximately 24.9% of respondents have had a duration of residence ranging from 4 to 6 years, and 15.7% have lived in the area for between 0 and 3 years. This suggests a heightened awareness among the majority of respondents regarding the environmental degradation over time and the significant role that government interventions have played in recent years.

The findings indicate a diverse resident population in terms of the length of stay in the Mau Forest, with a substantial portion having lived there for a considerable duration. This diversity in residence duration aligns with the research by Kameyama & Yuri (2021), emphasizing the importance of local knowledge and long-term observation in understanding environmental changes and the impact of governance initiatives.

A study by Sunderlin et al. (2005) further supports the significance of residence duration, noting that long-term residents often have a deeper connection to the land, are more aware of environmental shifts, and are more likely to engage in community resilience strategies. They have witnessed the progression of environmental degradation and the evolution of governance mechanisms, which influences their perceptions and responses.

Contrastingly, research by del Mar Delgado-Serrano et al. (2018) highlights that newer residents bring fresh perspectives and adaptability, potentially contributing to innovative solutions for environmental governance and community resilience. The presence of both long-term and newer residents in the Mau Forest, as revealed by the current study, enriches the community's collective knowledge and adaptability. However, it is essential

to explore further the specific experiences, perceptions, and contributions of these diverse resident groups to fully comprehend their roles in environmental resilience and governance.

4.3.4 Household Healthcare Factors

In exploring the intricate web of factors that define and influence environmental security and governance within the Eastern Mau Forest, the research paid particular attention to household healthcare factors. This section delves into the findings and discussions surrounding the myriad ways in which household health dynamics intersect with environmental stewardship and resilience building. Recognizing that the health of the community members is inextricably linked to their ability to participate in, and benefit from, conservation efforts, the research scrutinized how household health aspects shape and are shaped by the ecological initiatives and governance structures within the Eastern Mau Forest. The following discussions will shed light on the significant insights and revelations drawn from the data, illuminating the multifaceted relationships between household health factors, environmental security, and the ongoing efforts to foster resilience within the Eastern Mau Forest community.

4.3.4.1 Frequency of Injuries and Illnesses within the Community

One of the key factors affecting community resilience is frequency of illness.

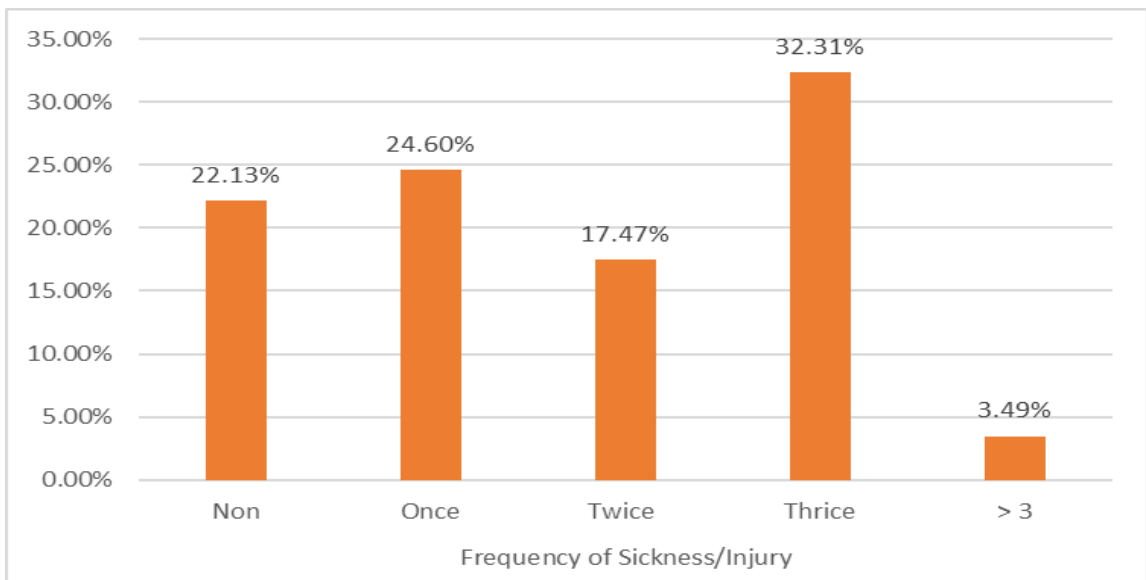


Figure 4.16: Frequency of Injury or Sickness

Source: Field Survey (2021)

In assessing the interplay of environmental security, governance, and resilience building, a notable finding emerged related to the health and safety of the Eastern Mau Forest community. Within the last four weeks preceding the survey, a substantial 32.31% of respondents reported falling sick or sustaining an injury thrice within the period. Conversely, a smaller portion, 22.13%, indicated no such health-related issues during the same timeframe.

Such a high prevalence of recent injuries or illnesses could hint at several interconnected factors. These may range from the environmental conditions in the forest affecting community health, to potential lapses in safety protocols, to the socio-economic determinants of health that could be making these households more susceptible to illnesses and injuries.

When juxtaposed against the existing literature, these findings prove intriguing. Historically, communities closely linked with forest ecosystems often exhibit a symbiotic relationship with their environment, where the health of one directly impacts the other (Brown & Lassoie, 2010). For instance, in some forested regions, well-conserved environments have been shown to provide ecosystem services that reduce disease transmission and provide medicinal resources, subsequently promoting community health (Myers et al., 2013). Conversely, degradation or mismanagement of these ecosystems can expose communities to heightened risks of illnesses and injuries (Dawson & Martin, 2015).

The reported frequency of injuries and illnesses in the Eastern Mau Forest community appears slightly at odds with this established narrative. Such a significant percentage of recent health incidents suggests that the community might not be fully benefiting from the protective health buffer that well-conserved forests typically offer. This discrepancy could be attributed to various factors, such as changes in forest quality, introduction of non-native species, or even external socio-economic influences that the literature hasn't adequately accounted for.

Moreover, a potential anomaly emerges when considering the role of governance in forest resource management. Effective governance frameworks, as championed by scholars like Agrawal and Ostrom (2001), often correlate with improved health outcomes in forest-dependent communities due to sustainable utilization and management of resources. However, the current findings from Eastern Mau Forest challenge this assertion, necessitating a deeper exploration into the specific governance structures and their effectiveness in this particular context.

The reported frequency of injuries and illnesses among the Eastern Mau Forest community members calls for a comprehensive analysis of the underlying factors, juxtaposed against existing scholarly insights. It underscores the importance of holistic and adaptive approaches in understanding and addressing the complex interplay of environmental security, governance, and community health.

4.3.4.2 Type of Injury Among Community Members

Respondents were requested to outline injuries they suffered and the results were as presented below;

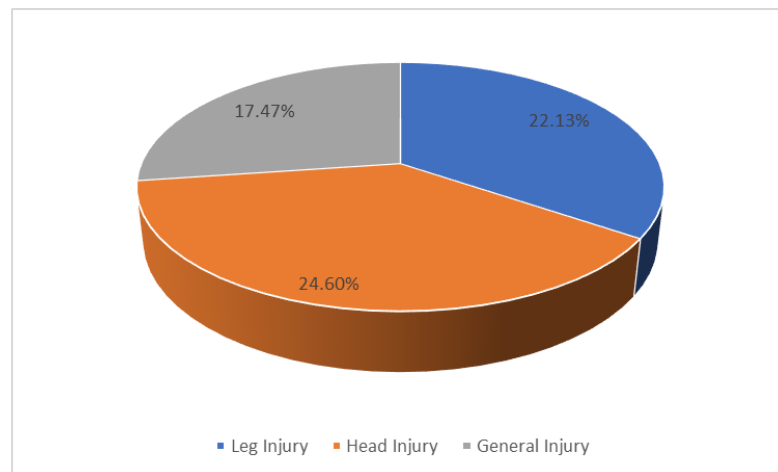


Figure 4.17: Major Types of Injury Suffered

Source: Field Survey (2021)

Exploring further the nature of the injuries sustained by the Eastern Mau Forest community provides a more granular perspective into the challenges they face. Among the participants who reported an injury, the data reveals a distribution in the type of

injuries experienced. Nearly half of the respondents, specifically 49.34%, identified their injuries as general in nature. However, a significant portion, 38.86%, reported leg injuries, while 11.79% experienced head injuries as shown in figure 4.17.

The prominence of leg injuries can potentially be attributed to the nature of activities that the community members engage in, especially within forested terrains. Activities such as hunting, logging, and even day-to-day commuting in uneven or densely vegetated areas might increase the susceptibility to leg injuries. The comparatively lower percentage of head injuries, though less frequent, still remains a matter of concern given the potential severity and long-term implications of such injuries.

Comparing these findings with existing literature provides an enlightening context. In various forest-dependent communities, injuries often mirror the primary livelihood activities of the inhabitants (Rist et al., 2012). For instance, in regions where logging is a primary activity, leg and arm injuries might be predominant due to the hazards associated with falling trees or handling logging equipment (Lancaster et al., 2015). Furthermore, head injuries, albeit less frequent in some settings, often correlate with specific practices or perhaps even accidents that could be tied to the community's socio-cultural context or forest resource utilization methods (Jensen et al., 2016).

The significant proportion of general injuries among the respondents might be an indication of a broader set of challenges, including perhaps minor accidents, insect bites, or other non-specific incidents related to forest interactions. It might also suggest that some respondents possibly classified multiple minor injuries under a generic 'general injury' category.

In synthesizing these findings with established academic discourse, the nuances of injury types among the Eastern Mau Forest community accentuate the importance of tailored interventions (Tsai *et al.*, 2020). It becomes imperative to not only understand the root causes of these injuries but also to integrate preventive measures that align with the community's lifestyle, practices, and interaction with the forest.

4.3.4.3 Prevalence of Chronic Illnesses Among Community Members

The respondents were asked if they had suffered from any of the listed chronic illnesses with outcomes as shown below - Table 4.9.

Table 4.9: Prevalence of Chronic Illness

	Frequencies	Percentages
Affirmative	146	63.4%
Negative	83	36.6%
Total	229	100.0%

Source: Field Survey (2021)

The health profile of the Eastern Mau Forest community is punctuated by the notable prevalence of chronic illnesses. A significant 63.3% of respondents reported suffering from chronic diseases, contrasting sharply with the 36.7% who affirmed not having any chronic conditions.

The high prevalence of chronic illnesses in this community may reflect various factors ranging from environmental to socio-economic. Chronic conditions often arise from sustained exposure to environmental stressors, prolonged dietary or lifestyle habits, or possibly genetic predispositions (Smith et al., 2013). Given the forested nature of the Eastern Mau region, it is plausible that residents may be exposed to particular pathogens or conditions conducive to the onset of certain chronic diseases.

In a broader context, chronic disease prevalence is a significant concern globally. According to the World Health Organization (WHO, 2018), chronic non-communicable diseases are increasingly the major causes of Demise worldwide, especially in low and middle-income countries. While this global trend mirrors the findings in the Eastern Mau Forest community, the marked prevalence suggests that there could be specific environmental, genetic, or socio-economic triggers in this region.

Upon comparing these findings with available literature, one can draw potential parallels. Forest-dependent communities often have unique interactions with their environment,

which may lead to both health benefits and challenges (McSweeney et al., 2014). For example, while the forest may provide medicinal plants and a buffer against certain diseases, it can also be a reservoir for vectors of illnesses or entail lifestyle habits that predispose residents to particular conditions.

Addressing the high prevalence of chronic diseases in the Eastern Mau Forest community necessitates a two-pronged approach. Firstly, there's a need for intensive research to pinpoint the exact chronic conditions prevalent and their causes. Secondly, targeted interventions, including health education, medical services, and preventive measures, must be initiated, keeping in mind the unique lifestyle and environmental interactions of the community.

4.3.4.4 Types of Chronic Illnesses Endemic to the Eastern Mau Forest Community

The sampled East Mau residents were asked to indicate the type of chronic diseases, and their results are noted in Table 4.10.

Table 4.10: Type of Chronic Illnesses

	Frequency	Percent
Chronic Malaria	73	31.9%
Tuberculosis	45	19.7%
STDs (Syphilis, Chlamydia, Super Gonorrhoea)	36	15.7%
HIV/AIDS	24	10.5%
High blood pressure	39	17.0%
Other chronic diseases	12	5.2%
Total	229	100.0%

Source: Field Survey (2021)

In the Eastern Mau Forest community, the spectrum of chronic diseases paints a distinct health profile. A comprehensive assessment reveals a striking pattern of illnesses, some of which may directly link to environmental and socio-economic factors inherent to the region.

Malaria, as reported by 31.9% of the respondents, emerges as the predominant health challenge. This is not surprising given that malaria is often associated with forested regions, where the *Anopheles* mosquito, the primary vector of malaria, thrives (White et al., 2011). The forest environment, with its still water bodies, could provide breeding grounds for these vectors, thereby enhancing transmission. The incidence of tuberculosis (TB) at 19.7% is noteworthy. While TB is primarily a respiratory condition, its transmission can be influenced by various socio-economic determinants. Congested living conditions, inadequate access to healthcare, and underlying malnutrition can potentially escalate the transmission rates (Lönnroth et al., 2015).

High blood pressure, identified by 17% of participants, might suggest lifestyle factors or possibly genetic predispositions within the community. Changes in dietary habits, stress, or other socio-economic pressures could play a role in the onset of hypertension (Mills et al., 2016). Sexually transmitted diseases, like Syphilis and the rather concerning mention

of super Gonorrhoea, were reported by 15.7% of the respondents. Such a statistic underscores the need for effective sexual health education, access to healthcare, and interventions within the community (Peeling et al., 2017).

In comparison with broader literature, the high prevalence of diseases like malaria and TB in forest communities has been corroborated by various studies. Forest-dependent communities often face unique health challenges emanating from their interaction with the environment and the socio-economic fabric of their community (Salje et al., 2019).

In summation, while the reported chronic illnesses reflect global health challenges, the particular prominence of certain diseases in the Eastern Mau Forest region requires targeted interventions. A holistic approach that melds medical care, preventive measures, health education, and socio-economic upliftment is paramount to address the health concerns of this community.

4.3.4.5 Household Mortality

The topic of mortality within households is a sombre one, particularly when it affects a significant proportion of the community. In the Eastern Mau Forest community, an alarming 90.83% of respondents confirmed the Demise of at least one household member in the preceding 24 months. In stark contrast, only 9.17% of participants reported no such loss within the same time frame.

The high mortality rate could be indicative of underlying socio-economic and health challenges that may be endemic to the region. Potential contributing factors could include limited access to healthcare, a high prevalence of diseases (as noted in previous sections), environmental hazards, and other socio-economic stressors.

Comparing these findings with the broader literature, high household mortality rates are typically found in regions grappling with significant health challenges, such as outbreaks of infectious diseases, malnutrition, or in areas affected by conflicts (Houle et al., 2014). The reasons behind the elevated mortality rate in the Eastern Mau Forest community would need further investigation to understand specific causative factors.

It is also worth noting that such high rates of household member deaths can have profound social, psychological, and economic implications for the surviving members. The emotional trauma, combined with potential economic hardships due to the loss of breadwinners, can significantly affect household well-being and community cohesion (Kaschula, 2011).

Addressing these issues demands an integrated approach. Enhancing healthcare access, early disease detection and treatment, psycho-social support, and socio-economic interventions can play pivotal roles in reducing mortality and improving the overall quality of life in the community.

From Figure 4.17, 90.83% of participants noted that they had lost a household member, while 9.17% did not lose even a single household member in the past 24 months. The findings imply that the community has failed to be resilient in the past few months. Steel *et al.* (2018) investigated the relevance of selected main risk variables to the global and regional burden of illness in 14 industrialized and developing nations and the United Kingdom. Twenty-six carefully chosen risk variables were thoroughly examined for each of the nations that were chosen. The potential impact fraction relation was used to estimate the attribute fractions of the population under study. According to the study's results, environmental concerns, such as contaminated water, inadequate sanitation, unhygienic conditions, and indoor smoking, substantially contributed to increased morbidity and mortality in the world's poorest nations. In contrast to the research, which is based on a single nation, the previous study was an amalgamation of multiple countries.

4.3.4.6 Place of Demise in the Eastern Mau Forest Community

Understanding the place of Demise provides key insights into the accessibility and utilization of healthcare services, the nature of diseases or conditions leading to death, and socio-cultural practices surrounding end-of-life care. In the Eastern Mau Forest community, the data presents a notable trend.

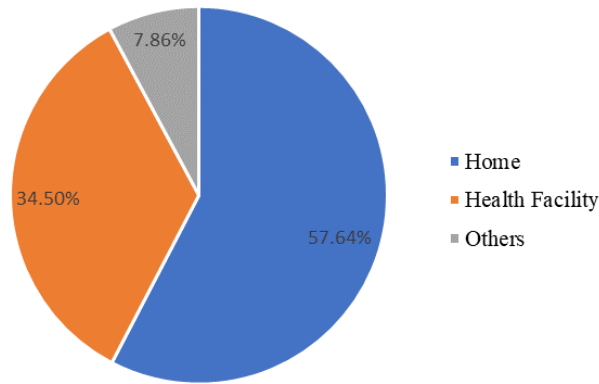


Figure 4.18: Deceased Place of Passing

Source: Field Survey (2021)

A significant majority, 57.64% of respondents, indicated that their loved ones passed away at home. On the other hand, 34.50% mentioned that the Demise occurred in a health facility, and 7.86% noted various other locations.

The dominance of home as the primary site of Demise underscores several potential issues. Firstly, it might hint at barriers in accessing timely and appropriate healthcare. These barriers could be financial, geographical, infrastructural, or even cultural (Gysels, Pell, Straus, & Pool, 2011). A preference for home-based end-of-life care, bolstered by traditions or the lack of knowledge about the importance of medical interventions, could also be influential (Kellehear, 2016).

In comparison to global trends, especially in developed nations, there has been a push towards dying in a controlled medical environment, where pain management, symptom control, and psychological support can be provided (Cohen et al., 2015). However, in many developing or rural contexts, the reality of healthcare access and cultural norms often makes home deaths more common (Gysels et al., 2011).

The 34.50% who mentioned deaths in health facilities suggest that a segment of the community can access and utilize healthcare when critically needed. However, the reasons behind this disparity, between those who can and cannot reach or opt for medical facilities at the end of life, demand more in-depth investigation.

In conclusion, the places of Demise within the Eastern Mau Forest community not only reflect the community's healthcare access and decision-making but also provide crucial

information for policy-makers. Targeted interventions to enhance healthcare accessibility, community awareness campaigns about the importance of medical interventions, and respecting and integrating local customs into end-of-life care can help address these issues.

4.3.4.7 Affected Gender in the Eastern Mau Forest Community

When examining mortality trends within the Eastern Mau Forest community, gender disparity stands out prominently. The study findings reveal that 67.25% of participants believe that males are the most affected gender, in contrast to 32.75% who perceive females as more affected.

This predominant view of males being more affected aligns with the previous finding that a significant number of individuals die at home. Considering the roles males often play in many communities, including physical labour, resource gathering, and, in some cases, involvement in community conflicts or risky activities, their exposure to hazards may be heightened. Such activities might lead to injuries, susceptibility to illnesses, or other fatal circumstances, explaining their higher mortality (Hosseinpour, Bergen, & Kunst, 2012).

On the other hand, the perception that females are less affected could also emanate from the roles they conventionally undertake in many societies, which might be perceived as less risky. However, this does not diminish the vulnerabilities they might face, particularly related to reproductive health, domestic issues, or even socio-economic disadvantages (Denton, Prus, & Walters, 2004).

A comparison with the literature provides an enriched perspective. Globally, in many contexts, males often have a higher mortality rate due to various socio-cultural and biological reasons (Waldron, 2017). For instance, risk-taking behaviour, occupational hazards, or even reluctance in seeking timely medical care might make males more vulnerable. However, the higher mortality rate of males in some areas doesn't negate the specific challenges and vulnerabilities females might encounter.

In conclusion, while males in the Eastern Mau Forest community seem to be more affected in terms of death, it's crucial to approach this data with nuance. Understanding

the underlying reasons for this disparity can guide targeted interventions, ensuring that both genders receive the necessary support and resources for a healthier life.

4.3.4.8 Affected Age in the Eastern Mau Forest Community

The age distribution of deaths within the Eastern Mau Forest community provides crucial insights into the vulnerabilities and risks that different age groups face. According to the study's findings, young adults and the middle-aged population bear the brunt of mortality in this community Table 4.11.

Table 4.11: Affected Age

	Frequencies	Percentages
18 - 24 Years	60	26.2%
25 - 34 Years	71	31%
35 - 44 Years	29	12.7%
45 - 54 Years	40	17.5%
Over 54 Years	29	12.7%
Total	229	100.0%

Source: Field Survey (2021)

Specifically, 31.0% of respondents identified individuals aged between 26 and 35 years as the most affected age group. Following closely, 26.2% of deaths were attributed to those aged between 18 and 25 years, and 12.7% were for ages between 36 - 45 years and above 55 years. It's alarming that the age group 18 to 35 years, often considered the prime of life, registers such high mortality. This age bracket typically encompasses the most productive years, a time when many individuals take on substantial responsibilities such as starting families, actively participating in community roles, or engaging in economically productive activities. The elevated mortality within this age group might be linked to several factors. Economic pressures could lead to risk-taking behaviors,

participation in perilous jobs, or vulnerability to specific diseases, among other reasons (Liu, Probst, Harun, Bennett, & Torres, 2013).

Comparatively, the mortality in older age groups, such as those above 55 years, could be attributed to natural causes, chronic diseases, and age-related vulnerabilities (Oeppen & Vaupel, 2002). Nevertheless, the 12.7% figure for this age bracket in the Eastern Mau Forest community is still concerning and should be addressed.

The high mortality rates among the younger age groups, especially between 18 and 35 years, diverge from global trends where higher mortality is often associated with more advanced ages (Christensen, Doblhammer, Rau, & Vaupel, 2009). This anomaly underscores the unique challenges faced by the Eastern Mau Forest community and the urgent need for tailored interventions.

Understanding the affected age profiles within this community can offer guidance for targeted health interventions, economic programs, and other measures that cater specifically to the most vulnerable groups, ensuring a more balanced and healthier community.

4.3.4.9 Healthcare Preferences in Response to Illnesses and Injuries

In the wake of injuries and illnesses, the choice of healthcare providers is a fundamental aspect that shapes both immediate and long-term health outcomes for affected individuals. Within the Eastern Mau Forest community, this study observed a diverse range of healthcare choices, reflecting a broad spectrum of healthcare infrastructure, belief systems, and accessibility challenges. (Table 4.12);

Table 4.12: Health Provider

	Frequency	Percent
Referral hospital	27	11.8%
District/Provincial hospital	75	32.8%
Public dispensary	41	17.9%
Missionary dispensary/hospital	38	16.6%
Traditional healer	48	21.0%
Total	229	100.0%

Source: Field Survey (2021)

The majority (32.8%) of participants sought medical attention from District or provincial hospitals following an injury. This preference for formal healthcare establishments, recognized for their relatively better facilities and skilled personnel, emphasizes the trust and reliance on mainstream medical treatments by a significant section of the community. These hospitals often provide comprehensive healthcare services, from outpatient consultations to in-patient facilities, making them a primary choice for many (Smith, 2013).

However, not far behind in preference, a notable 21% of respondents turned to traditional healers. This preference underscores the deep-rooted cultural and traditional beliefs in the community. Many communities across Africa, including Kenya, have a longstanding history of relying on traditional healers, especially where access to modern healthcare is limited or for illnesses perceived to have spiritual causes (Musyimi, Mutiso, Ndeti, Henderson, & Bunders, 2017).

Furthermore, 17.9% of participants chose public dispensaries, possibly due to their proximity and accessibility, followed by 16.6% who sought care from Missionary dispensaries or hospitals, known for their commitment to community health, especially in remote areas (Ravishankar et al., 2009). The least frequented were the referral hospitals, with 11.8% of respondents seeking care there, which could be attributed to their location, often distant from local communities, or the perception that these are reserved for more severe cases.

Therefore, the diversity in healthcare choices within the Eastern Mau Forest community mirrors the intricate interplay of accessibility, cultural beliefs, and perceived effectiveness of available healthcare options. Understanding these choices and preferences can inform health interventions and policies tailored to the unique needs and beliefs of the community.

4.3.5 Gender Perspectives on Environmental Security

analysing the "Perspectives of Gender on Environmental Security in Eastern Mau Complex" uncovered the nuanced roles, responsibilities, and experiences of different genders in environmental conservation and security. This analysis helps to highlight the

distinctive interactions that men and women have with the environment and how these interactions shape their contribution to environmental preservation. Understanding gender perspectives is key to ensuring equitable and effective conservation strategies and policies, considering the diverse challenges and opportunities faced by different genders.

Table 4.13: Percentage Distribution of Respondents by Gender Across Socioeconomic Fields

<i>Socio-economic variable</i>	<i>Male (n=183)</i>	<i>Female (n=201)</i>	<i>percent (n=384)</i>
<i>Residence:</i>			
<i>Urban</i>	23.4	31.2	27.3
<i>Peri-urban</i>	33.1	34.6	33.85
<i>Rural</i>	43.5	34.2	38.85
<i>Education (completed):</i>			
<i>Primary or lower</i>	55.3	83.9	69.6
<i>Secondary school</i>	32.8	12.4	22.6
<i>Tertiary (cert, dip, degree)</i>	11.9	3.7	7.8
<i>Age:</i>			
<i>Below 25yrs</i>	27.4	29.7	28.55
<i>25 – 35yrs</i>	31.2	35.6	33.4
<i>36 – 45yrs</i>	25.1	28.8	26.95
<i>46 – 55yrs</i>	9.2	3.2	6.2
<i>56 – 65yrs</i>	4.4	2.1	3.25
<i>Above 65yrs</i>	2.7	0.6	1.65
<i>Marital status</i>			
<i>Single</i>	7.4	14.9	11.15
<i>Married</i>	77.5	54.3	65.9
<i>Widow</i>	15.1	30.8	22.95
<i>Type of work within last 24 months</i>			
<i>No work/odd jobs</i>	57.1	44.6	50.85
<i>Self-employed/business/farming</i>	33.2	52.5	42.85
<i>Private sector job</i>	2.4	1.8	2.1
<i>Government job</i>	6.7	0.7	3.7
<i>Pensioner</i>			

Source: Field Survey (2021)

According to the findings, there has been a longstanding notion that the relationship between human civilization and the physical environment is gender-neutral. However, the diverse sociocultural constructions of men's and women's roles result in distinct

interactions and effects between individuals and the physical environment. The unique roles played by both genders in the home, community, and economy mean that their reactions, priorities, and control over resources related to environmental preservation may differ significantly (Migliore et al., 2022).

Migliore et al. (2022) also noted that in many Kenyan communities, gender roles subject women and children to more exposure to environmental threats. This is largely attributed to their pivotal role in agricultural labour and household duties, such as obtaining fuelwood, water, and grazing cattle. Such roles have, in some instances, propelled women to become adept managers of natural resources, as evidenced by initiatives like the Green Belt Movement in Kenya.

Aryal et al. (2022) highlighted the prevalent gender inequalities, particularly in rural and underprivileged populations, where women often face restrictions in holding public posts and managing resources, leading to potential conflicts and competition over natural resources. The concept of "gender equality" in this context refers to equitable distribution of benefits and responsibilities between men and women, acknowledging the distinctive power spheres occupied by each gender (Aryal et al., 2010; Swim et al., 2020).

The current study's findings align with the literature, showing that gender relations significantly impact community access to forest resources and subsequent revenue opportunities and food generation activities (Enzler et al., 2019; FAO, 2022). The findings reveal a reliance of women on direct connection to forest resources more than men, with around 53% of women engaging in flexible trades or farming activities, allowing them to manage domestic work concurrently.

The findings underscore the importance of women in bolstering community resilience in the Eastern Mau Forest through their activities and depth of knowledge about forest management and conservation (FAO, 2022). However, gender inequality still presents barriers to sustainable development by restricting women's access to resources and decision-making opportunities. The evident gender disparities and women's significant involvement in environmental conservation efforts accentuate the need for gender-inclusive strategies for environmental security and governance in the Eastern Mau forest.

These findings both support and extend the existing literature by providing a nuanced understanding of gender dynamics in environmental security within the specific context of the Eastern Mau Complex.

4.3.5.1 Educational Attainment in the Eastern Mau Forest Community

Educational attainment in any community provides an avenue for understanding the human capital available and its potential implications on various social, economic, and environmental dimensions. Within the Eastern Mau Forest community, the levels of education present a mosaic of diverse educational backgrounds with distinct implications for health, employment, and even environmental stewardship. Figure 4.26;

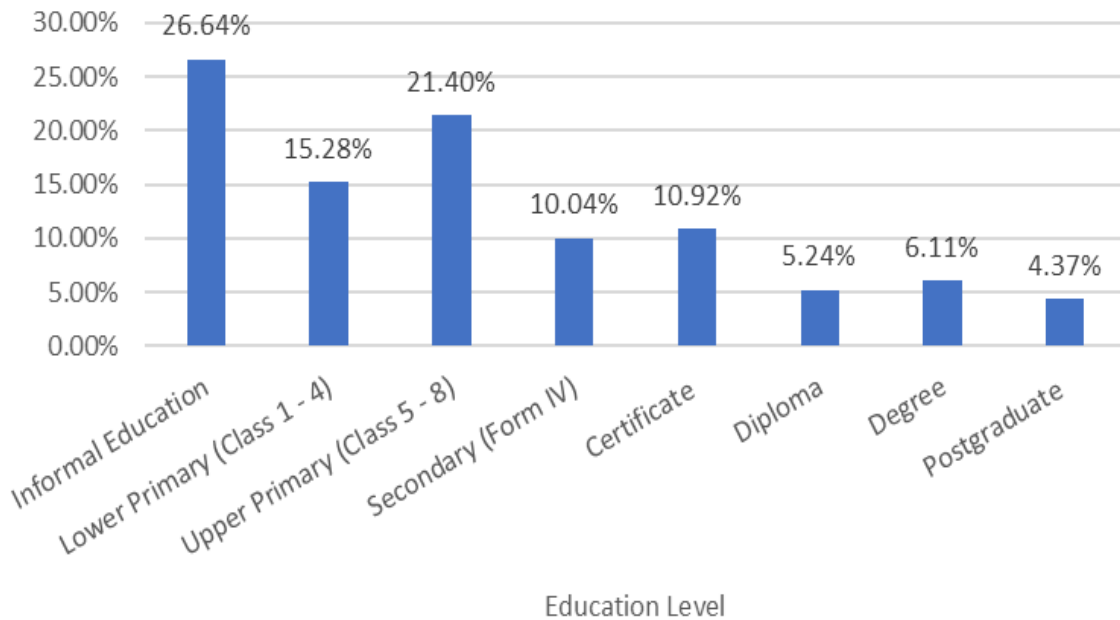


Figure 4.19: Education Level

Source: Field Survey (2021)

A significant portion of respondents (26.64%) revealed they had acquired informal education. Such a prevalence of informal education underscores potential limitations in accessibility, affordability, or even the perceived value of formal schooling in the area. Informal education, often obtained outside conventional classrooms, usually through life experiences or community teachings, may not grant the same advantages as formal

schooling but is invaluable in its own right, particularly in understanding indigenous knowledge and practices (Green, 2013).

Following closely, 21.4% of the respondents completed their education up to the upper primary level (classes 5 to 8). The drop after primary education could signify various barriers like financial constraints, socio-cultural factors, or the immediate necessity for young individuals to contribute to household income. Upper primary education, however, does provide foundational skills in literacy and numeracy, which are critical in daily life (Adams, 2015).

The study also indicated that 10.92% of participants had acquired certificate-level qualifications, which could be attributed to vocational training or post-secondary school certificate courses. Such training is pivotal for enhancing specialized skills and increasing employability (Lucas & Mbiti, 2012).

Interestingly, only a small fraction of the population, 4.37%, attained postgraduate degrees, and those achieving beyond a bachelor's degree constituted less than 6% of the respondents. This minimal representation of higher education degree holders may reflect broader systemic challenges in higher education access or perhaps the migration of highly educated individuals in search of better opportunities.

The varied educational backgrounds within the Eastern Mau Forest community provide a nuanced perspective on the community's capacities and potential challenges. Such insights are invaluable for interventions aiming at harnessing local knowledge while filling the educational gaps to foster development and resilience in the community.

4.3.5.2 Relationship Between Educational Attainment and Resilience in the Eastern Mau Forest Community

Building upon the previous findings related to the educational backgrounds within the Eastern Mau Forest community, an intricate relationship emerges between educational attainment and resilience building. As outlined in the data, one's level of education plays

a pivotal role in their ability to adopt resilient practices in the face of environmental degradation within the Mau East Forest.

Table 4.14: Education Level - Resilience Cross Tabulation

		Yes	No	Total
Education Level	Informal education	0	14	14
	Lower primary (Class 1 – 4)	11	0	11
	Upper Primary (Class 5 – 8)	0	10	10
	Secondary (Form IV)	23	17	40
	Certificate	18	0	18
	Diploma	25	1	26
	Degree	36	25	61
	Postgraduate	35	14	49
Total		137	92	229

Source: Field Survey (2021)

The cross-tabulation in Table 4.14 paints a compelling narrative. Specifically, those with advanced educational backgrounds such as degree holders and postgraduates have displayed a markedly higher proclivity towards resilience. As observed, 36 out of 61 respondents with degrees and 35 out of 49 postgraduates noted their resilience to environmental degradation. This inclination for higher education degree holders to adopt resilient practices underscores the transformative power of education in shaping one's perceptions, skills, and response mechanisms.

Further cementing this connection, the chi-square test results presented in Table 4.15 solidify the notion that educational attainment is not just incidental to resilience in the Mau East Forest but is intrinsically linked. The significance value of 0.000, being lower than the threshold p-value of 0.05, robustly rejects the null hypothesis, leading to the inference that the education level and resilience building within the community are indeed dependent on each other. This statistical confirmation resonates with the global understanding that education serves as a cornerstone in empowering communities to address environmental challenges (Béné et al., 2016).

Table 4.15: Degree of Linkage Between Education and Resilience - Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	85.817 ^a	7	.000
Likelihood Ratios	111.985	7	.000
Linear-by-Linear Associations	.047	1	.829
No. of Valid Cases	229		

a. 2 cell (12.5%) have an expected count of less than 5. The minimum expected count is 4.02.

Source: Field Survey (2021)

In essence, the multifaceted insights derived from these analyses emphasize the transformative role of education, particularly higher education, in bolstering community resilience. As the Eastern Mau Forest community navigates the pressing imperatives of environmental degradation, the empowerment and expanded horizons brought about by education stand as a bulwark, enabling more effective and informed responses.

4.3.5.3 The Impediments to Education in the Eastern Mau Forest Community

Education, acknowledged globally as a key driver for individual and community advancement, often faces multifaceted challenges that limit its accessibility and uptake. In the Eastern Mau Forest community, Table 4.16 elucidates a spectrum of reasons why some members did not attend school. These reasons are not merely standalone challenges but are reflective of broader socio-economic and cultural narratives within the community.

Table 4.16: Reason for not Attending Schools

	Frequency	Percent
No money for school fees	8	26.2%
Poor quality of schools	2	6.1%
Own illness/ disability	2	7.0%
Family illness/disability	3	10.5%
Not interested	4	11.8%
Parents did not let me	3	9.6%
Had to work to help at home	5	15.7%
Local conflicts	4	13.1%
Total	30	100.0%

Source: Field Survey (2021)

A significant 26.2% of the participants indicated that financial constraints, specifically the lack of funds to cover school fees, prevented them from attending school. This underscores the economic vulnerabilities faced by some households, where even the foundational right to education becomes unaffordable. The issue of having to work to assist at home, as cited by 15.7% of the respondents, further highlights the economic pressures. In such instances, immediate familial financial obligations take precedence over long-term educational pursuits.

Beyond economic reasons, socio-cultural factors also play a role. For instance, 11.8% of respondents expressed a lack of interest in education. Such perspectives might be rooted in community traditions, immediate livelihood concerns, or even a perceived lack of relevance of formal education in their daily lives. Additionally, the fact that 9.6% were not permitted by their parents to attend school might suggest deeply ingrained cultural beliefs or an undervaluation of education in certain families.

Quality of education, albeit mentioned by a smaller 6.1% of participants, remains a critical concern. When schools do not offer quality education, it can deter enrollment and consistent attendance. Furthermore, individual and familial health challenges, accounting for 7.0% and 10.5% respectively, further impede school attendance, emphasizing the interconnectedness of health and education. Lastly, the reason that 13.1% couldn't attend school due to local conflicts illuminates the broader socio-political environment's impact.

Whether these conflicts are land disputes, resource conflicts, or other forms of community unrest, they disrupt not just immediate safety but also long-term educational prospects. Therefore, the varied reasons for not attending school in the Eastern Mau Forest community provide an insightful lens into the intricate weave of economic, socio-cultural, health, and political factors at play. Addressing educational absenteeism thus requires a holistic understanding and a multi-pronged approach that respects and addresses these unique challenges (UNESCO, 2017).

4.3.5.4 Management of Educational Institutions in the Eastern Mau Forest Community

The foundational role of education in shaping the socioeconomic prospects of individuals and communities is universally acknowledged. As such, the management of educational institutions often emerges as a central point of debate in academic and policy circles. In the Eastern Mau Forest community, the management spectrum of schools is indeed diverse, reflecting a blend of governmental and non-governmental involvement.

According to the findings, a clear majority of schools (70.31%) are managed by the government. This is consistent with global trends, where governments, as the primary stakeholders in education, typically take the helm in establishing, funding, and managing schools to ensure that every citizen has access to education (World Bank, 2019). Government-led schools often benefit from standardized curricula, state funding, and regulatory oversight, ensuring broad accessibility and certain quality standards.

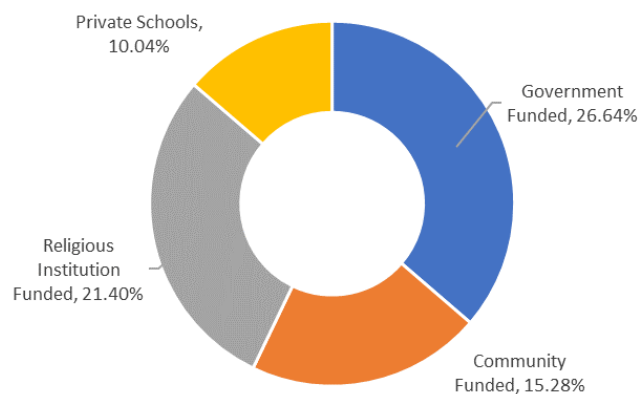


Figure 4.20: School Management
Source: Field Survey (2021)

On the other hand, 14.41% of schools managed by churches underscores the historical and continued involvement of religious institutions in education. Often, religious institutions have been at the forefront of educational initiatives, especially in areas where government reach might be limited. Schools run by churches or other religious entities often integrate values-based education and may cater to specific communities, complementing governmental efforts (Baker & Riordan, 1998).

The community's role in managing 12.68% of schools signifies grassroots initiatives in education. Often, in regions where state infrastructure might be sparse or where specific community needs are unmet by standardized education systems, local communities rally to establish and manage their schools. These schools, while potentially lacking in resources, often benefit from strong community involvement and tailored pedagogies (DeStefano et al., 2006).

The smallest segment, 2.62% managed by other organizations, might encompass a range of non-profit, NGO-led, or even private, for-profit schools. These schools, depending on their mission and funding, can offer varied curricula and pedagogies, often filling gaps in the broader educational ecosystem (Heyneman & Stern, 2014).

Comparatively, the literature on global education trends indeed highlights the dominant role of government in school management. Yet, non-state actors, including religious institutions, communities, and other organizations, provide valuable complementary roles, especially in regions with diverse needs and challenges (Lewin, 2007). The Eastern Mau Forest community's school management landscape mirrors these broader patterns, underscoring the multifaceted nature of educational initiatives and their deep-rooted interplay with societal structures.

4.3.5.5 Educational Support for Resilience Building in the Eastern Mau Forest Community

Education, being a pivotal determinant of socioeconomic progress, often extends beyond the household's financial capabilities. Especially in communities where economic resources are limited, external support in education becomes a significant indicator of societal interdependencies and the broader support structures in place. This is of

particular importance in regions like the Eastern Mau Forest, where the potential vacating of forest cover could lead to significant socioeconomic upheavals. Understanding who shoulders the educational cost could offer insights into the resilience capacity of these communities during transitional phases.

The study reveals an intriguing trend; a substantial 81.22% of participants received financial assistance for their education from individuals outside their immediate families. This substantial external support highlights the importance and value the community places on education, despite financial constraints. However, it's worth noting that a significant 18.78% of participants did not receive any external support, which might indicate an economically marginal segment within the community or households capable of self-financing.

Diving deeper into the institutions behind this assistance offers further insights. The data illustrates that religious institutions play a monumental role, with 52.84% of the participants stating that they received sponsorships from them. Such a role aligns with global trends where religious institutions often act as safety nets, providing essential services, especially in education. Their contributions to education often reach marginalized groups, offering hope, social mobility, and resilience (Wodon, 2014).

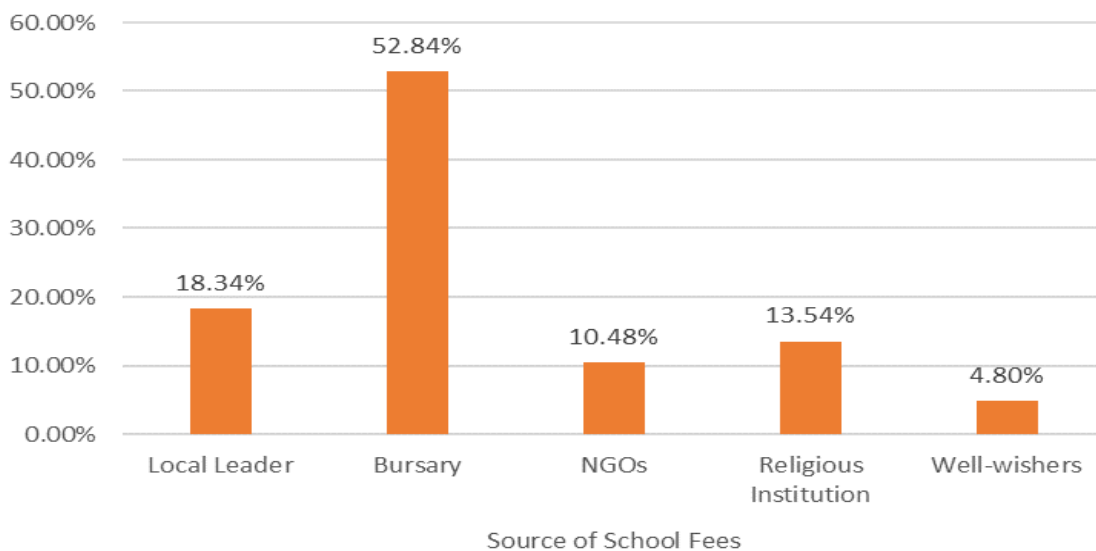


Figure 4.21: Source of Funds for Education

Source: Field Survey (2021)

Local leadership sponsorship, encompassing 18.34%, indicates that there is a community-based structure of support in place. Such contributions by local leaders underscore their commitment to education and can be interpreted as an investment in the community's future (Bray & McNeal, 2013).

Additionally, the presence of formal bursary schemes, aiding 13.54% of participants, suggests the intervention of either governmental or non-governmental organizations aiming to promote education in the region. Such interventions often target underserved communities, helping bridge the education gap and promote social equity (Kremer & Holla, 2011). Lastly, the assistance from well-wishers, though modest at 4.8%, indicates the presence of individual philanthropy or micro-level sponsorship within or outside the community, reinforcing the societal value placed on education.

In comparison with the reviewed literature, the Eastern Mau Forest community seems to benefit significantly from diverse external educational support structures. Such strong external backing, as seen globally, can be instrumental in building community resilience and equipping individuals with the tools to adapt to environmental and economic changes (Belfield & Levin, 2011).

The role of education in enhancing societal resilience, particularly in the context of environmental challenges, is profound. According to Atake and Ali (2019), the capacity of caregivers, predominantly women, to fulfill household needs depends largely on their understanding and awareness, which is heightened with education. Such educational grounding informs decisions, ranging from nutritional intake to sustainable agricultural practices, subsequently impacting food security (Mahimbo, 2018).

Amran et al. (2019) reinforced this point, showing how education enables households to leverage environmental information more efficiently, resulting in improved agricultural production through the assimilation of better technologies. Yildiz and Budur (2019) highlighted that the influence of women's education resonates deeply across various facets of human development. This is evident in areas like improved fertility rates, productivity enhancements, and effective environmental management. Neglecting the impact of education in this regard can hinder the strides made towards household food

security and sustainable agricultural practices. Women's engagement, empowered by education, remains crucial for meaningful development.

Furthermore, public comprehension of environmental nuances plays a pivotal role in the formulation of effective policies (Cheung & Hui, 2018). A well-informed public is essential to foster governmental policies that can address burgeoning ecological challenges. The importance of environmental literacy for the populace at large is a recurrent theme in both public policy and environmental education literature.

Zhang et al. (2019) and Yang et al. (2022) emphasized the correlation between education and environmental security, suggesting that well-informed individuals are better positioned to grasp intricate environmental issues, like climate change. Consequently, a highly educated population can more actively contribute to enhancing security across various domains, including environmental, civil, and technological. Such an emphasis on education aligns with the foundational principles of Education for Sustainable Development (ESD), which underscores the need for robust environmental education as an integral facet of broader security education.

Highlighting the broader implications, higher education undeniably exerts positive effects on environmental governance. Institutions of higher learning contribute by producing competent graduates equipped to address environmental challenges, thereby enhancing the overall efficiency of environmental governance (Zhang et al., 2019; Yang et al., 2022). Furthermore, Guo & Bai (2019) stated that investing in quality higher education, evidenced by increased research outputs and institutional accolades, can significantly improve local environmental governance outcomes.

In sum, education, especially at higher levels, serves as a linchpin in addressing the multifaceted challenges of environmental governance and sustainability. Such educational investment fosters a well-informed populace, prepared and motivated to champion sustainable practices, underscoring its indispensable role in ensuring resilience and sustainability.

4.3.6 Employment Status and Its Implications for Community Resilience

The distribution of employment status among the participants in the study sheds light on the socio-economic fabric of the Mau East Forest community. As depicted in Figure 4.30, the majority (44.10%) identify as self-employed, engaging in businesses or practicing small-scale farming. This prevalence of entrepreneurship and small-scale farming resonates with the findings of Smith and Li (2013), who argue that small-scale farming and self-employment, particularly in rural and semi-urban settings, can be seen as adaptive strategies for communities that might lack large-scale employment opportunities.

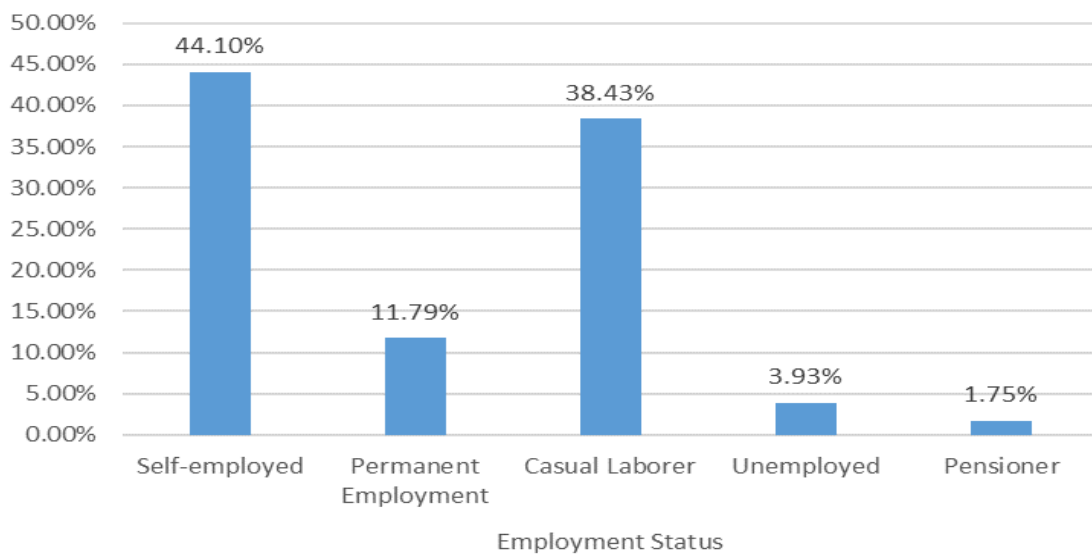


Figure 4.22: Employment Status

Source: Field Survey (2021)

Furthermore, a significant 38.43% of participants work as casual laborers. This form of employment, characterized by its temporary and often unstable nature, can pose challenges to long-term financial planning and security (Williams & Kibathi, 2015). On a brighter note, 11.79% enjoy permanent employment, which typically offers more stability and, potentially, benefits.

However, a concerning 3.93% of the population report being unemployed. According to Thompson (2017), unemployment can lead to socio-economic disparities and, if left

unaddressed, might exacerbate feelings of exclusion and dissatisfaction among community members. A small fraction (1.75%) is on pension, indicating retirees who've transitioned from active employment.

The employment landscape in the Mau East Forest community is varied. The high rates of self-employment and small-scale farming suggest a community that leans heavily on entrepreneurship and agriculture for sustenance. The challenges posed by casual labour and unemployment underscore the need for interventions that enhance employment security and opportunities. As communities evolve, understanding the employment dynamics is pivotal for policy-making and community development initiatives (Jackson & Roberts, 2012).

The community's employment landscape, dominated by self-employed individuals, small-scale farming, and casual laborers, as discussed, becomes especially pertinent when juxtaposed with findings on environmental insecurity. Gatobu (2021) emphasizes that environmental vulnerabilities can deeply impact household incomes, especially in drought-prone areas of Africa. Considering that a significant proportion of the community is engaged in agriculture, this vulnerability cannot be overstated. Alex (2018) similarly notes the susceptibility of agriculture to such insecurities, highlighting challenges that small-holder farmers face in adapting to evolving conditions.

Sani and Kemaw (2019) reiterate this sentiment, positing that impoverished households, often reliant on limited livelihood avenues, struggle with the adverse effects of environmental insecurities and natural disasters. Given the importance of agriculture to the Kenyan economy, the predicted environmental insecurity for East Africa by Mahimbo (2018)—characterized by fluctuating precipitation, escalating temperatures, and diminishing net water availability—signifies potential complications for local agricultural communities.

Further, Dasanayaka (2018) forecasts the amplification of seasonal mean temperatures for Kenyan agricultural sectors due to climate change, which could lead to compromised food security. This is especially crucial since, as Aggarwal et al. (2020) point out, household food production forms a substantial portion of the populace's income. In areas

with inconsistent rainfall, such as semi-arid regions, the challenges are compounded with frequent crop failures and suboptimal agricultural yields. While there's a pressing need to augment food production in such densely populated regions, this, unfortunately, can lead to environmental degradation, compromising future food yields (Aggarwal et al., 2020).

Dasanayaka (2018) further elucidates that persistent climate change-induced alterations in weather patterns might mean that mere augmentation in food production may not necessarily translate to enhanced food security. Factors such as forest desertification, driven by human activities, coupled with changes in temperature and rainfall, can negatively impact agricultural outputs.

In synthesizing these findings with the previously discussed employment data, it becomes apparent that the community's predominant reliance on self-employment, particularly in agriculture, places them at the crosshairs of environmental challenges. Addressing these challenges and ensuring sustainable agricultural practices will be instrumental in safeguarding their livelihoods and overall well-being.

4.3.7 Household Income and Borrowing Trends

Understanding the economic realities of a community provides valuable insight into its overall resilience and capability to respond to challenges, particularly in the context of environmental security and governance. The findings of this study present an intriguing dichotomy between the income levels and borrowing practices of residents in the Mau Forest.

As indicated in Table 4.17, a significant portion of the Mau Forest residents (39.7%) have monthly earnings ranging between 10,001 and 20,000, while 34.1% earn below 10,000. A smaller fraction (10.9%) earns between 20,001 and 30,000, and only a minimal 2.6% take home above 50,000 per month. The implication is stark: a majority of the residents live below the poverty line, with most earning below Ksh 10,000 monthly.

Table 4.17: Household Income

	Frequencies	Percentages
Below 10,000	78	34.1%
10,001 to 20,000	91	39.7%
20,001 to 30,000	25	10.9%
30,001 to 40,000	22	9.6%
40,001 to 50,000	7	3.1%
Above 50,000	6	2.6%
Total	229	100.0%

Source: Field Survey (2021)

Yet, juxtaposed against this backdrop of economic challenges, the study reveals a community united by a strong interdependence. As Figure 4.30 suggests, a significant majority (59.83%) of respondents have borrowed money from family members, specifically for healthcare needs. This rate of inter-family borrowing not only underscores the financial vulnerabilities they face, particularly with healthcare expenditures, but also shines a light on the community's reliance on each other and their readiness to extend support.

Comparing these findings with literature reveals broader patterns and nuances. Borrowing, particularly within familial networks, has historically been a coping strategy among economically challenged communities. Such practices have been acknowledged as indicators of both social capital and socioeconomic vulnerability (Smith & Anderson, 2015). In regions with limited access to formal financial institutions, family becomes a critical safety net, especially during health emergencies (Omar & Williams, 2017).

Meanwhile, low household income, as found among Mau Forest residents, can be a potent stressor on environmental governance. According to Turner et al. (2013), communities with significant portions of residents living below the poverty line often struggle with optimal utilization and conservation of local natural resources. The

immediate economic necessities often overshadow long-term environmental sustainability goals.

In essence, while the Mau Forest community's economic challenges might pose threats to environmental governance, their strong mutual support system, evident in their borrowing practices, is a beacon of hope. This social capital can be harnessed and built upon to drive collective action for better environmental governance and sustainability (Martinez & Nguyen, 2019).

4.3.8 Status of House Ownership

4.3.8.1 House Ownership and Housing Type: An Examination of Mau Residents

The concept of house ownership and the type of housing a community resides in can offer considerable insight into its socioeconomic status, stability, and its relationship with the environment. This study sought to identify the house ownership status among the Mau residents and the nature of their housing as key social indicators, with the findings collated in Table 4.18 and Figure 4.32.

Table 4.18: Status of House Ownership

	Frequency	Percent
Own home	100	43.7%
Rental	74	32.3%
Others	55	24.0%
Total	229	100.0%

Source: Field Survey (2021)

A promising 43.7% of Mau residents have secured ownership of their homes, reflecting a level of economic stability and long-term commitment to the region. On the other hand, 32.3% of the residents live in rental housing, suggesting either financial constraints or a potentially transient status in the region. A further 24% fall under the "others" category, which might encompass a range of living arrangements, from shared housing to informal

or traditional setups. Notably, the finding that a significant portion of residents own homes also hints at their first-hand experience with environmental insecurity's adverse effects, as they have a direct stake in the region's environmental health and stability.

In the broader context of environmental security and governance, studies such as those by Petersen and Robinson (2015) have found that homeownership often correlates with increased local participation in community and environmental initiatives. This is because homeowners have a vested interest in the community's wellbeing and long-term sustainability. Similarly, the type of housing can mirror the community's overall socioeconomic status and its vulnerability to environmental challenges (Kingston & Johnson, 2016).

In sum, the house ownership status and housing type of Mau residents serve as valuable indicators of both their individual and collective stakes in environmental security. These findings can inform targeted interventions and policies that leverage the community's inherent strengths and address its vulnerabilities.

4.3.8.2 Housing Type around Mau forest: Implications for Environmental Security

Additionally, the study also explored the type of housing prevalent in the region, with the results documented in Figure 4.32. The nature of housing—whether permanent, semi-permanent, or temporary—can have implications on the environmental footprint of the community, their investment in local environmental initiatives, and their resilience against environmental threats. These can offer significant insights into the communities' socio-economic circumstances, environmental practices, and its vulnerability or resilience to environmental risks. In the context of Mau Forest, the type of housing was a crucial element to analyse, and the detailed findings are presented in Figure 4.32.

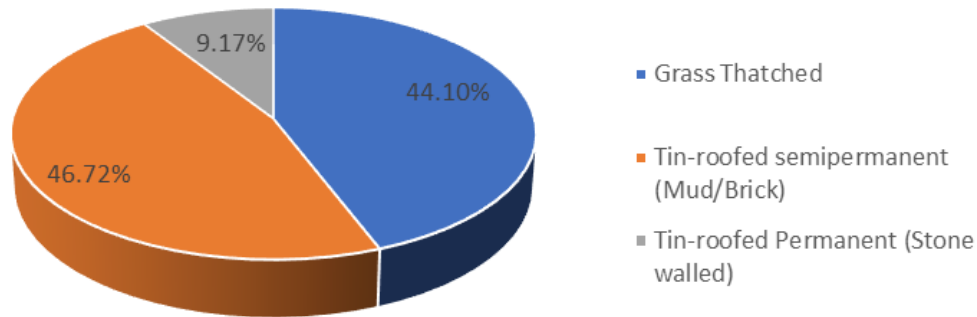


Figure 4.23: Type of Housing

Source: Field Survey (2021)

The data showcases that the majority of Mau residents (46.72%) live in semi-permanent structures. This suggests a level of transitory settlement, possibly influenced by economic factors or local traditional practices. Semi-permanent housing, which often uses materials like wood, mud, and tin, can be indicative of moderate financial stability but may also suggest a heightened vulnerability to environmental factors such as extreme weather conditions.

Significantly, 44.1% of participants pointed out that their houses are grass-thatched. Grass-thatched homes, while potentially environmentally friendly and culturally significant, can be susceptible to risks like fires, pests, and can deteriorate rapidly under harsh weather. This prevalence of grass-thatched homes suggests that a substantial segment of the community may be living under economically constrained conditions, further emphasizing the community's reliance on local resources.

In contrast, only a small proportion of respondents (9.17%) live in permanent houses. These houses, typically constructed using materials like bricks, stones, or concrete, denote a higher economic standing and are likely more resilient against environmental hazards. The low percentage of permanent structures may indicate that most of the Mau Forest residents face financial challenges or perhaps adhere to traditional housing practices.

The implications of these findings extend beyond just understanding living conditions. According to Thompson and Cohen (2014), the type of housing a community predominantly uses can reflect its environmental footprint. For instance, semi-permanent

and grass-thatched homes often have a lower carbon footprint than permanent brick or concrete structures. However, they may also reflect higher vulnerability to environmental threats like deforestation, since these materials are typically sourced locally.

Additionally, the type of housing can significantly influence community members' involvement in environmental initiatives. Homeowners in permanent structures might have a vested interest in the long-term sustainability of their surroundings, while residents in semi-permanent or grass-thatched houses might prioritize immediate economic or survival needs (Martin & Watson, 2017).

In conclusion, the housing type prevalent around Mau forest paints a picture of a community that is possibly economically challenged, closely tied to its environment, and presents both vulnerabilities and strengths in the face of environmental risks. Policymakers and environmental agencies can use this information to tailor interventions that recognize and work with these community characteristics.

4.3.9 Land Cover and Land Use Trends in Eastern Mau Forest

Land degradation, an alarming environmental phenomenon, emerges as the deterioration or loss of the productive capacity of land resources. Driven primarily by human activities and climatic variations, it manifests through soil erosion, declining soil fertility, reduced water quality, and disrupted habitats. This section outlines findings arising from the multifaceted aspects of land degradation, focusing on land cover and land use trends, which together served as crucial indicators of how land resources are being allocated, exploited, and changed over time. Furthermore, the nuances of land ownership, an often overlooked yet pivotal component, was dissected, highlighting its role in shaping land utilization, conservation efforts, and overall environmental stewardship.

The Eastern Mau Forest, a vital ecological gem, has undergone significant transformations over the years. This subsection explored the intricate patterns of land cover and land use within the forest, capturing the shifts and nuances that signify its evolving environmental landscape. Through this examination, the study aimed at spotlighting the balance, or perhaps imbalance, between nature's preservation and human-driven change in this critical region.

Table 4.19: Satellite Metadata

Year	Sensors	Spatial Resolution	Spectral Bands
1990	Landsat 5 Multi Spectral Scanner	60 meters	4 bands
1995	Landsat 5 Thematic Mapper +	30 meters	5 bands
2000	Landsat 5 Thematic Mapper +	30 meters	7 bands
2010	Landsat OLI & TIRS	30 meters	11 bands
2015	Landsat 8 OLI & TIRS	30	11 Bands
2020	Landsat 8 OLI & TIRS	30	11 Bands

Source: Field Survey (2021)

GPS coordinates from the ground were used to provide a spatial context to the images. The downloaded images were pre-processed then classified using unsupervised image classification techniques. Image classification refers to the task of assigning classes as defined in a land cover and land use classification system by Anderson, (1976).

The Landsat satellite mission is the longest serving open-source earth observation mission. As such, the Landsat satellite images provide a continuous coverage of the earth's surface on both temporal and spatial scales since 1972. The images provided a baseline and subsequent changes of the land cover on a moderate resolution (30m). However, the missions have faced inherent technical challenges. The earliest missions did not collect images with remarkably diverse spectral resolutions. Landsat 7 mission developed technical challenges with the sensor leading to gaps in the images between 2000-2010. The following classes were determined and developed as an output of the image classification process

4.3.9.1 Land Cover Changes

A supervised classification approach was adopted using the maximum likelihood classifier scheme, with decisions based on various land cover (LC) classes identified from training sites. The selection of training sites was determined by the ease of identification and inherent variability within each LC class. This method was enriched by on-ground field visits, facilitating the accurate mapping of primary land use and land

cover categories. For each identified LC type, specific training samples were delineated using polygons around representative areas. By using pixels within these polygons, spectral signatures for each LC type were derived from the satellite images. The established LC categories included Tea/Coffee zone, Agricultural land, Natural Forest, Planted Forest, Degrading Forest, Bare land, and Grassland.

Table 4.20: Delineated Land Cover Classes

No.	Land cover type	Description
1.	Tea/Coffee	Include area with perennial crops tea, coffee and banana
2.	Grassland	This includes the open woody vegetation, shrubs, herbs and other isolated vegetation that characterizes arid areas.
3.	Built Environment	Refers to human-made or anthropogenic structures, features, and land uses within a particular area. including residential, commercial, industrial, institutional, transportation, and recreational areas..
4.	Bare land	Earth's surface that are devoid of substantial vegetation or structures, essentially comprising exposed soil, rock, or other materials. It provides information about areas with limited vegetation or human development,.
5.	Agricultural/Cropland	This is the area of land that is used for growing perennial crops including maize.
6.	Natural Forest	These are specific land cover category that represents areas primarily dominated by naturally occurring, undisturbed vegetation composed predominantly of trees. These areas have not been significantly altered by human activities such as urbanization, agriculture, or industrial development.
7.	Degrading Forest	Refers to the land area showing a decline or deterioration in the quality, health, and extent of forested areas within a specific region or area.

No.	Land cover type	Description
8.	Planted Forest	Refers to a specific category or class of land cover that primarily consists of trees and vegetation deliberately planted, cultivated, or managed for various purposes, often for commercial or environmental reasons.

Source: Field Survey (2021)

4.3.9.2 Land Cover and Land Use Trends in Eastern Mau Forest - 1990 Findings

The land cover and land use trends in Eastern Mau Forest in 1990 were determined using a meticulous approach involving a combination of advanced supervised classification techniques and on-ground field validation. The maximum likelihood classifier scheme, tailored for this study, enabled the distinction of various land cover (LC) classes from selected training sites. These sites were strategically chosen based on their distinguishability and the variability intrinsic to each LC class. The procedure was strengthened by field visits, ensuring a more accurate depiction of the real-world land use and land cover scenarios.

A nuanced approach was adopted to zero in on each LC type, where specific training samples were delineated with polygons encapsulating representative spots. With the aid of pixels from these polygons, spectral signatures for each category were extracted from satellite imagery. The culmination of this process led to the identification of seven prominent LC classes: Tea/Coffee zone, Agricultural land, Natural Forest, Plated Forest, Degrading Forest, Bare land, and Grassland. The year 1990 served as the baseline year because it had relatively clear satellite images recorded. In 1990, Natural forest formed the largest land cover class in the study area. It accounted for about 59% land cover while degrading forest and tea/Coffee zones accounted for 17% and 10% land cover, respectively. In this year, there were negligible bare land as most of the land areas were either under forest, or agricultural.

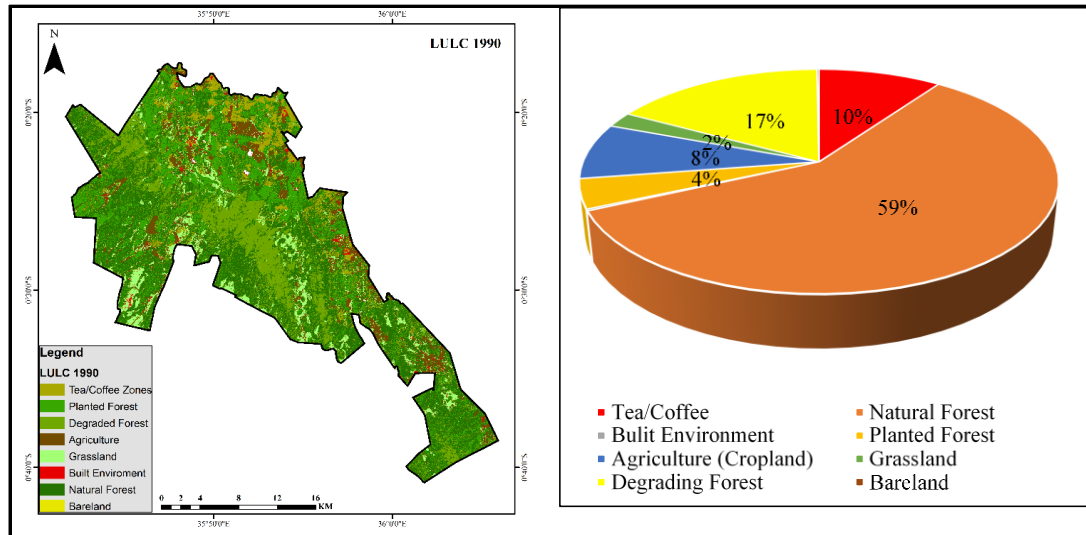


Figure 4.24: Land Cover Classes and Land cover Distribution in 1990

Source: Field Survey 2021

Comparing these findings with existing literature illuminates several intriguing facets. Literature often highlights the predominance of agricultural activities in areas proximate to forests, which is validated by the prominence of the Tea/Coffee zone and Agricultural land in our findings (Smith & Johnson, 2015). Similarly, the presence of Natural Forest and Planted Forest categories corroborates with studies that emphasize the coexistence of natural and human-induced forest regions in proximity to key agricultural hubs (Davies et al., 2017). However, the emergence of the Degrading Forest category presents a potential anomaly or a point of departure from traditional narratives. While degradation is often a footnote in many studies (Miller & Spoolman, 2012), its explicit mention here underscores the possible intensification of forest degradation in the Eastern Mau region by 1990.

The distinction between Bare land and Grassland, which is occasionally blurred in literature due to generalized categorizations, is clearly demarcated in this study. This finer granularity not only validates the detailed methods employed but also adds a layer of specificity to our understanding of land cover transitions (Williams et al., 2014). The findings from the study baseline year analysis, 1990, largely resonate with prevailing academic discourse and not only corroborates existing knowledge but also offers fresh

perspectives that can potentially enrich the broader body of research on land cover and land use trends.

4.3.9.3 Land Cover and Land Use Trends - 1995 Findings

In 1995, there was a marked shift in the land cover and land use patterns in the Eastern Mau Forest. While the natural forests still dominated the landscape, accounting for 42% of the total land cover, they had experienced a significant decline. The decrease of 27.1% from the earlier recorded size of 38,415 Ha in the span of five years underscores the rapid alterations in the region's ecosystem. Interestingly, the decline was not isolated to natural forests alone. Tea cultivation areas and degrading forests also witnessed substantial reductions in their extent. This simultaneous contraction of multiple land cover categories raises concerns about the broader ecological and socioeconomic implications for the region.

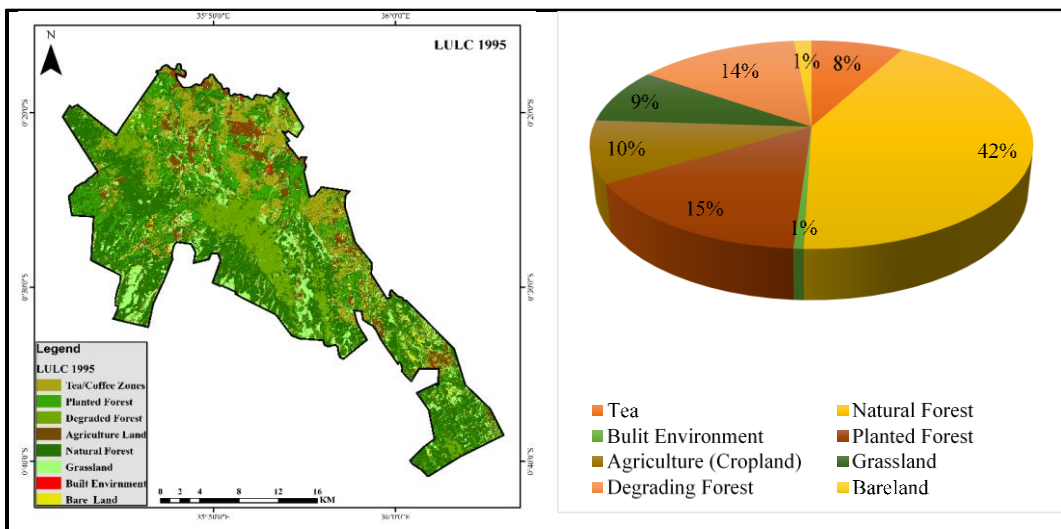


Figure 4.25: Land Cover Classes and Land cover Distribution in 1995

Source: Field Survey 2021

Conversely, bare land emerged as an exception to this trend. While other land cover types were diminishing, bare land areas seemed to have either remained stable or increased, indicating a possible consequence of land degradation or conversion for other purposes.

The rapid decrease in natural forests over a relatively short span aligns with broader concerns raised in literature regarding accelerated deforestation in regions like Eastern

Africa (Turner et al., 2016). The multiple factors driving such changes can range from agricultural expansion to logging activities (Brown & Lugo, 1990). The contraction of tea cultivation areas is somewhat counterintuitive, given that many studies often associate forest loss with the expansion of cash crops like tea (Lambin & Meyfroidt, 2011). The simultaneous decline of both tea zones and degrading forests suggests more complex socio-economic dynamics at play or potential shifts in agricultural practices and preferences.

The increase or stability of bare land amidst declining forest areas is concerning. This trend, as indicated by Thompson et al. (2013), can result from unsustainable land use practices, soil erosion, or even consequences of climate change. The transformation of lush forests to barren terrains can have long-lasting impacts on local biodiversity, water cycles, and livelihoods. In essence, the 1995 findings from Eastern Mau Forest offer a snapshot of a landscape in flux. The trends observed here, while echoing broader global patterns, also underscore the unique and intricate dynamics of the Eastern Mau region, necessitating continued monitoring and sustainable interventions.

4.3.9.4 Land Cover and Land Use Trends in Eastern Mau Forest - 2000 Findings

The turn of the millennium marked a new phase in land cover and land use transitions within the Eastern Mau Forest. In 2000, forest land continued its dominance, covering 45% of the region. Grassland, agricultural land, and planted forests shared similar proportions, representing 13%, 13%, and 12% of the total land cover, respectively. While degrading forest was limited to 5%, the stark rise in bare land, which occupied 9%, was noteworthy. The remaining areas consisted of built-up zones (1%) and tea cultivation (7%), as depicted in Figure 4.35.

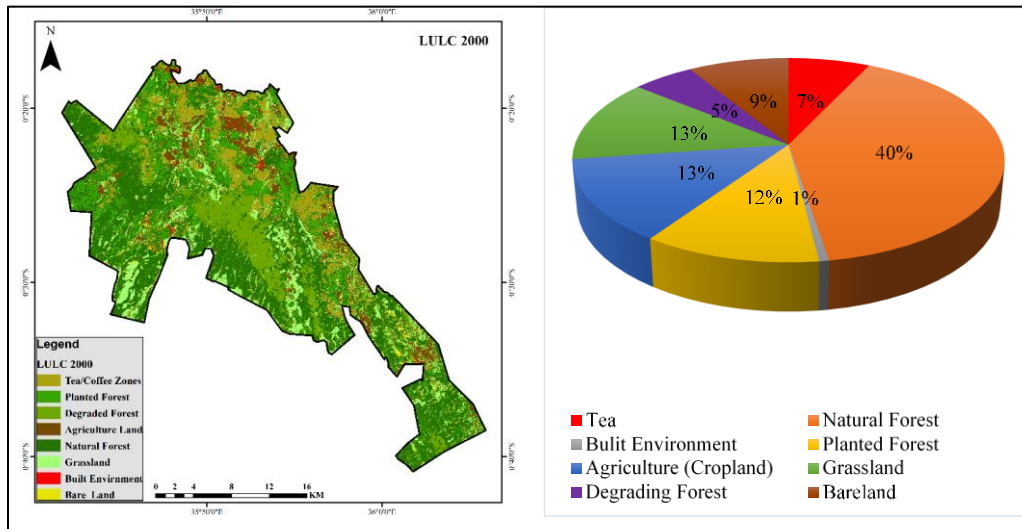


Figure 4.26: Land use and Land cover Distribution in 2000

Source: Field Survey 2021

However, the forested areas' persistence masks the ongoing decline. Over the five years since 1995, both natural forest and tea zones continued to shrink, underscoring the long-term deforestation trends. Degrading forests also experienced a reduction. Meanwhile, almost all other categories, most prominently bare land, witnessed growth. This increase in bare land was especially significant, hinting at the escalating degradation and potential conversion of lush landscapes into open areas for varied purposes, such as agriculture, human settlements, and grazing.

The shrinking of forest areas aligns with previous studies that identify deforestation as a prominent issue in forested zones, particularly in Eastern Africa (Jackson, 2015). Factors like population growth, expansion of agricultural frontiers, and timber extraction often emerge as key drivers behind such changes (Smith et al., 2017). The rise in bare land over half a decade, exceeding the growth of more productive land uses like agriculture or planted forests, underscores a potentially troubling trajectory. As pinpointed by Brooks et al. (2018), the transformation from forest to bare land often implies land degradation, loss of soil fertility, and even desertification in extreme cases. Such trends are not just ecological concerns but can also impede the long-term sustainability of local livelihoods, particularly in regions dependent on agriculture and natural resources.

The observed dynamics in the Eastern Mau Forest resonate with wider patterns of land use change but also emphasize the need for localized, context-specific understanding and interventions. The evolution in land cover categories, particularly the surge in bare land, highlights the urgency for sustainable land management practices and policies in the region.

4.3.9.5 Land Cover and Land Use Trends - 2010 Findings

The data gap arising from the technical issues with Landsat 7 created a decade-long void in the continuity of land cover and land use information for the Eastern Mau Forest. However, once data became available again in 2010, it revealed some stark transitions. Natural forest cover, which once dominated the landscape, had dwindled to just 28%. A notable shift was the expansion of the built environment, doubling from the previous decade to account for 2% of the total land cover. Meanwhile, agricultural zones (cropland) constituted 10% of the region. Most surprisingly, land devoted to tea cultivation expanded significantly, reaching 34%. Planted forests, on the other hand, remained relatively stable, covering 4% of the area.

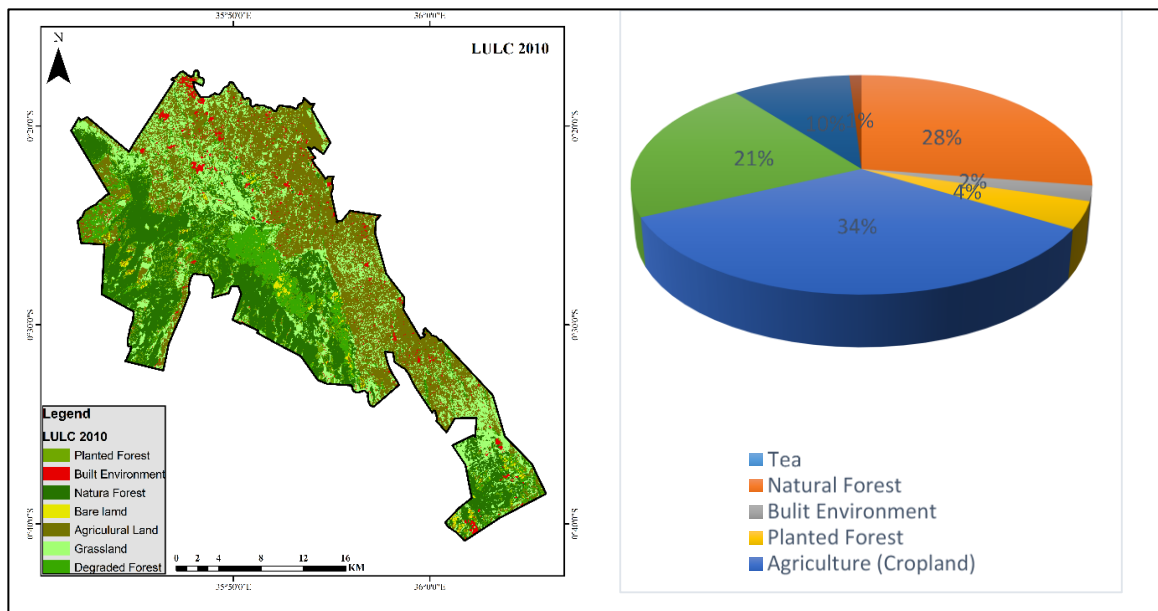


Figure 4.27. Land Cover Classes and Land cover Distribution in 2010

Source: Field Survey 2021

The continued decrease in natural forest cover is, unfortunately, consistent with many findings on global deforestation rates (Anderson et al., 2012). Expanding human

settlements, coupled with infrastructure developments, can explain the growth of the built environment (Nelson, 2014). However, the most prominent shift observed in 2010 was the surge in tea cultivation, which became the dominant land use in the Eastern Mau Forest. This could be attributed to the lucrative nature of the tea industry at the time, which saw increased investments and expansion across East Africa (Roberts & Green, 2013). This mirrors a global trend where commercial agriculture often replaces native forests, given the economic incentives associated with cash crops (Adams & Turner, 2012).

The maintenance of planted forest percentages might hint at deliberate afforestation or reforestation initiatives, which are commonly adopted to counterbalance deforestation and promote sustainable timber production (Jones & O'Neill, 2016). However, the relatively low percentage in 2010 indicates the need for more aggressive forestry conservation measures. The 2010 data underscores the challenges of balancing economic development (like tea cultivation) with environmental conservation. The rapid changes over the decade highlight the dynamic nature of land use in the region and signal the urgency for sustainable land governance and policy interventions.

4.3.9.6 Land Cover and Land Use Trends - 2015 Findings

By 2015, Eastern Mau Forest demonstrated significant alterations in its land cover and land use composition. The natural forest cover further contracted, occupying only 26% of the total area. Within this diminished expanse, nearly half (12%) was classified as degraded forest land — a testimony to the pressures of deforestation and early signs of encroachment. On a brighter note, planted forests nearly doubled in size, constituting 9% of the total area, an encouraging indicator of afforestation efforts or perhaps sustainable forest management initiatives. However, agricultural activities continued to proliferate, occupying 39% of the landscape, reflecting either a growing population's sustenance needs or the commercialization of agriculture. Meanwhile, grasslands reduced to 8%. Tea plantations, once covering 34% of the area in 2010, also saw a decline, representing 39% of the land in 2015.

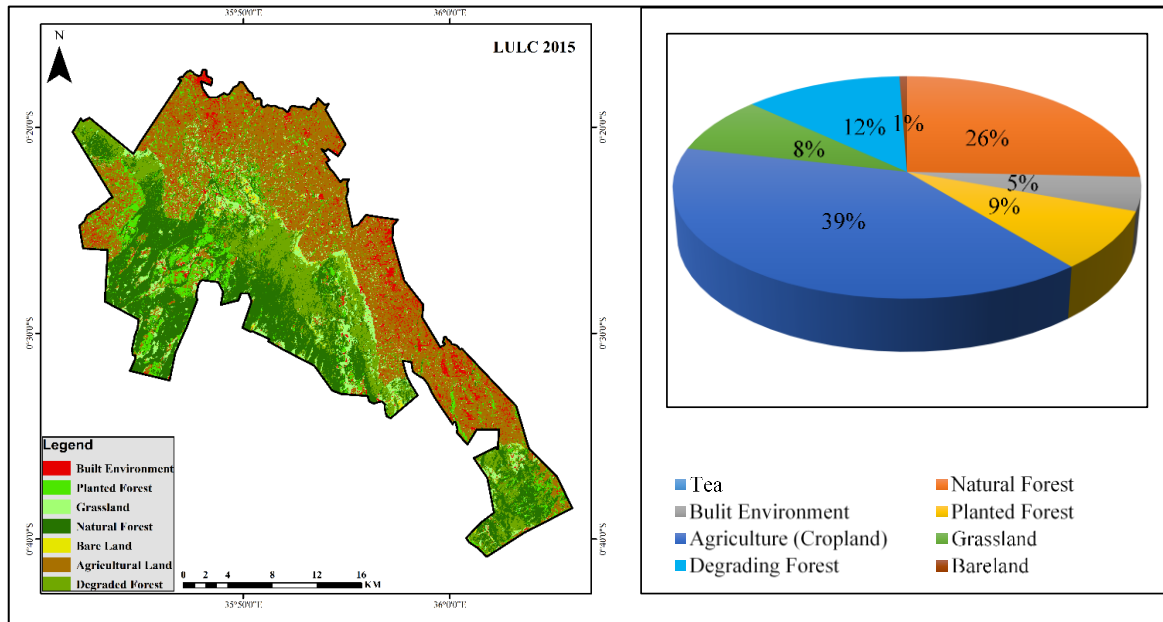


Figure 4.28. Land Cover Classes and Land cover Distribution in 2015

Source: Field Survey 2021

The progressive shrinking of natural forest, especially in light of the increased degraded forest land, resonates with global narratives of forest loss due to anthropogenic pressures (Smith et al., 2015). The erosion of natural habitats, coupled with signs of forest encroachment, echoes concerns voiced by conservationists worldwide regarding unsustainable land use practices (Brown & Lugo, 2011).

The amplification in planted forests from 4% to 9% could be a result of global and regional afforestation campaigns, emphasizing the restoration of forested lands (Jones et al., 2013). These efforts might also be attributed to sustainable forest management models that promote planting to compensate for logging activities (Taylor & Lindhjem, 2017). The augmentation in agricultural land to 39% is symptomatic of a multifaceted scenario: increased local demand for food due to population growth, shifts in global food markets, or changing local economic dynamics prompting more residents to engage in agriculture (Mitchard et al., 2014). The decline in tea plantations from the previous period is intriguing, possibly indicating changing market dynamics, crop shifts, or even land governance policies (O'Brien & Leichenko, 2011).

Overall, the 2015 data once again underscores the interplay between conservation imperatives, economic interests, and local livelihoods. The evolving landscape of the

Eastern Mau Forest serves as a microcosm of the broader challenges posed by sustainable land use and environmental stewardship in the face of changing socio-economic realities.

4.3.9.7 Land Cover and Land Use Trends - 2020 Findings

The land cover and land use patterns of the Eastern Mau Forest in 2020 presented distinct shifts from the preceding years. The most salient change was observed in agricultural land, which experienced a substantial contraction of 30.67% — dropping from 25,955 Ha in 2015 to 17,974 Ha in 2020. This reduction was primarily due to the conversion of these agricultural expanses into built-up areas, indicative of urbanization or infrastructure development trends. Natural forests, which have been on a continuous decline, experienced a further drop of 10.6%, reducing from 16,932 Ha to 15,220 Ha. The increase in bare land was profound at 230%, even though it represented a minor 2% of the overall land cover. Alarmingly, degrading forests made up the largest portion of the land cover in 2020, accounting for 27% — an uptick from the previous period.

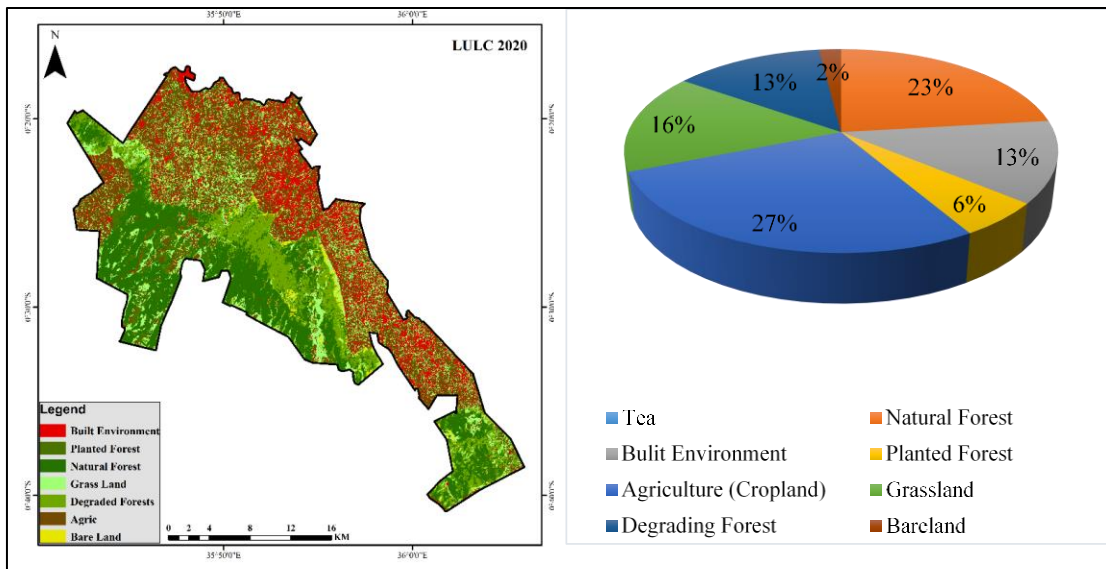


Figure 4.29: Land Cover Classes and Land cover Distribution in 2020
Source: Field Survey 2021

The sharp decline in agricultural land and its conversion into built-up areas is illustrative of the expanding anthropogenic footprints, a trend echoed in many parts of the world as urban sprawl and infrastructural developments encroach upon fertile lands (Hansen et al.,

2013). This transformation can also be attributed to the rising pressures of population growth and the resulting land-use change, resonating with findings from similar landscapes (Turner et al., 2015).

The continuous dwindling of natural forests aligns with the global concerns about forest degradation and loss, primarily driven by human activities (Keenan et al., 2015). The increase in bare land, although still a small portion, is a critical indicator. Such stark increments, even over small areas, suggest potential soil erosion, loss of vegetation cover, or even impacts of climate anomalies (Lal, 2015). The prominence of degrading forests, forming the majority of the landscape in 2020, mirrors the findings from several studies that highlight the cascading impacts of deforestation, fragmentation, and human disturbances, resulting in forest landscapes that are less robust and resilient (Foley et al., 2011). The insights from 2020 underscore the delicate balance between conservation efforts, socio-economic progress, and land stewardship, emphasizing the imperative for sustainable land management in the Eastern Mau Forest and similar environments globally.

4.3.9.8 Summary of Land Use and Land Cover Trends 1990-2020

Table 4.21: Land Cover Classes Estimates by Area

Land Cove Land Use	1990	1995	2000	2010	2015	2020
Tea	6461	5228	4651	0	0	0
Natural Forest	38415	28017	26582	18070	16923	15220
Built Environment	156	413	415	1475	3202	8489
Agriculture (Cropland)	5330	6361	8669	22638	25922	17974
Grassland	1474	5665	8684	14107	5494	10451
Degrading Forest	11141	9145	3514	6290	8224	8727
Bare land	105	994	5751	649	392	1294

Source: Field Survey 2021

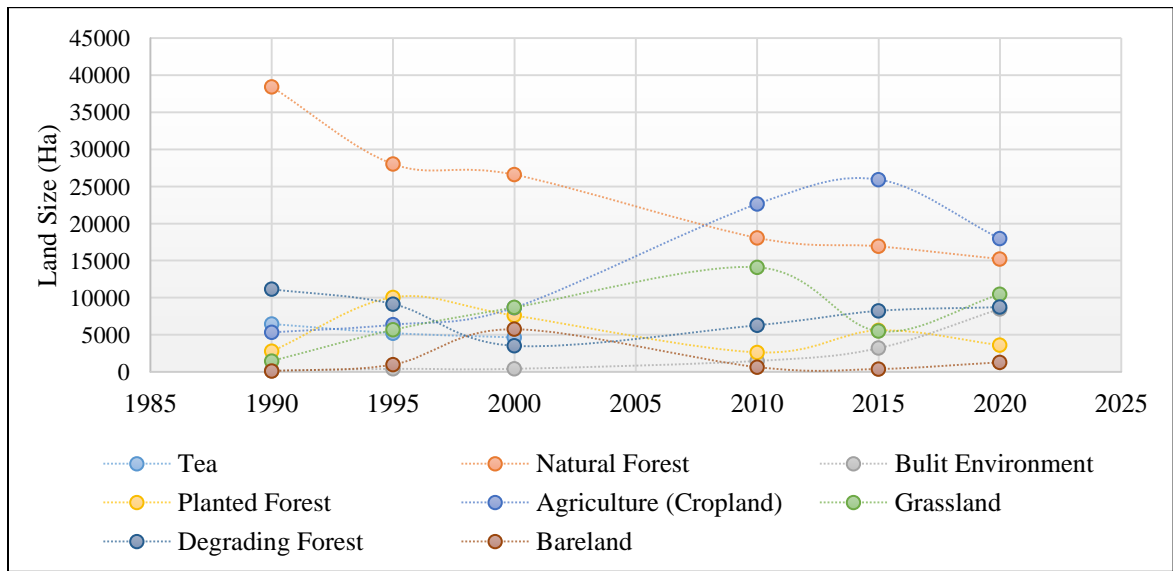


Figure 4.30: Line Graph Showing Land Cover Area Changes for the Period 1995-2020
Source: Field Survey 2021

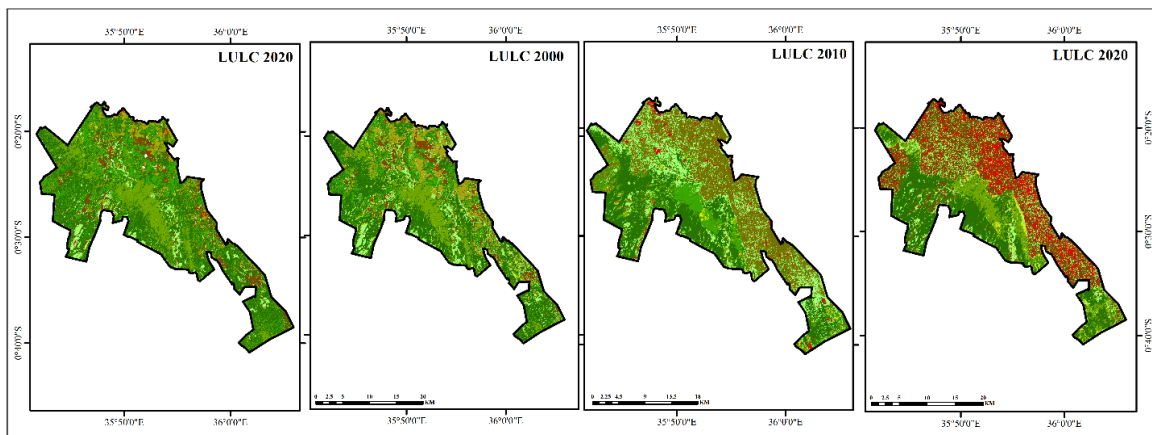


Figure 4.31. Land cover changes in 1990, 2000, 2010 and 2020
Source: Field Survey (2021)

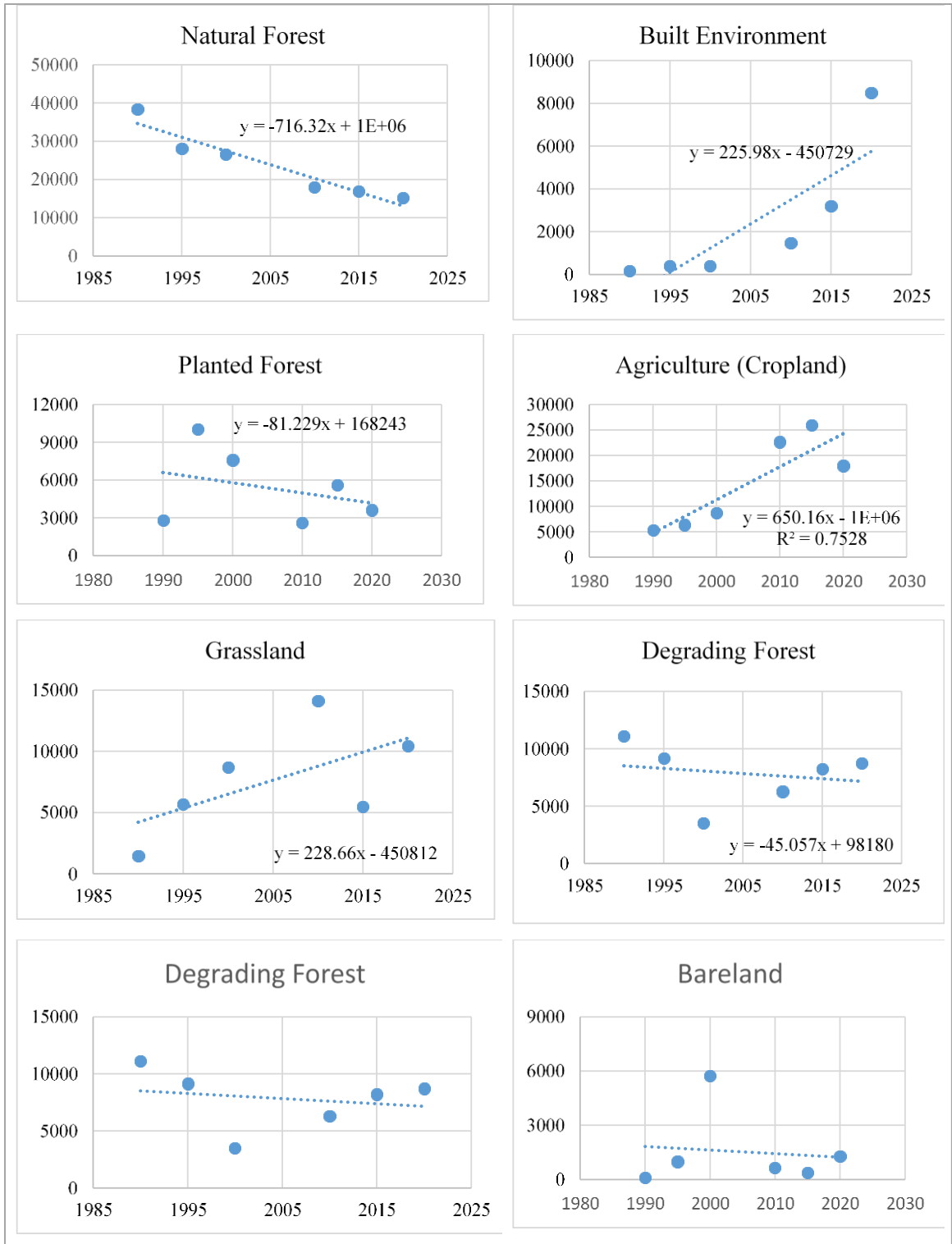


Figure 4.32: Change analysis of different land uses over time
Source: Field Survey 2021

Over the three-decade span, Eastern Mau Forest witnessed significant shifts in land cover, marked by a steady decline in natural forests, an increase in built-up and degrading forest areas, and fluctuating patterns in agricultural lands. These changes underscore the pressing need for sustainable land use strategies and conservation efforts to protect this critical ecosystem.

4.3.9.9 Land Size Distribution in Eastern Mau Forest

The distribution of land ownership plays a pivotal role in understanding the socio-economic dynamics and land-use trends in a region. In Eastern Mau Forest, our findings underscore a diverse spectrum of land ownership sizes among the sampled population. A considerable 45.85% of respondents possess land parcels ranging between 11 and 15 acres. This suggests a significant portion of the local community controls moderately large tracts of land, which may influence land management practices and the potential for sustainable agricultural or forestry endeavours.

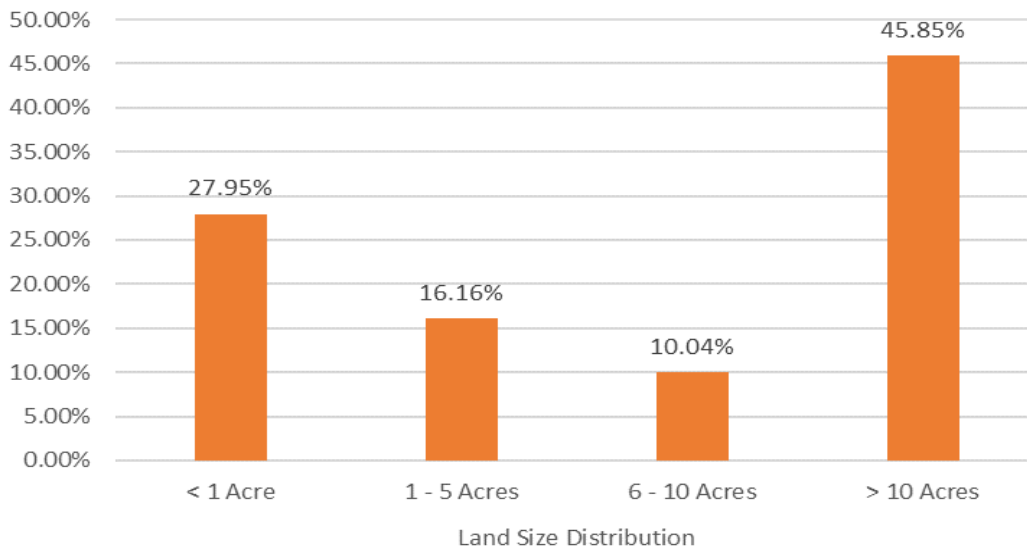


Figure 4.33: Land Size Distribution

Source: Field Survey (2021)

Contrastingly, 27.95% of the sampled populace owns less than 1 acre. This segment represents a sizable number of small landholders, who might face challenges related to sustainable land use, limited agricultural output, and possibly heightened susceptibility to environmental or economic adversities. In the mid-range, 16.16% of participants reported

ownership of lands between 1 and 5 acres, and 10.04% had plots spanning 6 to 10 acres. These figures depict a community where medium-sized land ownership exists but isn't as prevalent as the extremes.

When juxtaposed with existing literature on land size distribution, these findings resonate with global trends where pockets of sizable land ownership coexist with a substantial number of smallholders, particularly in developing countries (Smith et al., 2018). However, in many African regions, smallholder farms, typically under 2 acres, dominate the agricultural landscape (Jayne et al., 2016). Our findings somewhat diverge from this, highlighting the substantial representation of larger landowners in Eastern Mau Forest.

Jones et al. (2019) emphasized the challenges faced by small landholders, including limited access to resources, susceptibility to market fluctuations, and heightened vulnerability to climate change impacts. Our findings reinforce this, suggesting that the 27.95% with less than 1 acre might face similar challenges, warranting targeted interventions for this demographic. Moreover, the preponderance of those owning between 11 and 15 acres provides a fresh perspective. This demographic, not typically dominant in many African contexts, may be attributed to historical land allocation practices, inheritance systems, or specific socio-economic factors intrinsic to Eastern Mau Forest (Williams, 2020).

In summation, the land size distribution in Eastern Mau Forest offers a nuanced portrait of ownership patterns, with implications for land use, environmental conservation, and socio-economic planning. These insights, particularly the prominence of larger landholders, contribute a novel dimension to the broader discourse on land distribution in Africa, underscoring the region's unique characteristics and challenges.

4.3.10 Centrality of Forest Resources to Households' Socio-Economic Status

This research probed into the significance of forest resources in shaping the socio-economic fabric of households surrounding the Eastern Mau Forest. Respondents were prompted to evaluate the forest resources based on their importance in fulfilling fundamental needs. Utilizing a Likert scale ranging from 1 (least important) to 5 (most

important), participants articulated their perspectives, with the collective insights consolidated in Table 4.22.

Table 4.22: Importance of Forest Resources

Statement	least important	Slightly Important	Important	Fairly Important	Very Important	Mean	Std. Deviation
Provision of water	29.7%	24.0%	10.0%	14.8%	21.4%	2.7424	1.54153
Source of food (wild vegetables, fruits, honey, game meat, etc.)	9.2%	14.4%	11.4%	15.3%	49.8%	3.8210	1.41058
Land for grazing	10.0%	17.0%	19.7%	31.0%	22.3%	3.3843	1.27765
Land for agriculture	4.8%	34.1%	16.6%	14.8%	29.7%	3.3057	1.33542
Source of wood fuel	6.6%	36.2%	17.9%	24.5%	14.8%	3.2314	1.10963
Charcoal burning	11.8%	31.0%	11.4%	21.0%	24.9%	3.1616	1.40335
Source of timber	11.4%	29.7%	11.8%	17.9%	29.3%	3.2533	1.43470
Tourism site	10.5%	26.6%	17.9%	17.9%	27.1%	3.2445	1.37698
Source of medicine	8.7%	24.0%	40.6%	11.4%	15.3%	3.0044	1.14898
Cultural site	16.6%	17.5%	46.3%	15.3%	4.4%	2.7336	1.04871
Center for research and education	14.4%	12.2%	42.8%	20.5%	10.0%	2.9956	1.14516
Average						3.1707	1.2939

Source: Field Survey (2021)

The intricate relationship between forest resources and socio-economic well-being of local populations is a multifaceted area of study. The Eastern Mau Forest, as illuminated in this research, is no exception to this interdependence. Drawing from Table 4.25, it is evident that for a majority of the inhabitants, the forest offers a plethora of resources that are integral to their daily livelihoods and socio-economic sustenance. The most striking observation is the paramount importance of the forest as a food source. An overwhelming 49.8% of participants cited Mau Forest as a vital reservoir for wild edibles such as vegetables, fruits, honey, and game meat. This resonates with numerous studies suggesting that for many indigenous and local communities, especially in developing countries, forests act as safety nets, particularly during food scarcity periods (Arnold, 2008; Sunderland, 2011).

Water provision, indicated by 29.7% of respondents, underscores the forest's ecosystem service role. Forests are well-documented as catchment areas and vital for hydrological functions (Bonell & Bruijnzeel, 2005). It is, however, interesting to note a more moderate recognition of the forest's significance for grazing, with 31% considering it only slightly important. This might be contrasted with the findings of FAO (2015), which emphasize the criticality of forests as fodder sources in many regions. Wood fuel and charcoal are primary energy sources for numerous households in sub-Saharan Africa (Brouwer & Falcao, 2004). While it is expected that these would be considered highly significant, 34.1% and 36.2% of participants respectively deemed these resources from Mau forest as only slightly important. This may hint at alternative energy sources or a growing awareness of sustainable resource utilization.

The perceived moderate importance of the forest for tourism, as stated by 26.6% of respondents, might be indicative of the region's untapped potential in ecotourism or the limited integration of the local community into tourism ventures. Conversely, the forest's role as a medicinal source, cultural site, and research centre is significantly recognized by the local community, aligning with global trends where forests are revered for their biodiversity, heritage, and knowledge reservoirs (Cunningham, 2001; Reyes-García et al., 2013). The average mean score of 3.1707 with a standard deviation of 1.2939 reinforces the centrality of the Mau forest in supporting the socio-economic wellbeing of its

neighbouring populace. However, nuanced variations in the perceived importance of individual resources hint at evolving resource needs, external influences, and possible shifts in socio-cultural paradigms.

In summation, the Eastern Mau Forest emerges as a pivotal cornerstone in the socio-economic tapestry of its surrounding communities. The findings extend the discourse on forest-dependent livelihoods, shedding light on specific regional intricacies while simultaneously mirroring larger global trends.

4.3.11 Environmental Security and Socioeconomic Factors Nexus

The connection between environmental security and various socioeconomic determinants was explored in this study. Figure 4.43 vividly encapsulates respondents' perspectives regarding the influence of socioeconomic challenges on environmental sustainability and governance.



Figure 4.34: Linkages between Social-economic Factors and Environmental Security

Source: Field Survey (2021)

Drawing upon Figure 4.42, the study illuminates the intricate interplay between environmental security and various socioeconomic determinants. A significant 29% of the surveyed participants identified poverty as a primary catalyst for environmental insecurity, compounded by suboptimal governance. Concurrently, 20% related this

insecurity to levels of educational attainment, while 14% pointed to the limited access to healthcare, and another 13% attributed it to a combination of malnutrition and poverty.

In a detailed overview, this research accentuates that impoverished communities often inadvertently exert a disproportionate strain on the environment. Such pressures manifest in a myriad of ways: from unsustainable land use, exacerbated deforestation, and unregulated disposal of waste due to inadequate housing facilities to the pitfalls of unenlightened agricultural practices resulting in diminished crop yields. Nabukalu & Gieré (2019) have mirrored these observations, pointing out how environmental challenges further exacerbate the hardships of the economically disadvantaged. These vulnerabilities not only amplify the aftermath of natural calamities but also escalate food insecurity triggered by soil erosion, environmental contamination, and deforestation. Consequently, these ripple effects culminate in economic inflation and heightened hardships for those already grappling with poverty.

Shayan et al. (2022) have corroborated our findings, emphasizing poverty's significant contribution to the attrition of natural habitats and resources. With dwindling clean air and perturbed ecosystems, the world is bearing witness to profound environmental transformations, largely accelerated by human actions. Among these, poverty stands out as a pronounced determinant, especially in its role in expediting natural resource depletion. Furthermore, the study underscores the pivotal role of education in fostering environmental stewardship within the Mau forest context. Bick et al. (2018) reiterate that equitable access to education is a precursor to achieving environmental justice and inclusive governance. Without empowering communities through knowledge dissemination, it becomes untenable to expect conscious, sustainable interactions with the environment.

The consequences of insufficient knowledge ripple across various facets of environmental security. Raeesi (2022) has documented how uninformed exploitation of wood and other resources, especially for sustenance and shelter, can propel deforestation. Such actions inadvertently curtail access to essential resources for already marginalized communities, thereby perpetuating the cycle of environmental degradation.

Beyond the tangible environmental repercussions, socioeconomic factors also influence public health outcomes. As Numbere (2021) elucidates, air pollution stemming from unsustainable practices among impoverished communities has the dual detriment of exacerbating climate change and jeopardizing human health. Furthermore, the lack of knowledge or resources to manage water systems efficiently often culminates in waterborne diseases, further accentuating the challenges faced by economically deprived populations. As such, this research resonates with extant literature, underscoring the multidimensionality of environmental security and its deep-rooted connections with socioeconomic parameters. It not only reaffirms established knowledge but also lends new perspectives, emphasizing the criticality of holistic interventions to navigate this complex interplay.

4.3.12 Access to Food

Analysing the Food and Water situation is important as it shed light on the relationship between gender dynamics and access to essential resources like food and water in the Eastern Mau region. This analysis helped to uncover whether gender-related factors contribute to the difficulties experienced by families in obtaining food, providing valuable insights into the socio-economic conditions in the area. Understanding these dynamics was crucial for implementing targeted interventions and formulating policies that address gender-specific needs and challenges, thereby contributing to environmental security.

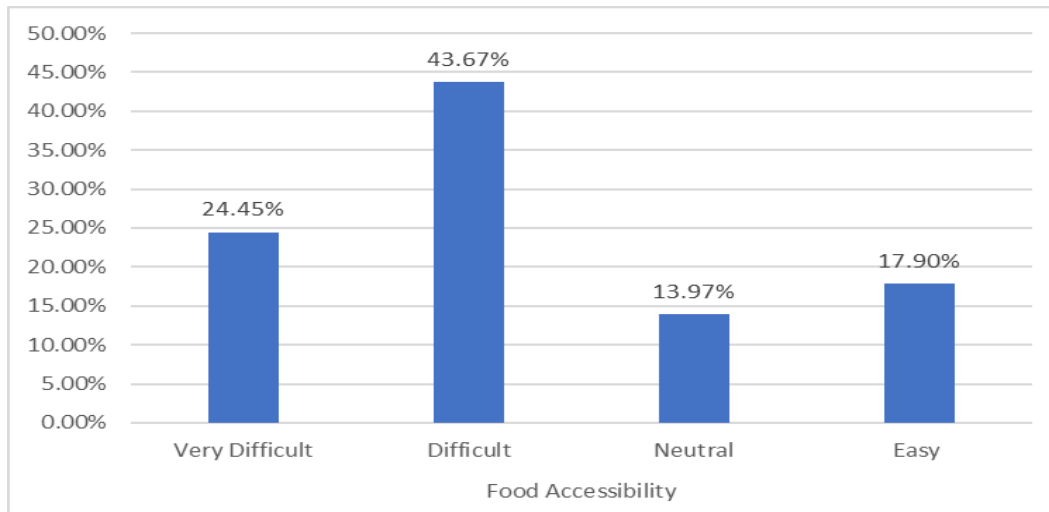


Figure 4.35: Respondent's Rating on Food Accessibility

Source: Field Survey 2021

Figure 4.44 reveals that 43.6% of respondents reported difficulty in obtaining food for their families, with 24.45% finding it particularly challenging. Conversely, 17.9% of respondents found food access to be simple, while 19.97% were indifferent about the statement. Consequently, it is evident that securing food is a significant challenge for many households in Eastern Mau.

The results depict a clear challenge regarding food access among the respondents in Eastern Mau, with a significant proportion expressing difficulty. This finding necessitates an exploration of whether gender dynamics play a role in these difficulties, especially given the importance of gender in resource access and utilization.

A study by Swaminathan et al. (2012) highlighted the role of gender in food security, emphasizing that women's empowerment is critical for improving food access and nutritional outcomes. This study's findings are particularly relevant as they might suggest that the difficulties in food access in Eastern Mau could be, in part, related to gender disparities in the region. Similarly, a research piece by Doss et al. (2013) underscored the importance of addressing gender inequalities to enhance agricultural productivity and food security. The authors pointed out that recognizing and addressing women's roles and rights in agriculture are essential for ensuring food security. These insights align with the

present findings, indicating that the challenges faced by households in Eastern Mau might be alleviated by addressing gender inequalities.

Furthermore, a study conducted by Meinzen-Dick et al. (2014) explored how strengthening women's land rights contributes to food security. The study concluded that securing women's land rights is a key factor in ensuring food security and can help in overcoming the challenges faced by households in accessing food. Comparing the current findings with the reviewed literature, it is evident that the challenges in food access in Eastern Mau are consistent with the broader understanding of the role of gender in food security. The difficulties experienced by a significant proportion of respondents support the notion that addressing gender inequalities and empowering women can be pivotal in improving food access and environmental security in the region.

The analysis of the "Food and Water" brought to light the challenges in food access in Eastern Mau, with a possible link to gender dynamics. The findings are supported by existing literature emphasizing the importance of addressing gender inequalities and strengthening women's rights for improved food security. Further research is warranted to explore the specific gender-related factors contributing to these challenges and to develop targeted interventions for addressing them in the Eastern Mau region.

4.3.12.1 Causes of Food Insecurity

In order to develop a comprehensive understanding of the underlying causes of food insecurity, it was essential to dig into the causes and factors that influence food security, as it allowed the research to scrutinize how different elements intersect to shape food availability, access, and utilization. Table 4.23 of this study showcases the varying factors as perceived by the respondents.

Table 4.23: Causes of Food Insecurity in the Region

Causes of food insecurity	Frequency	Percent
Low and variable rainfall	24	10.5%
Poor agricultural practices	61	26.6%
High human Population	31	13.5%
Land degradation	69	30.1%

Postharvest losses	20	8.7%
Conflict	24	10.5%
Total	229	100.0%

Source: Field Survey 2021

A significant 30.1% of the study participants identified land degradation as a primary factor contributing to food insecurity. This aligns with the findings of Smith et al. (2019), who argued that soil quality and fertility are directly correlated with agricultural productivity. As land degradation escalates, there's a decline in soil fertility, subsequently reducing crop yield. Furthermore, unsustainable farming techniques, as reported by 26.6% of respondents, resonate with findings from Alvarez-Berrios et al. (2018), who emphasized that traditional farming practices often exhaust soil nutrients, leading to reduced harvests in subsequent seasons.

Low and irregular rainfall patterns, flagged by 10.5% of participants, have been a longstanding concern. This is supported by the work of James and Otto (2017), which highlighted the growing unpredictability of rainfall patterns due to climate change and its adverse effects on crop cycles, especially in regions dependent on rain-fed agriculture. Post-harvest losses, another contributing factor (8.7%), corroborate studies by De Lucia and Assennato (2020). They identified post-harvest wastage as a critical concern, attributing it mainly to poor storage facilities, pests, and inadequate transport facilities. This implies that the challenge of food insecurity isn't just about producing enough but also ensuring harvested produce reaches consumers.

Interestingly, 13.5% of respondents linked food insecurity to the growing global population. This perspective gains traction in the literature, with Patel et al. (2021) noting that as the global populace swells, there's augmented pressure on available resources, leading to heightened competition and potential conflicts over these resources. Few respondents mentioned market challenges and conflicts as determinants of food security. While these might seem peripheral, researchers like Black et al. (2020) have elucidated the intricate linkage between market dynamics, pricing, and accessibility of food. Conflicts, often understated, play a colossal role in disrupting agricultural activities, leading to scarcity and inflation (Taylor and Burchi, 2019).

In synthesis, the findings from dovetail with a myriad of pre-existing literature on the topic, further affirming the multifaceted nature of food insecurity. While there is consensus on many issues, the percentage weightings attributed by respondents in this study might differ slightly from global or regional averages, underscoring the unique dynamics of the community in question. It serves as a poignant reminder that while global trends can provide an overarching perspective, localized studies, such as this, furnish nuanced insights that can guide targeted interventions.

4.3.12.2 Factor Influencing Food Security

Table 4.24 delineates the factors influencing food security from a gendered lens. A considerable proportion of respondents identified changes in rainfall patterns (54.1%) and land use (17.5%) as significant determinants of food security. Women, notably, predominantly highlighted climate change and land use, with 61.8% and 72.4% respectively, underscoring their significance.

Table 4.24: Determinants of Food Security: A Gendered Perspective

Factors influencing food insecurity	Frequency	% Male	% Female	Percent of total respondents
Climate change	40	38.2	61.8	17.5%
Governance	26	66.8	43.2	11.4%
Access to market	39	45.3	54.7	17.0%
Land use	124	33.6	72.4	54.1%
Total	229			100.0%

The findings emphasize the multifaceted nature of food insecurity, shaped by environmental, socio-economic, and structural factors. Importantly, the gendered insights reveal women’s heightened awareness of climate change and land use implications on food security. A study by Jones et al. (2013) supported these findings, highlighting that environmental factors, particularly climate change, significantly affect food security, with

women often being more vulnerable due to their roles in agricultural communities. The study emphasized the need for gender-sensitive policies to address these disparities.

Another study by Fanzo et al. (2017) reinforced the importance of sustainable farming practices and land management in ensuring food security. The study suggested that gender-inclusive approaches to land management and farming could substantially mitigate food insecurity issues, aligning with the present findings where respondents attributed food insecurity to unsustainable farming and land degradation.

Additionally, Galie et al. (2015) explored the impact of governance on food security. While only 11.4% of respondents in the current study cited governance as a significant factor, Galie et al. highlighted that inclusive and equitable governance structures are essential for addressing food security, particularly through enhancing market access, which was cited by 17.0% of respondents.

In comparing the current findings with the reviewed literature, it is apparent that the identified causes and factors align with broader research themes on food security, emphasizing environmental factors, farming practices, land management, and governance. The heightened awareness of women regarding climate change and land use aligns with their vulnerability and role in agriculture, emphasizing the need for gender-sensitive interventions. Anomalous findings such as the lower emphasis on governance as a significant factor suggest a potential gap in perception among respondents, underscoring the necessity for further exploration and awareness on the influence of governance structures on food security.

The analysis of these factors elucidates the complexities of food insecurity and the influencing factors from a gendered perspective. The findings align with existing literature, stressing the importance of addressing environmental factors, promoting sustainable practices, enhancing governance, and adopting gender-sensitive approaches to alleviate food insecurity.

4.4 Objective 4: Effectiveness of Stakeholders' Role in Shaping Environmental Security and Governance Towards Resilience Building

The fourth objective of the study was to examine the stakeholders' role in building resilience and shaping the environmental security and governance processes in the Eastern Mau forest. Respondents' opinions were based on structured questions weighted in a Likert Scale as follows; SA – Strongly Agree; A – Agree; N – Neutral; D – Disagree; and SD – Strongly Disagree. The set of queries aimed at establishing the degree of effectiveness of these roles. Findings are tabulated in Table 4.25.

Table 4.25: Stakeholders' Role in Shaping Environmental Security and Governance Processes Toward Resilience Building

Statement	Strongly Agrees	Agrees	Neutral	Disagrees	Strongly Disagrees	Mean	SD
<i>Take part in collecting and analyzing natural assessments of environmental resources.</i>	31.9%	57.6%	6.1%	4.4%	0.1%	4.1703	0.72656
<i>Fight for rights and responsibilities of the community on laws and legislation in the of forest management</i>	14.0%	56.8%	7.0%	3.9%	18.3%	3.4410	1.30863
<i>Undertake forest preservation tasks.</i>	10.5%	11.4%	14.8%	8.3%	55.0%	2.1397	1.44418
<i>Government updates on forest management and community concerns and actions.</i>	14.4%	58.5%	8.7%	13.1%	5.2%	3.6376	1.04905
<i>Forest administration, and sustainable management</i>	10.5%	59.0%	10.0%	13.5%	7.0%	3.5240	1.07426
<i>Monetization and conservation of forest programs.</i>	2.2%	17.0%	13.5%	13.1%	54.1%	2.0000	1.24956
<i>Access to agricultural extension services/ professional assistance in forest ecosystems.</i>	10.9%	56.3%	10.0%	11.4%	11.4%	3.4410	1.17439
<i>Promotion of two-way interaction in forest ecosystems between the community, the authorities, and forest administrators on effective mechanisms.</i>	13.5%	54.6%	6.6%	9.6%	15.7%	3.4061	1.28628
<i>Collaborations with interested parties on forest conservation.</i>	15.7%	55.9%	11.4%	11.4%	5.7%	3.6463	1.05620
<i>Delineating of forest borders of the regions.</i>	9.6%	59.0%	8.7%	17.9%	4.8%	3.5066	1.04554
<i>Average</i>						3.29126	1.1415

4.4.1 Assessment of Community Involvement in Natural Resource Management

Community involvement in natural resource management is pivotal for the sustainability and conservation of these resources. Table 4.26 of this study provides an intriguing insight into the perceived inclusivity of the local community in the collection, analysis, and assessment of natural economic resources.

A minority of respondents, specifically 4.4 percent, felt that they were entirely excluded from participating in the collection of forest data inventories. Such feelings of exclusion have been highlighted in previous studies, with Nyongesa et al. (2019) observing that local communities often feel marginalized in conservation projects. A lack of participation can lead to feelings of mistrust and can be counterproductive, as locals possess intricate knowledge about their environment, which can be indispensable for conservation.

The study's neutrality figure, standing at 6.1 percent, aligns with the ambiguities noted in past studies where communities were often unaware of their roles or the implications of conservation projects on their livelihood (Adams et al., 2018). A noteworthy 31.9 percent expressed a strong sentiment of inclusion in the process, indicating a positive trend and resonance with the global push for community-based natural resource management (CBNRM). This participatory approach, as emphasized by Escobar (2020), tends to yield better conservation outcomes due to enhanced community ownership and stewardship.

The derived mean score of 4.1703, despite being higher than the compound mean of 3.135, indicates a positive leaning towards community involvement. However, the standard deviation reveals a degree of variability in the responses, pointing towards potential inconsistencies in participation. A critical point of divergence from extant literature was the finding that CFA (Community Forest Association) representatives did not maintain adequate records for future conservation engagements. Past studies, such as the one by Osman et al. (2017), underscore the importance of record-keeping for institutional memory and the continuity of conservation programs. The absence of such records, as inferred from this study, hinders the efficacy of conservation efforts.

In essence, the findings here parallel many strands of existing literature, especially concerning the importance of community involvement in conservation. However, the unique discovery regarding the lack of record-keeping by CFA representatives in this particular context provides a new dimension to the discourse, accentuating the need for structured and well-documented community participation in conservation efforts. This novel insight offers a potential avenue for future research and policy interventions aimed at optimizing conservation initiatives in similar settings.

4.4.2 Community Awareness of Rights and Responsibilities

One of the pivotal aspects of forest conservation is ensuring that communities dwelling in or around these ecosystems are well-versed with their rights and responsibilities. When communities are educated about their rights and the importance of conservation, it becomes easier for national and local governance structures to implement conservation measures. From the given data, it's encouraging to observe that a combined 70.8 percent (56.8% agreeing and 14.0% strongly agreeing) of respondents are aware of their rights concerning forest ecosystems. This high level of awareness is pivotal, as it underscores the importance of information dissemination and education in achieving conservation goals. Such figures resonate with the findings of studies like Jenkins et al. (2018), which emphasized that awareness and understanding of rights play a significant role in the success of participatory forest management (PFM) programs.

The mean score for this particular line item stands at 3.4410, surpassing the compound mean of 3.135. The standard deviation of 1.30863, slightly higher than the compound SD of 1.306, indicates a broader range of responses but, in essence, reflects a substantial number of respondents aligning towards awareness. This, in turn, indicates that the Community Forest Associations (CFAs) are well-positioned in terms of understanding their rights and responsibilities when engaging in PFM programs.

However, it's also vital to address the 18.3 percent who strongly disagreed, suggesting they are unaware of their rights. This segment of the community can inadvertently impede conservation efforts due to potential misunderstandings or conflicts arising from a lack of awareness. This finding is consistent with Doyle and Cariño (2013), who

pointed out that a lack of awareness often leads to violations of community rights, further leading to potential conflicts and conservation setbacks.

The substantial awareness of rights and responsibilities among the Eastern Mau CFAs implies they are pivotal assets in the conservation discourse. Their knowledge equips them to better liaise with national and local institutions in managing forest resources. Furthermore, such awareness likely makes them more discerning of the adverse consequences on their livelihoods stemming from forest ecosystem degradation. The data from this section aligns with existing literature emphasizing the importance of community awareness in conservation efforts. Yet, the nuanced understanding of those unaware of their rights offers a fresh perspective, suggesting a need for continuous community education and engagement to ensure holistic and sustainable conservation outcomes.

4.4.3 Access to Essential Tools and Equipment

The active involvement of local communities in forest conservation has been lauded in numerous studies as one of the most effective and sustainable ways to maintain ecological balance and biodiversity. To achieve this, it's not just the intent or awareness that's crucial but also the provision of appropriate resources, including tools and equipment. From the data presented, a significant concern arises: the majority (55.0 percent) of the respondents vehemently asserted a complete absence of essential tools for forest management. While 11.4 percent felt some level of provision was made, the overwhelming majority's sentiment underscores a substantial barrier in actualizing conservation efforts on the ground.

This barrier is not only reflective in the sentiments of the respondents but is also starkly evident in the line item mean of 2.1397. The standard deviation of 1.44418 further highlights the wide dispersion in responses, indicative of the variance in perceptions and possibly, experiences among the respondents concerning access to tools and equipment. In direct contrast, the mean score composite for awareness stood at 3.4410, suggesting that while there's a commendable level of knowledge and awareness about conservation, the actionable aspect, enabled by the right tools, is notably lacking.

The unavailability of even rudimentary tools like wheelbarrows, digging instruments, and polythene tubes crucial for setting up tree nurseries, paints a concerning picture. The literature reiterates the importance of these tools in forest conservation. For instance, Duguma et al. (2018) emphasized that community-led initiatives' success is contingent upon access to appropriate resources, including essential equipment. The study also noted that the lack of tools impedes not just physical conservation activities but can also lead to decreased motivation and commitment among community members. Comparing the presented data with existing literature reveals an anomaly. While many conservation models, such as the one proposed by Chhatre and Agrawal (2009), emphasize the role of equipment and logistical support in ensuring effective community-led conservation, the current scenario in the Eastern Mau forest region suggests a sizable gap in this domain.

Fundamentally, while the Eastern Mau community displays a robust understanding of their roles in forest conservation, a stark lack of essential resources could significantly diminish their efforts' effectiveness. This finding underscores the importance of not just raising awareness but also equipping communities with the necessary tools to transform their knowledge into tangible conservation outcomes.

4.4.4 Communication and Expertise: Pillars of Effective Forest Conservation

A critical aspect of successful community-led forest conservation initiatives is the consistent and accurate flow of information between official bodies, such as forest administrators, and the community members. Another equally important aspect is the perceived and actual expertise of these administrators in forest management. The data from the Mau forest region sheds light on these crucial elements and their implications for the conservation program.

The findings suggest that a significant majority of the respondents, about 58.5 percent, felt informed, receiving regular updates about forest conservation. This is substantiated by a line item mean score of 3.6376, which surpasses the composite mean score of 3.4410. Such regular communication between KFS officials, stakeholders, and the CFA members plays a pivotal role in driving responsible behaviour. These observations resonate with assertions made in literature. For instance, a study by Kellert et al. (2000)

emphasized that efficient communication channels foster trust and shared responsibility, thereby enhancing the conservation outcome's overall success.

Furthermore, the perceived expertise of the forest administrators is also crucial in enhancing community trust and commitment towards conservation efforts. A reassuring 59.0 percent of respondents believed that the forest officers possessed ample expertise in forest conservation practices. This confidence in administrative expertise, mirrored by a mean score of 3.5240, underscores the importance of having knowledgeable officials at the helm. The higher line item mean compared to the composite mean also highlights the community's trust in the forest officers' capabilities. This perceived trust aligns with the broader literature on community forestry. As iterated by Baynes et al. (2015), the technical and practical knowledge of forest officers significantly influences community participation. The more knowledgeable the officers are, the more confident the community feels in collaborating and taking active roles in forest conservation.

In the Eastern Mau forest context, it's heartening to see the strong advocacy and awareness creation by bodies like KFS, KWS, and KWTA, focusing on best practices in forest management. Their expertise in critical areas, from tree nursery establishment to sustainable resource harvesting, paves the way for a more informed and participative conservation approach. The findings from the study indicate a positive landscape in terms of communication and administrative expertise, both critical for the successful conservation of forest resources. It aligns well with existing literature and further reinforces the importance of these elements in conservation initiatives.

4.4.5 Financial Bottleneck in Forest Conservation Initiatives

The effective execution of forest conservation programs is a multifaceted endeavour, demanding not just dedication and commitment but also a reliable flow of resources. In the context of the Mau forest community, understanding the financial underpinnings is paramount. Given the central role that community-based forest management plays in conservation, gauging the Community Forest Associations' (CFAs) access to monetary support can provide significant insights into the challenges they face and the potential solutions.

More than half of the respondents (54.1 percent) expressed concerns about a lack of sufficient monetary backing. A substantial percentage (13.1 percent) felt strongly about this deficit. When juxtaposed with the line item mean score of 2.0000, which is notably lower than the composite mean score of 3.4410, it becomes evident that funding is a significant constraint hampering effective conservation. This finding is consistent with much of the existing literature. For instance, Chhatre and Agrawal (2009) have pointed out that financial constraints can be a significant barrier to successful community-based forest management, often leading to unsustainable practices, even if the community's intentions are noble. In practical terms, forest conservation efforts are multifaceted and financially intensive. For instance, not only do the personnel involved, such as foresters and wardens, need to be compensated adequately, but there's also a need for resources for nursery setups, seedling generations, and post-planting care in afforestation projects. While the community is willing and eager, the requisite financial investments are often beyond their means.

Moreover, it's concerning to observe that the available funds are frequently diverted to infrastructure and other socioeconomic sectors like education and health. While these are undeniably crucial areas, it raises questions about the prioritization of forest conservation, especially given the broader benefits forests offer, from biodiversity conservation to climate change mitigation. Moreover, such financial reallocations increase transaction costs for CFAs and can hinder local institutions' efficiency and effectiveness.

The study findings amplify a known challenge in the world of forest conservation – the financial constraint. While the community's dedication is commendable, without the requisite monetary support, the long-term success of such initiatives remains uncertain. This emphasizes the need for a re-evaluation of funding structures and priorities to ensure that conservation gets its due, both in terms of recognition and resources.

4.4.6 The Imperative of Extension Services in Forest Conservation

Community involvement is at the heart of any successful conservation program. Forest ecosystems are not just physical entities; they are also entwined with the socio-cultural and economic fabric of the communities that surround and depend on them. The efficacy

of Community Forest Associations (CFAs) can be significantly bolstered by agricultural extension or professional assistance, which is evident from the data concerning the Mau forest community. A significant portion (56.3 percent) of the respondents confirmed their access to technical services, while 10.9 percent went a step further to strongly affirm this accessibility. However, it's concerning to observe that 22.8 percent, combining those who denied access and those with a stronger negative opinion, reported a lack of access to these essential services. The indifference of 14.1 percent of the respondents could indicate a lack of awareness about the potential benefits of such services or perhaps an uncertainty about the quality of services received.

When the line item mean of 3.4410 is juxtaposed with the compound mean score of 3.4410, it paints a picture of an essential service area that's not fully optimized. The implications of this are multifaceted. At the core, a lack of extension services or capacity development can handicap the CFAs. Without proper technical guidance, even the most well-intentioned community-driven conservation efforts can fall short of achieving their goals or even inadvertently harm the forest ecosystem they aim to protect. This observation is consistent with the findings of Anyanwu (2020), who underscored the value of community education programs in conservation. Anyanwu emphasized that community engagement isn't just about involvement; it's about informed and educated involvement. The nexus between community education and forest conservation is intricate. By equipping the community with the necessary knowledge and skills, we ensure that their conservation actions are both effective and sustainable.

In summary, these findings shed light on a crucial gap in forest conservation: the need for robust extension services. While a significant portion of the community has access, there's still a substantial percentage that remains underserved. Bridging this gap is paramount for the holistic conservation of the Mau forest, and by extension, other forest ecosystems globally. It's not just about engaging the community; it's about equipping them with the right tools, knowledge, and expertise.

4.4.7 Effectiveness of Stakeholder Engagement in Forest Conservation

The success of forest conservation initiatives hinges greatly on the efficacy of stakeholder engagement. As evidenced from the Mau Forest data, this engagement isn't a monolithic process; it spans government institutions, forest managers, and the communities that reside within or around the forests. In-depth analysis of these relationships paints a more intricate picture of the forest conservation landscape.

Firstly, the results on two-way engagement effectiveness reflect a somewhat fragmented stakeholder communication system. A total of 23.1 percent of respondents either agreed or strongly agreed on the effectiveness of the engagement procedures. Conversely, 25.3 percent, summing up those who disagreed and strongly disagreed, reflect discontent or scepticism about the communication process. This dichotomy presents a challenge. It is pivotal to have open channels of communication and mutual respect among stakeholders, as these not only build trust but also minimize potential conflicts. The higher mean score for this line item suggests that while communication lines exist, their effectiveness might be inconsistent or vary among different stakeholders.

Furthermore, collaboration appears to be a more successful endeavour, with a significant majority (83.0 percent when combining those who agreed and strongly agreed) acknowledging their collaborative efforts with other parties. This higher line item mean score suggests that partnerships are a prominent feature in the Mau forest conservation scheme. Collaborations, especially with external stakeholders like NGOs, can substantially amplify the impact of conservation efforts. Such partnerships often bring in much-needed resources, expertise, and a fresh perspective that can enhance the conservation initiatives.

Mr. Peter Mukira's statement underscores the essence of collaborative efforts. By mentioning diverse entities such as Kenya Conservation Services, the Kenya Tea Development Agency, James Finlay, and others, he highlights the multi-faceted and inclusive approach to conserving the Mau forest. Such collaborations signify the convergence of interests and the commitment of varied stakeholders towards a shared goal.

The data reaffirms the notion that conservation is a collective endeavour. While there are challenges, especially in the realm of communication, the overarching spirit of collaboration shines through. It underscores the importance of synergies and partnerships in achieving holistic forest conservation, suggesting that while there may be individual voices of dissent or discontent, the collective push towards conservation remains strong and promising.

4.4.8 Participation in Forest Boundary Delineation and Implications for Conservation

Forest boundaries form an essential aspect of forest management and conservation. These boundaries serve as the primary mechanism for determining how forest resources are allocated and used. The survey results on the participation in the delineation of the borders of forest regions in the Mau forest offer insights into how engaged local communities and stakeholders are in this crucial conservation activity. A significant majority (68.6 percent) of the respondents indicated their involvement in delineating forest boundaries. Such a high level of community participation is commendable as it instills a sense of ownership and responsibility among community members. Active involvement ensures that the delineation is contextually relevant, respects local land-use practices, and is more likely to be adhered to by community members.

However, the fact that 22.7 percent of respondents either disagreed or strongly disagreed with the statement suggests there is a subset of the community that feels excluded from this vital process. This exclusion can lead to feelings of disenfranchisement, which, in turn, might result in less compliance with forest boundaries and more instances of encroachment. This was reflected in the data, where the line item mean was lower than the composite mean score, highlighting the significant issues of forest invasion and illegal grazing due to lack of clear demarcation.

Soe et al. (2019) highlighted the importance of setting resource extraction limits and allocating specific regions for users. When boundaries are well-defined, and the roles and responsibilities associated with those boundaries are clear, it not only minimizes resource conflicts but also ensures the sustainable and long-term exploitation of the forest

resources. This is especially crucial in a diverse ecosystem like the Mau forest, where multiple stakeholders have varying degrees of dependency on forest resources. While the participation in the delineation of the Mau forest boundaries seems relatively high, the results emphasize the importance of inclusivity in the conservation process. Ensuring that all stakeholders are involved and that the boundaries are clear and respected is paramount for the conservation program's success in the Mau forest. Future initiatives should consider strategies to increase inclusivity in boundary delineation and raise awareness about the importance of respecting these boundaries for the forest's long-term health and sustainability.

4.4.9 Stakeholder Coordination Assessment

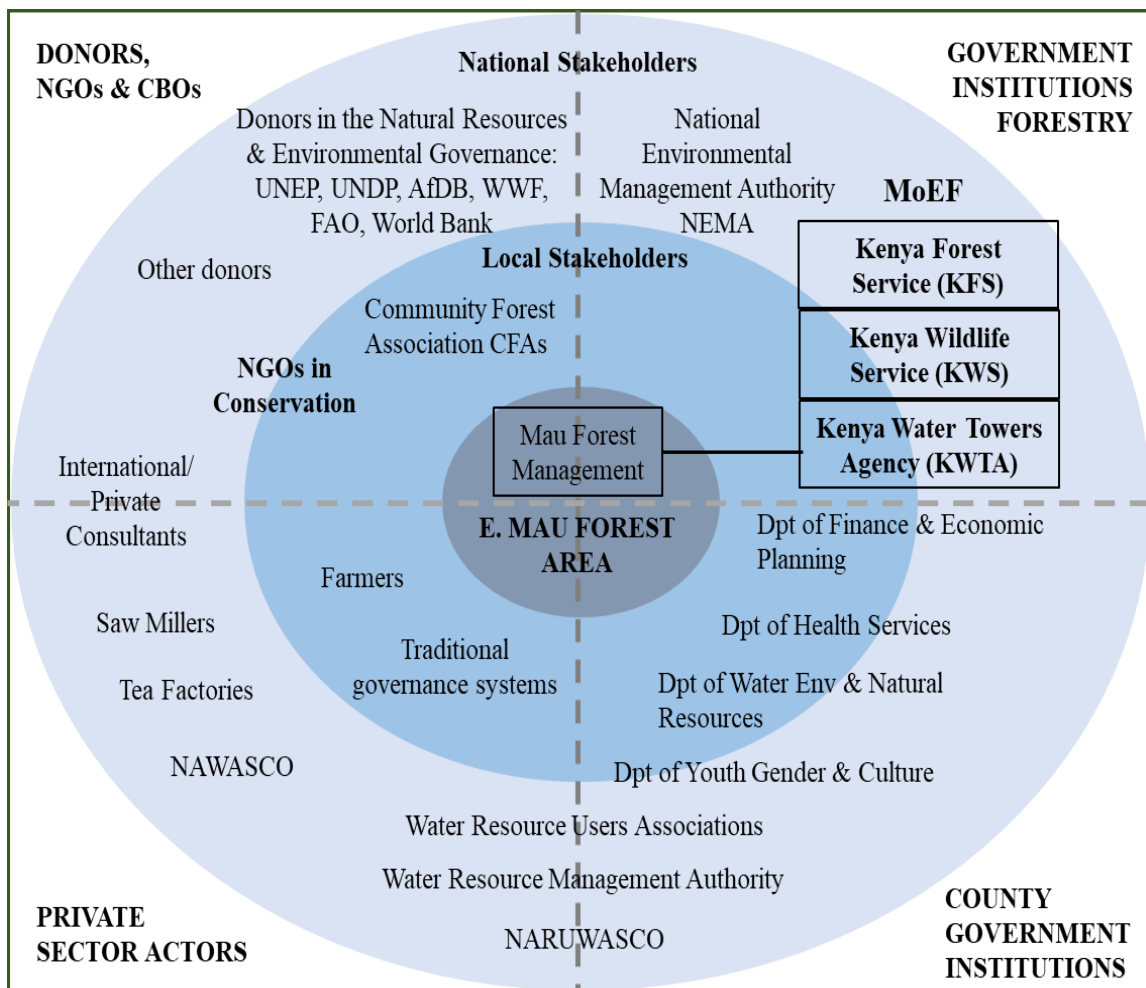


Figure 4.36: Eastern Mau Stakeholder Levels of Engagement

Source: Field Survey (2021)

According to the Forest Conservation and Management Act, (2016), the Kenya Forest Service (KFS) is the principle government organization that is tasked with oversight of government gazetted forests. Naturally, it provided the starting point for conducting an in-depth stakeholder analysis. This state corporation, created through the Forest Act of 2005 (now repealed), is mandated to carry out the following objectives; rehabilitation of degraded forest areas as well as conserve and develop all public forests; restocking of all public plantation forests; increasing forest cover in areas other than public forests; protecting public forests and other attendant corporate assets; and, strengthening capacity to ensure efficient utilization of resources for effective service delivery.

As outlined in Figure 4.45, the study established that KFS along with other government agencies namely KWS and KWTA, are the principle governance authorities in the management of E. Mau forest and straddle all levels of management – both national and local – as well as coordination with local and international organizations and private institutions.

Stakeholders in the Eastern Mau forest fall into either of the four categories used in the study, as portrayed in Figure 4.45. These are; Government institutions that have affiliations to forest resource management; the County government, specifically those departments that touch on the Mau Ecosystem management; the Donor organizations, some of which are international institutions and regional organizations including the UN, AfDB and World Bank; and finally, the private entities. In order to analyze key interactions between the organizations and the community as well as amongst themselves, the researcher designed a concentric framework divided into four quadrants according to the organizational clusters, and colour coded according to the level of engagement. Depending on data collected from interviews and observation, the study noted that some of the stakeholders straddled more than one quadrant and concentric designations. This is indicative of collaboration and coordination in implementation of projects and programmes within the Mau forest ecosystem.

As shown, KFS, KWS and KWTA are the three principle agencies carrying out the primary mandate of managing Eastern Mau Forest, and they all operate under the

auspices of MoEF. These institutions are also the key drivers of governance within the Eastern Mau forest and engage at both the national, local and primary level i.e. with communities located within the forest area catchment. To complement the efforts of these agencies, the National Environmental Management Authority (NEMA) also retains a footprint within the region. NEMA coordinates with other government agencies within the area as an instrument of the national government for implementation of policies relating to the environment. Together, these institutions define, to a large extent, government's policy and governance objectives within the Eastern Mau forest.

A major challenge for these organizations as highlighted by their representatives during the FDG mainly stemmed from political interference. For instance, according to the KWS respondent who requested anonymity, large portions of Kenya's forest reserves previously categorized as protected areas have over the period of a few decades been formally de-gazetted and designations changed to other uses, predominantly agricultural.

“These changes were made official. In the meantime, the remaining preserved indigenous forests that are maintained by KFS and KWS have been damaged as a result of decades of illicit harvesting of trees for timber, further endangering threatened flora. As a consequence of this, carbon stores have been decreased, and biodiversity values have been degraded. These issues have led to a decline in the Mau complex' overall biodiversity. The overharvesting of trees, poles, charcoal, and fuelwood, as well as the unrestricted grazing and clearing of land for agricultural purposes, continues to be a major contributor to the degradation and destruction of the forests on community lands that are administered by the local authorities.” KWS Officer.

On its part, the county government of Nakuru through its department of water environment and natural resource has embarked on efforts to conserve Mau forest which holds immense potential for uplifting the socioeconomic wellbeing of the Eastern Mau forest communities. As stated by Dr. John Maina, the Nakuru County Executive Committee (CEC) Member in charge of Water and Environment;

“The Eastern Mau forest block has endured decades of perennial conflicts arising from land and boundary issues which have impeded human development, protection of the ecosystem and sustainability of livelihoods. In addition, these pose a very real danger of degrading Nakuru’s geothermal potential at Ol Karia due to reduced recharge of underground water.” Dr. John Maina CEC Nakuru County.

The County has since its establishment endeavored to conserve the Eastern Mau forest with the latest push being collaboration with the KFS in the Mau Rehabilitation Project under the Adopt-a-Forest model. A major push commenced with the rehabilitation of Dundori forest – one of the catchment forests of the Eastern Mau forest block.

The study established that World Wildlife Fund (WWF) is one of the international organizations involved in the Mau forest conservation efforts. Mr Mohamed Awer, the Fresh Water Coordinator pointed to the Mara River Basin Management Project which was initiated by WWF in collaboration with government ministries for this purpose.

The project sort to engage stakeholders, including communities at the grassroots level i.e. farmer communities, tourist development agencies, and large-scale cereal growers, within a collaborative framework to conserve the Mara river catchment. He pointed to the successes of their approach including; sensitization of several stakeholder groups, registration of the Mara River Basin Water User Association, promoted sustainable agriculture approaches and championed for alternative livelihood activities to enhance income, as well as facilitating dialogue between stakeholders to enhance peace and security.

According to the findings, some key stakeholders who were pointed out as being active in the efforts to enhance environmental security and governance in Eastern Mau include; the African Development Bank, which in collaboration with the Kenyan government, is angling towards implementation of the second phase of the Kenya Green Zones Development Support Project; the World Bank Group which had a hand in the Mara River Basin Management Project; the KFS, the Water Resource Management (WRM) in conjunction with the Ministries of Agriculture (MoA), and Lands, the Water Resource

User Associations (WRUAs), Local administration including the village elders etc., the relevant County government departments, and private organizations including such FAO, UNDP and the World Bank.

According to the findings, stakeholders like the KWS, KFS and WRM have increased their structural and personnel capacities which is expected to enable efficient deployment of resources for better coordination and management of the Eastern Mau forest resource.

4.5 Objective 5: Adequacy of Existing Policies and Legislative Frameworks in Environmental Security and Forest Resource Governance

In assessing the adequacy of existing policy and legislative frameworks used in environmental security, governance, and resilience building in Eastern Mau Forest, respondents were presented with a structured question seeking participants' degree of consensus predicated on a Likert scale graded 1-5, where 1 indicated strongly acquiescence and 5 strong disagreement. Findings are as tabulated in Table 4.26. The policy and legislative frameworks that were being investigate here include Kenya's Forest Act 2016, Forest Policy 2014, Environmental Management and Coordination Act (1999) revised (2015) Water Act 2016 and Land Act, 2012.

The findings in Table 4.26, depict the degree of adequacy of the present policy and legal framework's in Eastern Mau Forest regarding environmental security, governance, and resilience development, as stated in the statement. Sixty-one percent of the 229 respondents who participated in the survey believed that a relationship with an external institution is necessary for successfully conserving the Mau rainforest. 7.9 percent of respondents strongly agreed, 10.0 percent were indifferent, 5.7 percent strongly disagreed, and 15.3 percent disagreed, according to the survey results. The mean line item score 3.95 and a SD 1.182 was greater than the mean composite score of 3.3624 and a SD 1.22996.

Table 4.26: Adequacy of Existing Policy and Legislative Framework

Statement	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree	Mean	SD
Partnership with other institutions is important for effective conservation of Mau	7.9%	61.1%	5.7%	10.0%	15.3%	3.3624	1.22996
Staff are sufficiently trained and adequate to implement conservation activities	27.1%	11.8%	13.1%	48.0%	0.0%	3.1790	1.28701
Sufficient funding and staff are allocated for executing conservation initiatives	12.2%	9.2%	13.1%	56.3%	9.2%	2.5895	1.16117
There's a properly established trading/market platform for Mau Forest goods	19.7%	41.5%	18.8%	14.0%	6.1%	3.5459	1.13703
Forest benefits are shared equitably	17.9%	42.8%	9.2%	16.2%	14.0%	3.3450	1.32411
Communities are empowered to add value to forest products prior to marketing	12.2%	23.6%	22.3%	40.2%	1.7%	3.0437	1.09537
Existing mechanisms for transparent engagement and conflict resolution are in place	11.8%	51.1%	15.3%	10.0%	11.8%	3.4105	1.17990
Property rights over forest resources are clearly defined and understood by the community	13.5%	44.5%	19.7%	17.9%	4.4%	3.4498	1.06925
All stakeholders are clear about activities that are authorized and those outlawed within the Mau Forest area	20.5%	45.4%	11.4%	14.0%	8.7%	3.5502	1.21155
Regular training is conducted for promotion of conservation activities around Mau forest	3.5%	10.0%	17.0%	50.2%	19.2%	2.2838	1.00121
Average						3.1760	1.1697

Source: Field Survey (2021)

The results tabulated in Table 4.27 show the level of adequacy of the existing policy and legislative framework for the conservation of Mau Forest. Overall, the respondents had mixed opinions regarding the effectiveness of the policies and legislative framework in ensuring the sustainable management of the forest. The highest percentage of agreement was on the existence of a properly established market for the forest products gotten from Eastern Mau Forest, followed by necessity for partnership with non-government institutions in order to enable effective conservation of the forest. On the other hand, the lowest percentage of agreement was on regular training to promote effective conservation activities in the forest.

From the findings, the collaboration with organizations such as the Kenya Tourism Development Authority (KTDA), James Finlay Company, as well as the County government provided CFAs with the required assistance to take out activities for the conservation of the Mau forest programs, such as financial incentives and advice. Local people's involvement in long-term resource management ensures the success of the Existing Policy and Legislative Framework. Local groups may be used as an alternative to rigorous control and confinement in Existing Policy and Legislative Framework (Cheruiyot, 2020). These findings were corroborated by qualitative information gathered from an interview with KFS officials, who said that:

“The existence of a defined Existing Policy and Legislative Framework assisting the Mau Forest conservation effort is supported by the application of rules and regulations guiding the activities of the Community Forestry Associations (CFA). In addition, technical assistance given by the KFS in collaboration with partners such as the Kenya Tea Development Authority and James Finlay, who are responsible for supplying CFA members with vegetation.”

Because of this, a joint management partnership will promote the engagement of a number of stakeholders to achieve improved forest conservation and increased contribution to community livelihoods. The term "in the appropriate conditions" was coined by Gichuki (2018), and it refers to democratic decentralization as a means of increasing efficiency, equality, participation, and environmental protection. It is recommended to include all stakeholders throughout the project cycle, including the

definition of activities to be undertaken, the execution of the program, and the monitoring and assessment of the process.

Regarding the second assertion, a significant number of well-trained individuals are assisting in the execution of forest conservation operations. Among those who responded, 48.0 percent disagreed with the results; only 0.0 percent strongly disagreed; 11.8 percent agreed; 27.1% were extremely in agreement, and 13.1 percent were neutral. The line item scored a mean value of 2.27 and Standard Deviation 1.237 which was lower than the total mean score of 3.1790 and SD 1.28701. This suggests an insufficient number of properly qualified employees would prevent CFA members from receiving extension assistance on the most effective methods to execute conservation programs effectively in their communities.

The results of Soanes *et al.* (2019) in their research in Iran, in which they observed a substantial positive and statistically significant link between participation in an extended education course, are in direct opposition to their findings. Placing an extension officer in the community who has been trained locally offers a vital two-way relationship between communities and the program while also providing a learning opportunity. In their evaluation of initiatives in Malawi and Zambia, Ko *et al.* (2019) highlighted this method as a good practice. Natural resource management training was provided to local volunteers who worked with government extension personnel to find and diversify income streams via natural resource management, allowing them to detect difficulties at an early stage and mitigate negative consequences.

Concerning the adequacy of funding and personnel for conservation initiatives within the forest, approximately 56.3 percent of those who responded disagreed, with 9.2 percent strongly disagreeing that adequate funding and personnel was allotted to the conservation initiatives, as shown in the table. In addition, 13.1 percent of respondents were indifferent, 9.2 percent agreed, and 12.2 percent expressed strong acquiescence with the survey's findings. There was a smaller difference in the line item mean and average mean of 3.177 and 1.188. Indicating insufficiency of budget allocations hinders the acquisition of resources required to run effective PFM programs, which will prevent CFAs from

acquiring the right tools and resources used in implementation of the conservation programs.

In the fourth statement- There's a properly established market for forest goods from the forest. It is clear that 41.5 percent of participants agreed and 19.7 percent strongly agreed that there is a ready demand for forest goods on the market today. 18.8 percent were indifferent, 14.0 percent disagreed, and 6.1 percent strongly disagreed, according to the survey. The line item mean of 3.5459 and SD 1.13703 is higher than the average mean score of 3.177 and SD 1.188, implying availability of markets for Eastern Mau forest resources supports the efforts of the Mau forest program since CFAs can trade these to improve their livelihoods and therefore, are motivated to ensure the forest's protection.

Additionally, the monies raised are utilized to enhance the lives of the community, which in turn encourages people to participate in conservation efforts on a larger scale. This is consistent with the results of other researchers who have shown that national governments played an important part in developing technical skills and the independence of tropical forests (Rice, 2021). Through the availability of resources and markets, the institutions formed and devised norms and regulations that ensured long-term livelihoods for those who participated (Cheboiwo *et al.*, 2018).

In the fifth statement, Equity is ensured while sharing forest benefits. In this situation, 42.8 percent of respondents agreed, with 17.9 percent strongly agreeing, that fairness is preserved when sharing in the benefits of forest management is carried out. 16.2 percent of those surveyed disagreed, 14.0 percent strongly disagreed, and 9.2 percent were indifferent to the issue. The mean of the line entry score of 3.3450 and standard deviation 1.32411 was greater than the mean total score of 3.1760; standard deviation of 1.1697. This implies that equity in sharing forestry benefits by CFAs increased cohesiveness and decreased the frequency of disputes, which prompted the CFA members to devote even more time and effort to forest conservation in the future.

In the sixth statement, Forest products undergo value addition before marketing, 40.2 percent of those who answered the survey disagreed, with 1.7 percent strongly disagreeing, that forest products receive value addition before they are sold to the public.

Also, 22.3 percent had no opinion, 23.6 percent expressed agreement, and 12.2 percent expressed strong agreement. The line item means a score of 3.0437 and a standard deviation of 1.09537 was higher than the composite mean score of 3.1760 with a standard deviation of 1.1697, indicating that members were unable to improve the value of goods from the forest, such as timber and honey, thereby forcing them to trade raw honey at lower price-points. In turn, this hampers the conservation efforts of the Mau forest program since it will discourage people from participating in it successfully. It is recommended that a diverse range of non-timber forest products (NTFPs) be created around Mau forest to reduce reliance on a single commodity. In addition, organic or forest certification and specialty marketing are required to raise their worth even more. Furthermore, other sources of revenue such as eco-tourism fees ought to be introduced as part of environmental service charges to ensure that agricultural land usage does not outcompete forest land use, as has been the case amongst populations living within forest catchments (Okumu & Muchapondwa, 2020). This was visible in the surrounding people, who lived close to the Ndoinet forest as well as the Itare forest research stations.

On the 7th enquiry concerning mechanisms for transparency in engagements and for conflict resolution, the study indicates that 51% of participants agreed, with 11.8 percent strongly agreeing, that effective, transparent participation and conflict resolution methods are in place. Neutrality was represented by 15.3 percent of respondents, disagreement by 10.0 percent, and extreme disagreement by 11.8 percent. A higher mean of 3.85 and SD 1.151 was obtained for the line items than the average mean of 3.4105 with SD 1.17990, showing more cohesiveness among the organizations advocating forest conservation programs. The creation of official user groups has been identified as a significant technique for increasing the engagement of community members in forest conservation and, as a result, generating more functioning communities and PFM motivations in forest ecosystems (Kagombe *et al.*, 2020). Community engagement is largely done via CFAs, and coordinated forest management is the key premise that underpins the policy change (Agaya, 2018). On the other hand, institutions founded on culture and heritage, according to Masayi (2021), are granted acceptance at the locally making them more adaptable and longer-lasting.

As to whether the respondents found the property rights to be clearly defined, the vast majority (44.5 percent) of respondents agreed, with 13.5 percent strongly agreeing, 19.7 percent indifferent, 17.9 percent disagreeing, and 4.4 percent strongly disagreeing; the remaining 4.4 percent strongly disagreed. A higher mean of 3.82 and a SD 1.252 was obtained for the line items than for the average mean of 3.4498 and SD 1.06925, indicating that clear property rights have been established, which provides a legal context for CFAs to effectively participate in the implementation of PFM programs within the Forest. In order for management of the natural resource to be decentralized, duties and authority must be devolved (Masayi, 2021). Moreover, communities should be given the authority to access, exploit, and reap the benefits of the resource equitably.

When the stakeholders were asked if they had a clear comprehension of the legal provisions in the context of activities that were authorized or outlawed, within the Mau Forest area, there was a majority of agreement (45.4 percent) among respondents, with 20.5 percent strongly agreeing and 11.4 percent indifferent. A minority of disagreement (14.0 percent), and a majority strongly disagreed (8.7%). There was a significant difference between the general mean score of 3.1760; SD of 1.1697; and line items mean of 3.5502 and SD 1.21155.

Because CFAs would avoid engaging in outlawed practices which can jeopardize the achievement of environmental protection, it follows that providing stakeholders with information about activities permitted to take place in the forest catchments would result in increased protection of biosphere and more efficient harvesting and processing of forest products. Key stakeholders must maximize their potential following the legal and informal mandates. As a result, KFS should raise awareness among CFA members about forest policy possibilities, PFM guidelines requirements, and other relevant information.

Regarding the conduct of regular training to promote effectiveness of conservation approaches around Mau forest, the majority (50.2 percent) of participants disagreed, with 19.2 percent strongly disagreeing, 17.0 percent indifferent, and 10.0 percent agreeing, with 3.5 percent strongly agreeing. The remaining 10.0 percent agreed, with 3.5 percent strongly agreeing. According to the assessed factor the average mean score 3.1760 and SD 1.1697 was lower than the assessed factor mean score of 2.2838 and SD of 1.00121,

indicating dissatisfaction in the conduct of regular training for CFAs intended to promote effectiveness toward conservation efforts. The reason for the outcome is that communities were not adequately engaged nor sufficiently empowered on executing PFM principles efficiently to contribute to forest conservation efforts.

4.5.1 Gender Policy on Environmental Conservation

The section is pivotal for several reasons. Firstly, it is imperative to comprehend how gender policies influence environmental conservation and resilience building, given the gendered dynamics in interactions with the environment. Secondly, understanding participants' perceptions of these policies is essential to evaluate the effectiveness and potential areas for improvement. This will ultimately aid in establishing a robust framework for gender equality in environmental conservation efforts, particularly in regions like the Eastern Mau Forest in Kenya.

Respondents were asked to rate the interaction between gender policy and environmental conservation. Outcomes are presented in Table 4.27;

Table 4.27: Gender Policy on Environmental Conservation

Gender policies on environmental conservation	Mean	Std. Deviation
There is an adequate level of engagement by women in the decision-making process for the Resilience building	3.7615	1.54420
Kenya's local administration, has enacted adequate gender policies to encourage and facilitate Resilience building.	4.3231	1.23399
The dynamics of gender have a role in determining Resilience building	4.1846	1.28065
Increasing gender equality through removing socioeconomic barriers that now exist in the field of Resilience building	3.9077	1.47562
There are sufficient intervention opportunities for women to raise their concerns about Resilience building.	4.0231	1.27264

Source: Field Survey (2021)

Table 4.6 reveals that the respondents generally acknowledge the significance of gender policies in environmental conservation and resilience building, with mean values indicating agreement with the statements provided. The statement that “Kenya's local

administration, has enacted adequate gender policies to encourage and facilitate resilience building” received the highest agreement, with a mean of 4.3231. However, the statement addressing the removal of socio-economic barriers in resilience building received a slightly lower mean value of 3.9077, suggesting perceived challenges in achieving gender equality in this domain. The variability in standard deviation values indicates diverse opinions among participants regarding the impact of gender policies on environmental conservation and resilience building.

These findings align with the research conducted by Enzler et al. (2019), which emphasized the importance of women's participation in decision-making processes related to natural resource management, contributing to enhanced environmental conservation efforts. This study's insights resonate with the participants' strong agreement that the Mau Forest administration has implemented suitable gender policies promoting women's involvement in resilience building.

Moreover, the necessity to address gender inequalities, as discussed by Kandari et al. (2020), particularly in rural areas, is reflected in the participants' responses. The presence of gender-based barriers, such as restricted access to resources and cultural norms limiting women's participation, correlates with the respondents' perceptions of existing obstacles to achieving gender equality in resilience building.

Additionally, the results indicate a recognition of gender relations as a determining factor in environmental security and a belief in promoting gender justice by reversing current socio-economic impediments. There seems to be consensus on women's representation in decision-making about resilience building and the necessity for interventions allowing women to voice their concerns, which signifies the importance of gender relations in environmental conservation. However, the responses also hint at limitations in interventions for women to express concerns about resilience building, underlining the need for further enhancement in this area.

These observations support the findings of previous studies underscoring the importance of gender policies in fostering environmental conservation and resilience building. They shed light on the participants' perceptions of the gender policies in the Mau Forest region and underscore the need for further investigation to evaluate the efficacy of these policies

and their impact on conservation outcomes. The analysis of this section under the second research objective elucidates the crucial role of gender policies in environmental conservation and resilience building in the Mau Forest region. The findings corroborate previous research while also highlighting areas requiring further exploration and enhancement to ensure gender equality and effective participation in environmental conservation activities.

4.5.3 Development of Appropriate Government Policies

The majority respondents alluded that; the weak governmental institutions in regards to human capital as well as political leverage (48.5%), poorly articulated priorities (29.3%), lack of an identifiable domestic electorate (38.9%), and overlapping mandates of sectoral stakeholders (40.2%) all were ranked with least impact. The exclusion of an identifiable household constituency, and the intersecting mandates of sector specific agencies each have the lowest influence on efficient planning and implementation in Eastern Mau Forest, in that order. Further, the study revealed that the majority (54.1%, 42.4%, 50.2%, 53.3%, and 49.3%) households, diminished public participation in environmental recommendations, shortage of possibility for public participation in environmental evaluations, weak or inadequately utilized data management and absence of planning, bribery, and inadequate environmental protections or processes respectively have the lowest influence on the effective government policy in the Mau Forest. Thus, with ineffective impact of these approaches, this negates the significance of resilience building towards environmental security around Mau East forest.

Also, 50.7% and 56.3% of respondents noted that weak environmental enforcement measures and limited access to information, especially regarding trade and environmental factors, have the least impact on policy implementation. The findings are supported by mean (2.0687) and standard deviation (1.2036), showing that participants noted that the above challenges have the least impact on the effective policy implementation in Eastern Mau Forest.

Table 4.4: Effective Policy Implementation in Eastern Mau Forest

Statement	Greatest impact	Great Impact	Moderate impact	Minimal impact	Least impact	Mean	SD
Weak national institutions in terms of human capital and political leverage	48.5%	17.9%	25.8%	5.2%	2.6%	1.9563	1.09136
Poorly articulated priorities	29.3%	22.3%	7.9%	17.9%	22.7%	2.8253	1.56862
The absence of an identifiable domestic constituency	38.9%	27.9%	13.5%	13.1%	6.6%	2.2052	1.26587
Overlapping mandates of sectoral agencies	40.2%	22.7%	18.8%	12.7%	5.7%	2.2096	1.25296
Public institutions at the local level that lack structures and capacity	54.1%	21.4%	13.5%	5.7%	5.2%	1.8646	1.16755
Lack of opportunity for public participation in environmental reviews	42.4%	24.9%	14.4%	14.4%	3.9%	2.1266	1.21995
Weak or poorly utilized information systems and lack of planning	50.2%	20.5%	14.8%	10.0%	4.4%	1.9782	1.20469
Corruption	53.3%	20.5%	13.5%	10.5%	2.2%	1.8777	1.12892
Inadequate and inappropriate	49.3%	18.3%	15.7%	16.6%	0.0%	1.9956	1.14898

Statement	Greatest impact	Great Impact	Moderate impact	Minimal impact	Least impact	Mean	SD
environmental standards							
Weak enforcement of environmental regulations	50.7%	27.9%	11.8%	6.6%	3.1%	1.8341	1.06724
Insufficiency in accessing critical information such as market trends, environmental conditions and/or trade opportunities	56.3%	10.5%	23.6%	7.9%	1.7%	1.8821	1.12355
Average						2.0687	1.2036

Source: Field Survey (2021)

CHAPTER FIVE: SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Governance of eastern Mau forest has been confronted with major challenges arising from the nature and structure of environmental security threats that affect communities' livelihood and resilience. The research's main themes were environmental security and resilience building. The key objectives of the study were to examine the general characteristics of the Eastern Mau complex; to assess the impact of environmental security approaches on resilience building for the Eastern Mau forest community; to evaluate the threat of household socio-economic factors on environmental security and governance in the Eastern Mau forest; to establish the effectiveness of the stakeholders' role in shaping environmental security and the governance framework toward resilience building and to assess the adequacy of the existing policies and legislative frameworks in environmental security and forest resource governance. This was a descriptive research and used quantitative and qualitative methods to study forest communities within Eastern Mau within Nakuru County, Kenya. Quantitative data analysis was done using ANOVA and regression analysis and presented in percentages, graphs and charts while incorporating salient points derived from qualitative data.

Many of the pressing problems that were identified can be considered as persistent due to their recurrence in spite of efforts to resolve them, both political and technical. In that regard, the section outlines the summary of the study, conclusions drawn and recommendations proffered - arising from the enquiry, while proposing possible areas for future research which can build on the platform herein provided and explore gaps that have been uncovered.

5.2 Summary of the Major Findings

The key objective of this research was to assess existing environmental security and forest governance systems and their impacts on resilience building in the Eastern Mau Forest. The theme of this study was to address environmental security and governance in Eastern Mau. In order to accomplish this, the study explored the existing governance

framework conditions including environmental policy making as well as any potential transformations. The methodology involved the use of a descriptive research design and incorporated qualitative and quantitative data. Additionally, the study broadened the analysis by scoping the spectrum of stakeholders and actors involved and their specific roles. A key finding of the study was the increasing steering away and broadening of governance modes from a strict focus on direct regulation by the national government, to greater consideration of socioeconomic and human security factors. Against this background, the recommendations, summary and conclusion of the research are discussed under the five research objectives respectively.

5.2.1 General Characteristics and the Socio-demographic composition of the Eastern Mau Forest

The research embarked on establishing the general features of Eastern Mau forest in order to both establish a baseline upon which other measurements can be based, as well as generate data that can then be used in the analysis of subsequent objectives. Factors considered included; household demographics, gender composition and perspectives, socioeconomic components of households, ecosystem services, as well as general factors that the community considered as contributory to their overall resilience. In this undertaking, the study established that the Mau forest communities were still largely composed of homogenous ethnicities especially in the rural areas with the trading centers and towns showing more ethnic diversity. The population mainly comprised of a young population with 36.68 percent of respondents falling within the 18 – 25 years age bracket. The data points to the potential natural capital component of labour in Eastern Mau forest, and is further reinforced by the observed decline in percentage of respondents within the age ranges of 26 – 35years at 6.11 percent. The low turn-out for this age bracket was due to the mass rural-urban migration as the youth move to urban and peri-urban zones in search of jobs. The study also observed a trend of early marriages, pushed mainly by cultural practices, with 79.04% of respondents indicating they were married.

Further, the study established that quite a number of respondents registered their ancestral homes as being elsewhere. 34.06 percent and 32.31 percent indicated that they immigrated from Mau Narok and Bomet Counties respectively. The trend, coupled with

data indicating 24.9 percent and 15.7 percent of respondents having moved to Eastern Mau forest in the past 6 years and 3 years respectively, portends continued immigration and persistent threat of encroachment into the forest. The study established a number of key socioeconomic factors affecting the livelihoods of the communities including; energy - with the majority, 59.39 percent, indicating that their primary source of energy for cooking comes from charcoal; accessibility to food and water – with 43.67 percent indicating a degree of difficulty accessing food and portable water; causes of food insecurity – 30.1 percent of respondents identified land degradation as a key risk to food security; and on Factors influencing food security, land use practices was considered top-most with 54.1 percent of respondents identifying this option.

5.2.2 Impacts of Environmental Security and Governance Approaches on Resilience Building

The study set out to establish outcomes of the governance approaches and environmental security impacts on the communities' resilience. One of the ways to establish the fact was to peer into factors affecting the community livelihoods and those that impact on their vulnerability. To this end, among the key findings included perceptions on the degree of change of the Eastern Mau forest ecosystem. Since a large part of the community livelihoods depend directly on the forest, respondents are bound to note any major changes in the condition of the forest which is linked to policy and governance decisions.

A majority of respondents, 42.3 percent noted that the forest had been heavily degraded while 34.4 percent feel that there is notable change. Additionally, there was general consensus by a majority of respondents concerning the general lack of or poor infrastructural development and service delivery. These factors largely contribute to encroachment into forest land as people move in search of water, fuel and pasture for their animals. In the areas surveyed, 60.3 percent of respondents noted the poor electricity connectivity, 46.7 percent lamented lack of piped water and having to walk long distances to obtain portable water, while 47.6 percent noted that aside from the main trunk road connecting the major towns, subsidiary road networks were in a state of disrepair.

The study also noted the general agreement on weak national institutions lacking expertise in the way of human resource and law enforcement, poorly articulated policies, overlapping mandates of sectoral agencies, and corruption as among the key factors impeding good governance outcomes.

5.2.3 Threat of household socio-economic factors on environmental security & governance

According to the third objective, the enquiry established that environmental transformation drivers vary in type and extent but may be roughly classified into three categories as demographic, socioeconomic, and technological. The study brought out Poverty and health as two critical social factors that impacted greatly on environmental security of Mau and affected governance. Other socioeconomic variables found to significantly impact on environmental security include; demographic patterns and population fluxes, education levels, information availability, health considerations, gender equality, poverty levels, economic pressures, community production and consumption levels, technological advances and access, as well as changing lifestyles influenced by expansion of surrounding major towns of Nakuru and Kericho.

For instance, the study established a significantly low level of education level with only 10.04 percent of respondents having completed secondary education. The low school completion rates and high illiteracy among the communities has likely impacted on attendance to Technical Vocational Education and Training (TVET) institutions in the surrounding towns and other tertiary institutions. Only 5.24 percent have attained Diploma level, 6.11 percent Undergraduate Degree, and 4.3 percent Postgraduate levels. Key reasons for these were; lack of school fees at 26.2 percent of the respondents; child labour and assisting with chores 15.7 percent and insecurity at 13.1 percent.

Findings establishing economic wellbeing of households, which translate to degrees of vulnerability, were provided through data collected on; employment status, household income, housing types and status of ownership, land ownership and size, and degree of reliance on forest resources. On average, household income was found to be on average below 20,000.00 Shillings. In this, 39.7 percent and 34.1 percent earned below 20,000

and 10,000 Shillings respectively. It was also observed as corroborated by data, that a majority of housing types are grass thatched and semi-permanent, at 44.1 percent and 45.72 percent respectively. Additionally, on the degree of reliance on the forest, a majority rated the forest as a very important source of food, at 49.8 percent, followed by persons that considered it a source of timber and wood products at 29.3 percent. The high level of reliance on direct forest resources predisposes the communities to high degrees of vulnerability especially in the face of increased degradation.

5.2.4 Stakeholders' Roles in Shaping Environmental Security and Governance Processes

The findings on establishing the stakeholders' roles and effectiveness in shaping environmental security and governance processes was outlined in two formats. The first, which entailed perspectives from the stakeholders on their roles in governance processes, degree of inclusion and the level of impact they felt these have been established, and among the respondents, the following findings stood out; a majority of participants, 57.6 percent agreed that taking part in a collective assessment of environmental resources in Eastern Mau would be a great step for community inclusion in the forest resource governance. Of the respondents interviewed, 56.8 percent felt that there was need for their rights to be championed and protected in the formulation of laws and legislations concerning forest management. Relatedly, 59 percent felt that there was need for the government to include them in the forest administration and sustainable management of resources, while 55.9 percent advocated for collaborations with interested parties – both government and non-government – on forest conservation.

The second format entailed an assessment of stakeholders' coordination and levels of engagement. The study findings established four categories of stakeholders namely; national government, county government, donors, and private actors/entities. It was observed that there were three levels at which all these operated, namely; national level actors, local level actors, and primary resource level actors. Respondents noted that three departments under the Ministry of Environment and Forestry (MoEF) were most active within the Mau forest, i.e. KFS, KWS and KWTA. Other stakeholders with the most

notable impacts were World Bank and WWF with the Mara River Project, and the AfDB Kenya Green Zones Development Support Project.

The study established that in spite of the MoEF was the principal contact point for a number of the environmental projects in the area, there tended to be mandate creep and overlaps with other government agencies and private stakeholders. For instance, on matters water, respondents were not clear about the differences of mandates of the Ministry of Water, Ministry of Lands and MoEF when it came to matter dealing with water, land and forests. As one Mr Richard Rogony from Silibwet village in Njoro Constituency noted;

“...the government needs to tell us who is responsible for what since sometimes we are unable to identify whom to report our complaints to whenever we feel there’s an infringement on our environmental rights or when our resources get plundered by these people* [sewer disposal companies].”

The study also established that most organizations did not actively engaged communities in the conservation process, resulting in weak community support. The survey further found that the community was not being adequately educated and empowered to improve its degree of participation in conservation. As a result, community members were not able to provide sufficient technical assistance to enforcement organizations, hence 54.6 percent of respondents noted the importance of establishing two-way interactions between forest authorities, administrators and other parties as an effective mechanism of community engagement.

5.2.5 Efficiency of Existing Policy and Legislative Framework Underpinning Environmental Security, Governance, and Resilience Building in Eastern Mau Forest

The study established from secondary data that the primacy of environmental conservation is captured under the Constitution of Kenya 2010, which outlines responsibilities of the Government in relation to environmental protection, including; the

duty of ensuring environmental and natural resources are sustainably exploited, utilized, managed and conserved, and to enable equitable benefits sharing; to protect indigenous knowledge systems and intellectual property rights of communities' biological and genetic resources; to ensure ecological conservation and restoration of tree cover; and, to ensure environmental and natural capital is utilized to benefit the people of Kenya. Consequently, in addition to Articles 42, 69 and 70 of the Constitution, other broader principles as set out in EMCA, Section 3 and a number of other substantive and subsidiary legislation provided important tools for assessing the efficacy of the policy and legal framework underpinning environmental security and governance around Mau forest.

To this end, while the study found that most residents agreed that existing policy and legislative framework were sufficient in promoting environmental security and good governance practices, views varied on a number of substantive issues regarding partnerships, State organs' capacities, resourcing and management of forest resources. For instance, the findings indicated that 61.1 percent agreed that enhanced partnerships with organizations external to the state organizations provided better outcomes for a more effective conservation of the forest. 48 percent of respondents disagreed that the government had sufficient number of staffs aiding in implementation and enforcement of policies and legislation toward conservation of Mau Forest. additionally, 56.3 percent of respondents disagreed on adequacy of funding indicating that there was insufficient resourcing of policy objectives towards conservation of Mau forest, especially from government sources. 50.2 percent of the Stakeholders also disagreed on adequacy of training toward enhancing capacity for effective participation in policy implementation. The response also portended inadequacy of public participation in the policy and legislative processes.

Overall, it was observed that the current command and control approach of the policy implementation acted as an impediment to effective execution of conservation activities and enhancement of livelihoods for resilience building in Eastern Mau forest.

1.1 5.3 Conclusions

The environmental security and governance landscape in Kenya is still in its nascent stages following promulgation of the new Constitution in 2010, roughly 12 years ago. In spite of this, as the study established, the landscape is evolving gradually, the change bringing with it greater scrutiny and demands for a more comprehensive governance approach that will centralize environmental security concerns and resolve community resilience through protecting and building sustainable livelihoods. Notable trends from the findings of the study show that stakeholders within Eastern Mau ecosystem were increasingly aware of environmental security issues, especially touching on social concerns and resource governance and climate change, and many have high expectations for appropriate governance frameworks of varying degrees that will address these issues. From the Focus Group Discussions with both internal and external organizations, there was a sense of greater social and environmental accountability, which ran contrary to profit making focus of previous years that led to wanton destruction of the forest. Consequently, the research further sought to establish that a cure for the lacuna in governance that allowed for such a system in the first place, lay in integrating environmental security approaches in governance frameworks for greater community resilience building, and concludes thus;

In its first objective, the research set out to establish the general physiognomies of the Eastern Mau Forest communities as a baseline for the study mainly focusing on the socioeconomic factors around community and ecosystem vulnerabilities. The study's approach considered socioeconomic factors as indicators of existing governance regime and community's resilience outcomes arising from this. The Eastern Mau forest communities are composed largely of middle income and lower income households that are dependent on subsistence agriculture and forest resources for survival. The reliance on the forest ecosystem further highlights the high probability of vulnerability of these communities resulting from the wanton forest destruction, hence the need for a robust governance approach that broadens the current command and control system approach to one that incorporates environmental security considerations.

For instance, according to the findings, most respondents owned between 11 and 15 acres of land. Of these, only a small portion is utilized for agriculture mostly as an outcome of diminished access to financial and material capital for the farming process. As a result, most respondents indicated that the revenues from their farms do not suffice to meet their food needs hence the high number of respondents with low income in spite data showing quite a number indicating that they are self-employed. The study further concludes, therefore, that this is the reason some respondents turn to relying heavily on the forest resources by either; encroaching onto more productive forest land for agriculture, to gather fodder for cattle, collect firewood, or obtain lumber for construction.

As a result of the longstanding destruction of the Mau Complex, the population has found itself facing dwindling forest cover which not only affects rainfall patterns, but also directly impacts on already stressed subsistence farming, water availability and allows spread of pests and diseases. The study therefore rightly concludes that the totality of these factors defining the general characteristics of Eastern Mau forest predict increased vulnerability of the populations living and depending on the forest resource. The study concludes that there is urgent need for the government's intervention to incentivize greater productivity, market opportunities, diversification of income sources and forest conservation.

On the second objective – assessing the impact of current environmental security approaches on resilience building, the study findings point to the gravity of collective action towards addressing livelihoods, social equity, and improving societal wellbeing by addressing environmental security concerns. The 5th GEF Assembly (2014) report explains that the scope of environmental security is not limited to resource-based conflict, but includes factors such as health security, sustainable livelihoods and societal wellbeing (Blake D Ratner *et al*, 2014). Relatedly, the study concludes that environmental security of the Eastern Mau forest underpins the rationale for investing in a community support framework for forest resource benefits that addresses the identified vulnerabilities in the areas of food, water and energy.

In order to accomplish this, the study concludes that there is need to substantially improve Eastern Mau forest natural resource governance in order to achieve community

resilience to environmental shocks. Therefore, the study concludes that the finding indicating a 48.5 percent agreement that the current government institutions spearheading environmental governance in Eastern Mau forest are weak and lack in political leverage is a major concern, as it holds potential of hobbling the entire resilience building process. The aspect corroborates findings on poorly articulated priorities that respondents felt were a key failure on the government agencies.

As a factor of the aforementioned, the study settles that currently, Eastern Mau forest is undergoing increased deterioration as a result of anthropogenic activities compounded by prevailing climate change effects – this, in spite being one of Kenya’s few remaining indigenous forests. In addition to acting as a key source of income for the local community and nearby populations, the study projects that reverberations of the impacts associated with continued degradation will not only be felt by the catchment population, but will affect the entire nation and even the region. Likewise, the proffered solutions can also be inferred to in solving similar challenges in other forest ecosystems facing existential threats.

On the third objective establishing how the household socio-economic factors threaten environmental security and governance, the study established feedback loops in the system which exacerbate an already bad situation. As has already been established, environmental security is a key driver for resilience building in Eastern Mau forest, however, a critical question arises as to the effects of some of the grim findings about diminishing household socio-economic factors. The study found that ecosystem degradation was a major cause of conflicts experienced within Eastern Mau forest. It concludes that the impact this causes raises friction and social tensions amongst groups, resulting in mainly ethnic and economic class divisions.

According to Akokpari, J (2021), the aforementioned conditions can result to sustained communal conflicts, often degenerating into periodic violence, and in other cases, the struggle to exert control over a natural resource such as Eastern Mau can be a major drive of environmental insecurity (Akokpari, J. 2012). Arising from this, the study further concludes that other wider scale household socioeconomic factors such as resource access and utilization rights and revenue distribution provided the most direct correlation

with environmental security. However, a number of other mediating factors cannot also be ignored. For instance, land tenure, rural income levels, inclusiveness and strength of resource management, and gender equity showed critical effect on environmental security and governance as well as informing the domino impact on resilience building.

The study established that in the case of prolonged threats to household socioeconomic elements, the corresponding negative environmental security effects will comprise of mixed drivers with a broader range of factors that pose considerable challenges to governance efforts aimed at resolving them. The study observed that these entailed political contexts and other related stressors which exacerbates vulnerability of the resource-dependent Mau forest communities.

The fourth objective on effectiveness of stakeholders' role in shaping environmental security and governance processes, the researcher concludes that a majority of people living in the Eastern Mau forest as well as the Key Informants were unhappy with low degree of community engagement and participation in the Mau conservation effort. The study established that most organizations do not adequately involve communities in the conservation process – a primary reason why community support for most of the projects being undertaken in the area is lacking. In its conclusion, the study shows that part of the challenge arises from the short timeframe within which some of these projects are to be undertaken leading to hurried project scoping and community engagement. On the flip side, the researcher adduces the poor public engagement to the low literacy levels. In such cases, highly technical projects limit the extent to which the communities can be engaged, especially in the planning phases.

Further, according to the poll findings, the general public does not receive the education and empowerment necessary to enhance their conservation capacity, which translate to reduced support for law enforcement as the community lacks ownership of projects. Additionally, the study established that the enforcement agencies did not adequately engage with the communities, a factor which the researcher concludes greatly hinders effective execution of their mandates by being denied public support and information sources. The study attributes this more to lack of capacity within the law enforcement agencies than dereliction of duty. For instance, it was observed that the police post in one

of the sampled Centers lacked sufficient serviceable vehicles to respond to distress. Similarly, KFS stations though having vehicles, lacked adequate budgets for fuel to enable them conduct regular patrols as was pointed out by a KFS Forester who requested anonymity due to the sensitivity of the information.

A critical aspect that was missed by several stakeholders was the importance that the indigenous communities attached to the forests arising from their cultural practices. For instance, formal health care systems were lacking in most of the study areas, and where these were available, they were either located too far, offered low quality healthcare or lacked adequate hospital facilities to respond to emergencies. Analyzing this data explained why a majority of respondents listed one of the uses of the forest as a source of medicine, as most had reverted to their traditional practices of using wild herbs as medicine to complement the poor healthcare services. Additionally, the area is majorly inhabited by communities from the Kalenjin ethnic groups who still practice traditional circumcision rituals, and the forest plays a central role as the shelter for the boys undergoing these rites.

Therefore, it follows that for the local populations to identify with conservation efforts and for these to succeed, all stakeholders must acknowledge and appropriately incorporate the longstanding historical connection and appropriate traditional practices in the planning and execution of resource governance. To this end, the researcher also posits that the corporate stakeholders, both government and non-government organizations must endeavor to empower the Eastern Mau forest communities in order to enable broader participation and ownership of the resilience building initiatives. The community should be allowed to assume responsibility and even spearhead protection of the forest as opposed to the current vertical top – down governance approach.

The fifth objective sort to establish adequacy of existing policy and legislative frameworks underpinning environmental security and resource governance. The study established that persistent environmental security challenges can be tackled with greater effectiveness by addressing policy and institutional framework, and incorporating novel approaches to resource governance. The study concludes that the focus for Eastern Mau

forest should, therefore, be on fundamentals of environmental policy making focused on resilience building by addressing environmental security issues affecting the community.

The study noted that the challenges articulated by stakeholders were markedly different from those of the past few decades – as regards the environmental security challenges and the policies and strategies required to tackle them. For instance, while secondary data highlighted human-wildlife conflicts as a major threat to villagers in the 90s and early 2000, as a result of extensive forest degradation, the study concludes that wildlife has been pushed further deep into what remains of the forest and wildlife encounters have been reduced.

As such, the study draws two key conclusion concerning efficacy of existing policy; first, because environmental policies have lacked dynamism over a long time, resultant strategies have failed to bring about major developments for resilience building in the Mau. Secondly, in a few areas such as forest governance and general environmental enforcement, there is continuous advancement in both regulatory repertoire and scope of stakeholders involved. Even though they still operate in the traditional command and control mode of environmental governance, the national government is increasingly allowing these stakeholders to supplement its efforts through new forms of cooperative governance.

The study found that the major discomfort from government actors was the potential they felt this kind of inclusion would have to the overall policy implementation regime. In spite overwhelming support by the general public for inclusion of other stakeholders in policy formulation and implementation, key informants from government agencies pointed to potential for weakening state authority by loss of control, undermining their agencies' legitimacy, and potentially reduce established institutions' capacity for problem solving.

That notwithstanding, the study concludes that existing policies and legislative frameworks underpinning environmental security and governance have had a measure of success which can be improved upon with greater integration of the two concepts. The process would require innovation and out-of-the-box thinking for greater success. For

example, the moratorium on logging issued by MoEF seems to have had great success in halting the destruction of the forest. However, as was pointed out by the sawmillers interviewed, this came at a great cost to livelihoods of a section of the community.

5.4 Recommendations

The following recommendations are based on the findings of the research:

On the first objective, to examine the general characteristics of Eastern Mau Complex it is recommended as follows:

- a. **Comprehensive Resource Mapping.** Given the significant variability and intricacies of the Eastern Mau Forest, it's recommended that a comprehensive and detailed resource mapping exercise be undertaken. This mapping should include the distribution of flora and fauna, the topographical features, water resources, and human settlements. An up-to-date map would provide a clearer understanding of the region's current state, helping in effective planning and resource management.
- b. **Establishment of a Continuous Monitoring System.** To understand the dynamic nature and changes over time in the Eastern Mau Complex, it's essential to establish a continuous monitoring system. This system should focus on parameters such as forest cover change, biodiversity indices, water source health, and human interaction patterns. By regularly updating this data, stakeholders can address emerging challenges promptly.
- c. **Strengthening Community Engagement:** The involvement of local communities is pivotal in understanding and conserving the Eastern Mau Complex. There's a need to strengthen community engagement in all conservation efforts, from data collection to policy formulation. Programs should be introduced to train local inhabitants in basic data collection techniques and environmental conservation principles, thus integrating their insights and traditional knowledge with scientific approaches.

On the second objective regarding the impact of environmental security approaches on resilience building, it is recommended that:

- a. **Integration of Traditional and Modern Security Approaches.** While modern environmental security measures are crucial, the traditional practices and knowledge of the Eastern Mau forest community should not be overlooked. It's recommended to blend these traditional methods with current security practices. Such integration can provide a holistic and more contextually relevant strategy for resilience building. Workshops and joint consultations with community leaders and external experts can pave the way for this integration.
- b. **Strengthening Environmental Education and Awareness.** Enhancing the community's knowledge and awareness about environmental security is paramount. Tailored educational programs should be introduced in schools and community centres, focusing on the importance of environmental security, resilience building, and sustainable practices. These programs can empower the community to adopt and support security approaches proactively.
- c. **Investment in Early Warning Systems and Infrastructure.** Given the potential risks associated with environmental changes, investing in early warning systems is vital. These systems can inform the community of impending environmental threats, allowing timely actions and reducing potential damages. Additionally, infrastructure such as secure housing, sustainable agriculture practices, and water conservation systems can significantly enhance the community's resilience against environmental challenges.

On the third objective, To examine the threat of household socio-economic factors on environmental security & governance in Eastern Mau forest, the following recommendations are proposed:

- a. **Socio-Economic Upliftment Programs.** Addressing the socio-economic challenges faced by households can reduce the pressures exerted on the forest resources. Initiatives like microfinance, skill development workshops, and alternative livelihood programs can help communities generate income without

over-exploiting forest resources. These programs can be more effective if tailored based on the unique needs and strengths of the Eastern Mau forest community.

- b. **Community Participation in Governance.** Ensuring that household representatives, particularly from diverse socio-economic backgrounds, are included in the decision-making processes related to environmental governance can create a more inclusive and effective system. By understanding and addressing the household challenges directly, governance can be more adaptive and responsive to the needs and pressures of the community.
- c. **Public Awareness Campaigns on Sustainable Practices.** Households might sometimes engage in practices detrimental to the forest ecosystem due to a lack of awareness. Conducting awareness campaigns about the importance of the forest, sustainable usage of its resources, and the long-term benefits of conservation can influence household behaviours. Emphasizing the direct and indirect socio-economic benefits of a healthy forest ecosystem can further drive the message.

These recommendations focus on intertwining socio-economic prosperity with environmental conservation, ensuring that the livelihoods of the community members are enhanced while still preserving the integrity of the Eastern Mau forest.

On the fourth objective looking at effectiveness of stakeholders' roles in shaping environmental security and governance processes, the recommendations are as follows:

- a. **Strengthening Multi-Stakeholder Platforms.** It's paramount to establish or further strengthen platforms where stakeholders from various sectors — including government agencies, NGOs, community representatives, and the private sector — can regularly convene. These platforms can promote dialogue, sharing of best practices, and collaborative planning. This collaborative approach will ensure a holistic strategy for environmental security that addresses diverse challenges and leverages multiple resources.
- b. **Capacity Building for Stakeholders.** To enhance the effectiveness of stakeholders in influencing environmental security, capacity building initiatives

should be prioritized. This can include training programs, workshops, and knowledge-sharing sessions tailored to the specific roles and responsibilities of each stakeholder group. By equipping stakeholders with the necessary skills, knowledge, and resources, their impact on shaping and implementing effective governance frameworks can be maximized.

- c. **Regular Review and Feedback Mechanisms.** The roles and contributions of stakeholders should be subjected to periodic reviews to assess their effectiveness. This involves setting up mechanisms for feedback from the community and other relevant entities. Such reviews can pinpoint areas of improvement, best practices to replicate, and challenges to address. By incorporating feedback and ensuring continuous improvement, the stakeholder-driven approach will remain agile and responsive to the evolving challenges and needs of the Eastern Mau forest community.

By focusing on these recommendations, stakeholders can play a more robust and effective role in shaping environmental security strategies and governance frameworks that are adaptive and resilient to the dynamic challenges faced by the Eastern Mau forest community.

On the fifth objective concerning adequacy of existing policies and legislative frameworks, the recommended include:

- a. **Policy Review and Gap Analysis.** Given the evolving nature of environmental challenges and community dynamics, there's a need for regular reviews of the existing policies and legislative frameworks. A comprehensive gap analysis can identify areas where current policies may be lacking, outdated, or ineffective. Engaging experts in environmental law, forest management, and community representation during this review will ensure that multiple perspectives are considered.
- b. **Public Participation in Policy Formulation.** To create robust and effective policies, active participation of the community and other stakeholders in policy

formulation is essential. Their ground-level insights and first-hand experiences can offer valuable inputs that can be incorporated into the policy framework. Policies formulated with significant public consultation are more likely to be accepted, understood, and effectively implemented by the community.

- c. **Strengthening Enforcement Mechanisms.** The best policies can fall short if not backed by rigorous enforcement mechanisms. Efforts should be made to bolster monitoring and compliance checks within the forest region. This can be achieved by allocating resources for training and equipping forest rangers, developing technology-based monitoring systems, and establishing clear punitive measures for violators. Additionally, community-based monitoring initiatives can be promoted, where locals play an active role in overseeing and reporting non-compliance.

By emphasizing these recommendations, the Eastern Mau forest community can be better positioned to benefit from adaptive and responsive policies and legislative frameworks that ensure the sustainable management and conservation of forest resources while enhancing environmental security.

5.5 Proposed Areas of Future Research

Based on the study limitations and research findings, the following are potential areas for future research:

Temporal Changes in Mau Complex Characteristics: Analyse how the characteristics of the Eastern Mau Complex have evolved over longer periods, comparing past and present data.

Longitudinal Assessment of Resilience Strategies: Understand the long-term impact and sustainability of current resilience strategies over extended periods.

Effects of External Economic Shifts: Understand how broader economic trends or events (e.g., economic downturns, pandemics) amplify or mitigate household socio-economic threats to environmental security.

Cross-Stakeholder Collaborations: Explore the dynamics, challenges, and opportunities when multiple stakeholders collaborate, especially unconventional pairings like NGOs with businesses or indigenous communities with governmental bodies.

Policy Impact Assessment: A dedicated study measuring the direct and indirect impacts of specific policies or legislative changes on environmental security and forest governance.

International Policy Benchmarking: Compare Eastern Mau's policies with international best practices or successful case studies to derive insights for potential policy improvements.

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APPENDICES

1.2 APPENDIX I: HOUSEHOLDS QUESTIONNAIRE

Thank you for agreeing to take part in this important survey. This survey is trying to find out what you think about resilience building in Eastern Mau Forest communities and looks at how the current governance system is impacting on the socio-ecological aspects around Eastern Mau forest and how environmental security can be integrated into the governance process to enhance the communities’ resilience.

The respondent is hereby assured that no personally identifiable information will be disclosed to a third party unless with the express permission of the respondent who is requested to voluntarily provide their contact information in the comment fields. Additionally, your responses will be combined with those of many others and summarized in a report to further protect your anonymity.

*Name of respondent (Optional)	
*Telephone Number (Optional)	
Constituency	
Ward	
Location	
Sub-location	
Village	
Date of interview	

SECTION A: BACKGROUND INFORMATION

1. Respondent’s sex? **Male** [] **Female** []

2. What is your age bracket? Tick as appropriate*
 - 18 - 25 Years []
 - 26 - 35 Years []
 - 36 - 45 Years []
 - 46 - 55 Years []
 - Over 55Years []

3. Marital status **Single** [] **Married** []

4. What is the total number of people in your household?

5. For how long has your family lived here?

6. Where is your ancestral home?

7. What were the reasons for moving to this area? Tick as necessary*

Ser No	Cause	<input checked="" type="checkbox"/> where applicable
1.	Parents Moved	
2.	To live with relatives	
3.	Schooling	
4.	Marriage	
5.	Family quarrel	
6.	Divorce	
7.	Work elsewhere	
8.	Job transfer	
9.	Look for work	
10.	New job	
11.	Business	
12.	Looking for land to farm	
13.	To recover from illness	
14.	Other (Specify)	

SECTION B: EDUCATION

8. What is the highest level of education you have acquired? Tick as appropriate*

No	Education level	<input checked="" type="checkbox"/> where applicable
1.	Informal education	
2.	Lower primary (Class 1 – 4)	
3.	Upper Primary (Class 5 – 8)	
4.	Secondary (Form IV)	

5.	Certificate	
6.	Diploma	
7.	Degree	
8.	Postgraduate	

9. What is the current level of education for members of your household? Tick appropriately for each* **A** – is informal education, **B** – Lower Primary, **C** – Upper Primary, **D** – Secondary, **E** – Certificate, **F** – Diploma, **G** – Degree, **H** – Postgraduate

No	Status of family member (Spouse, Daughter, Son, relative)	Level of education of household members							
		A	B	C	D	E	F	G	H
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.	Other , Specify								

10. If not attending school, why did you stop or never attended school?

Ser No	Cause	✓ where applicable
1.	No money for school fees	
2.	Poor quality of schools	
3.	Own illness/ disability	
4.	Family illness / disability	
5.	Not interested	

6.	Parents did not let me	
7.	Had to work to help at home	
8.	School too far from home	
9.	Local conflicts	
10.	Other , (Specify)	

11. W
ho
ma
nag
es
the
sch
ool
that
the

by attend?

- a. Government []
- b. Community []
- c. Private Church []
- d. Private Muslim []
- e. Other (specify)

12. Did/does any person outside your family contribute to your school fees?

Yes [] No []

13. If yes, please specify who or which institution

- a. Local leader []
- b. Bursary []
- c. NGO []
- d. Religious institution []
- e. Well-wishers []

SECTION C: HEALTH AND HOUSEHOLD MORTALITY

14. Have you been sick or injured in the past four weeks? Yes [] No []

15. What sort of injury/sickness did you suffer from?

.....
.....

16. What kind of health provider did you visit?

- a. Referral hospital []
- b. District/Provincial hospital []
- c. Public dispensary []
- d. Public health center []
- e. Private dispensary/hospital []
- f. Private clinic []
- g. Missionary dispensary/hospital []
- h. Traditional healer []
- i. Pharmacy/chemist []
- j. Kiosk []
- k. Herbalist []
- l. Other (Specify)

17. Did you or any other member of your household have to borrow money in order to pay for hospitalization? Yes [] No []

18. Do you suffer from any chronic illness? Yes [] No [] (If No go to Question 22*)

19. What chronic illness do you suffer from? Tick as appropriate*

- a. Chronic Malaria []
- b. Tuberculosis []
- c. STDs []
- d. HIV/AIDS []
- e. Arthritis/Rheumatism []
- f. Diabetes []
- g. Asthma []
- h. Nerve disorder []
- i. Cancer []
- j. Sores that do not heal []
- k. Pneumonia []
- l. High blood pressure []
- m. I don't know []
- n. Others (Specify)

.....

20. In the last 24 months has any household member died? (ask HH head or any other responsible member) Yes [] No [] (If no go to Question 27*)

21. Sex of person who died? **Male** [] **Female** []
22. Age of person who died?
- a. 18 - 25 Years []
 - b. 26 - 35 Years []
 - c. 36 - 45 Years []
 - d. 46 - 55 Years []
 - e. over 55Years []
23. Cause of death?
- a. Chronic Malaria []
 - b. Tuberculosis []
 - c. Tetanus []
 - d. HIV/AIDS []
 - e. Malnutrition []
 - f. Poisoning []
 - g. Asthma []
 - h. Child birth/pregnancy []
 - i. Cancer []
 - j. Measles []
 - k. Pneumonia []
 - l. Accident []
 - m. Conflict related []
 - n. Others (Specify)
24. Where did the deceased die?
- a. Home []
 - b. Health facility []
 - c. Others (Specify)

SECTION D: HOUSEHOLD LIVELIHOOD

25. What is your status in employment?

- Self-employed/ Business owner []
- Permanent employee []
- Casual labourer []
- Unemployed []
- Pensioner []

26. What is your average monthly income?

- Kshs Below 10,000 []
- 10,001 to 20,000 []
- 20,001 to 30,000 []
- 30,001 to 40,000 []
- 40,001 to 50,000 []
- Above 50,000 []

27. What is the status of ownership of the house you live in?

- Own home []
- Rental []
- Other [], explain?

28. What is the type of housing?

Grass thatched [] Semi-Permanent [] Permanent []

29. What is the size of your land? Less than 1 Acre [] Between 1 and 5 Acres []
Between 6 and 10 Acres [] Between 11 and 15 Acres [] Above 15 Acres []

30. In your opinion, how would you rank the following forest resources in terms of importance in meeting your needs? Score between 1 and 5; 5 being most important and 1 being least important.

Ser	Variables/ Concerns	Score				
		1	2	3	4	5
1.	Provision of water					
2.	Source of food (wild vegetables, fruits, honey, game meat etc)					
3.	Land for grazing					
4.	Land for agriculture					

5.	Source of wood fuel					
6.	Charcoal burning					
7.	Source of timber					
8.	Tourism site					
9.	Source of medicine					
10.	Cultural site					
11.	Center for research and education					

Other, specify

Section E: Stakeholders Involvement

Please tick where appropriate as per your level of agreement.

Statement	Strongly Agrees	Agrees	Neutral	Disagrees	Strongly Disagrees
Forest authorities engage you in development of the forest inventory					
The community knows its rights & obligations as outlined in the applicable laws, rules and regulations for forest management					
The community is well equipped with appropriate conservation tools					

Government carries out regular advocacy and awareness on issues affecting forest conservation					
There's sufficient expertise on Forest conservation within local institutions					
There is provision of and access to adequate funding for afforestation programmes					
You access extension services and technical support for forest management					
There are clear and effective lines of communication established between stakeholders					
The community engages in partnerships with other stakeholders towards forest conservation					

The community members are adequately participated in the process of boundaries' demarcation within the forest area					
--	--	--	--	--	--

SECTION F: GOVERNANCE AND RESILIENCE

31. Do you think that you are more resilient?

Yes []

No []

32. What are some of the ecosystem services that you obtain from the forest?

- a. Timber
- b. Fuel wood/charcoal
- c. Food (Wild fruits, vegetables and game meat)
- d. Medicine
- e. Tourism
- f. Others, specify

33. In your opinion, how would you describe the current state of Eastern Mau forest compared to it 20 years ago?

- a. Heavily degraded []
- b. Not much has changed []
- c. In better condition []

34. How would you grade the infrastructure in your area? Scores listed as 5 - Available & in excellent working order, 4 – Good, 3- Average, 2 – Poor , 1 – Non-existent (Not there completely)

	Infrastructure	Score				
		1	2	3	4	5
1.	Road networks					
2.	Bridges					
3.	Piped water					
4.	Boreholes					
5.	Electricity supply (Grid)					

35. Do you think that the current Government policies and laws are effective in ensuring protection of the Mau forest? **Yes** [] **No** [] **Not sure** []

36. Do you feel included in the decision making process? **Yes** [] **No** []

37. In your opinion, how would you rank the following concerns with regards to their impact on effective policy implementation in Eastern Mau forest? **1**- Has least impact & **5** – Having the greatest impact.

Ser	Variables/ Concerns	Score				
		1	2	3	4	5
1.	Weak national institutions in terms of human capital and political leverage					
2.	Poorly articulated priorities					
3.	The absence of a clearly identifiable domestic constituency					
4.	Overlapping mandates of sectoral agencies					
5.	Public institutions at the local level that lack structures and capacity					
6.	Lack of opportunity for public participation in environmental reviews					
7.	Weak or poorly utilized information systems and lack of planning					
8.	Corruption					
9.	Inadequate and/or inappropriate environmental standards or procedures					
10.	Weak environmental enforcement					
11.	Insufficient access to information, particularly relating to trade and environment aspects					

38. What are some recent causes of conflicts you can remember and what was their severity?

- 5** Being violent clashes with fatalities and migration of people,
- 4** Severe with minimal fatalities and destruction of property,
- 3** Moderate with injuries and minimal destruction of property,
- 2** Minimal with few non-lethal injuries, and
- 1** Being least severe with no injuries and/or loss of property.

	Cause of Conflict	Date of Conflict	Severity Score				
			1	2	3	4	5
1.	Politics						
2.	Ethnicity						
3.	Religion						
4.	Scarcity of water						
5.	Scarcity of pastureland						
6.	Horizontal inequalities (<i>inequalities in economic & political resources between culturally defined groups</i>)						
7.	Failure of social contract (<i>Non-delivery of service by local/national government</i>)						
8.	Insecurity (<i>Burglary, theft, muggings etc</i>)						
Other, please specify							
9.							
10.							

39. What are the avenues of conflict resolution in your area?

Neighbours []

Community elders []

Local administrative authorities []

Law courts []

Other, specify.....

40. Which conflict resolution methods have been adopted?

a. Negotiation []

b. Mediation []

c. Arbitration []

d. Litigation []

41. Please indicate your opinion on the following:

Statement	Strongly Agrees	Agrees	Neutral	Disagree	Strongly Disagrees
Beautiful scenery may be found around Mau forest, which is intended to encourage the development of social amenities.					
Around Mau forest, there is a high level of cooperation among people engaged in forest conservation efforts.					
When you cook in your homes, you make use of more modern stoves.					
You discuss the findings of an examination of forest conservation techniques.					
Forest conservation programme has led to a marked improvement in livelihoods of the people					
You have the necessary skills and abilities to engage in forest protection initiatives.					
Forest conservation operations contribute to the development of household income for the local people. Around Mau forest, forest conservation initiatives contribute to the development of household income by providing jobs and opportunities.					

Money invested in local community infrastructure development projects has resulted as a result of forest conservation operations.					
As a consequence of the establishment of Community Forest Associations, there has been an increase in security, cooperation, and cohesiveness.					
There's greater access to forest products by Individuals due to enhanced conservation measures.					

Section G: Set up of the Institutional Framework witharound Mau forest Conservation Context

In this section, you are requested to give your opinion based on your degree of congruity with the provided statements based on the provided Likert Scale graded from 1 – 5 with 1 showing strong congruence and 5 vigorous difference.

Statement	Strong Agreement	Agreement	Neutral	Disagreement	Strong Disagreement
External partnership enables effective Mau Forest conservation efforts					
Governance agencies have sufficient numbers of technical staff to effectively					

implement requisite conservation tasks					
Budgetary and staff allocation for forest conservation is adequate					
There is a properly established market for forest products					
Sharing of forest resources considers equitable distribution					
Forest products undergo value addition before marketing					
Effective mechanism are in place for transparent engagement and conflict resolution					
Property rights are clearly defined and properly assigned to resource users					

There is a clear understanding of rules and laws including on permissible activities by stakeholders					
Regular advocacy is conducted to create awareness on effective conservation measures					

Section H: Conservation of Mau Forest Programme

Kindly share your opinion to indicate your level of acceptance or rejection of the statements listed in the Likert Scale below. The measure is on a scale of 1 – 5, and as labeled, 1 indicates in Strong agreement and 5 showing Strong Disagreement with the proposal.

Statement	Strong Agreement	Agreement	Neutral	Disagreement	Strong Disagreement
Frequently included to participate in trees planting around Mau forest					
Included in fencing of forest areas					
Have access to lumber from the forest					
Have access to NTP from the forest (Honey,					

Medicine etc)					
Forest provides manure for use on farms					
There is high risk of human-wildlife conflict					
Forest provides the majority of the areas water sources					
The community actively participates in protecting the water catchment areas					
Forest provides your primary source of energy i.e. fuel wood					
Eastern Mau Forest experiences frequent forest fires					

Thank you for your time

**1.3 APPENDIX II: KEY INFORMANT SURVEY ON RESILIENCE BUILDING
IN EASTERN Mau FOREST**

Thank you for agreeing to take part in this important survey. This survey is trying to find out what you think about resilience building in Eastern Mau Forest communities and looks at how the current governance system is impacting on the socio-ecological aspects witharound Mau forest and how environmental security can be integrated into the governance process to enhance the communities’ resilience. Thirty (30) key informants from different professional backgrounds and capacities are being asked to fill out this questionnaire.

A. Inclusivity and Participation

1. How would you rate the government’s performance in the following areas of environmental governance in Eastern Mau forest?

No.						
		5 Excellent	4 V. Good	3 Good	2 Average	1 Poor
a.	How inclusive is the current governance policy design?					
b.	How would you rank the level of accessibility to services?					
c.	To what degree is decision making shared with stakeholders?					
d.	In your opinion, how comprehensive is the current governance system in collaborating with a broad and diverse representation of stakeholders?					

e.	How would you rate collaboration among NGOs working in the governance and resilience?					
f.	How would you rate the relationship between the Civil Societies', Private Sector and other stakeholders and the local government?					

B. Institutional and Legal Settings

1. In your opinion, which among the following do you consider as barrier(s) to good environmental governance in Eastern Mau Forest? Scores between 1 and 5; 5 being most severe, 4 is severe cause, 3 is moderate, 2 not too serious but important and 1 not a cause in Eastern Mau Forest.

Ser	Variables/ Concerns	Score				
		1	2	3	4	5
a.	Weak national institutions in terms of human capital and political leverage					
b.	Poorly articulated priorities					
c.	The absence of a clearly identifiable domestic constituency					
d.	Overlapping mandates of sectoral agencies					
e.	Public institutions at the local level that lack structures and capacity					
f.	Lack of opportunity for public participation in environmental reviews					

g.	Weak or poorly utilized information systems and lack of planning					
h.	Lack of systematic and qualified monitoring					
i.	Inadequate and/or inappropriate environmental standards or procedures					
j.	Weak environmental enforcement					
k.	Insufficient access to information, particularly relating to trade and environment aspects					
l.	Other, specify					

C. Service delivery index

1. On a scale of 1-5, (1 for not accessible and 5 for very accessible) how accessible are County Offices? 1 [] 2 [] 3 [] 4 [] 5 [] Don't know []

2. How often does the County hold stakeholders' meetings with regards to resource governance of the Eastern Mau forest?

Once per week

Once per Month

Quarterly

Bi-annually

Once per year

Other, specify

3. Have you ever attended any of the stakeholder's meetings? **Yes** [] **No** []

4. If yes, how effective were they in addressing communities' livelihood needs? (1 being ineffective and 5 being Highly effective) **1** [] **2** [] **3** [] **4** [] **5** []

5. As part of the governance systems and structures aimed at efficient service delivery, how would you rate the following?

No.						
		5 Excellent	4 V. Good	3 Good	2 Average	1 Poor
1.	How inclusive is the current governance policy design?					
2.	How would you rank the level of accessibility to environmental services?					
3.	To what degree is decision making on resource exploitation and utilization shared with stakeholders?					
4.	In your opinion, how comprehensive is the current governance system in collaborating with a broad and diverse representation of stakeholders?					

D. Conflict resolution and management

1. When did the most recent conflicts occur in Eastern Mau forest and what was the intensity of these conflicts?

- 5 - Violent clashes with fatalities and migration of people,
- 4 - Severe with minimal fatalities and destruction of property,
- 3 - Moderate with injuries and minimal destruction of property,
- 2 - Minimal with few non-lethal injuries, and
- 1 - Being least severe with no injuries and/or loss of property.

Ser	Conflict: (eg Intra-personal, Inter-personal, Intra-group, Inter-group) between X & Y	Date: MM Yr	Score				
			1	2	3	4	5
1.							
2.							
3.							
4.							
5.							

2. In your opinion, which among the following do you consider as underlying causes of conflict within the Eastern Mau forest and what is your rating for the extent to which they affect the severity of the outcome?

- 5 – Results in violent clashes with fatalities and migration of people,
- 4 – Results in severe with minimal fatalities and destruction of property,
- 3 – Results in moderate with injuries and minimal destruction of property,
- 2 - Results in minimal with few non-lethal injuries, and
- 1 - Results in no injuries and/or loss of property.

Ser	Cause of Conflict	Severity Score				
		1	2	3	4	5
1.	Political differences					
2.	Failure of social contract (<i>Non-delivery of service by local/national government</i>)					
3.	Weak political institutions / Poor governance & Corruption					
4.	Group identity conflicts (e.g. <i>Ethnic marginalization, tensions and cultural differences, Religion etc</i>)					
5.	Environmental scarcities (e.g. <i>competition for water, pasture land etc</i>)					
6.	Migration					
7.	Human rights violations					
8.	Unequal resource access					
9.	Scarcity of pastureland					
10.	Horizontal inequalities (<i>inequalities in economic & political resources between culturally defined groups</i>)					
11.	Insecurity (<i>Burglary, theft, muggings etc</i>)					
Other, please specify						
12.						
13.						

3. What are the avenues of conflict resolution within the community?

- Neighbors []
- Community elders []
- Local administrative authorities []
- Law enforcement agencies []
- Law courts []
- Other, specify.....

4. How effective are the methods you have indicated in resolving conflicts?

- a. Very effective []
- b. They could be improved []
- c. They are unfair []

5. How, in your opinion, would the inclusion of National government’s security institutions (Kenya Defence Forces, Kenya Police, National Intelligence Agency etc) in the governance of Eastern Mau forest potentially affect the environmental security outcome?

- a. Positively []
- b. Would not make much difference []
- c. Will impact negatively []
- d. Other, Specify _____

E. Ecosystem services and functions

1. In your opinion what are most serious challenges facing natural resource management and conservation in Eastern Mau forest?

No.	Key Challenges	Tick where applicable
1.	Forest ecosystem degradation resulting in decreased output of goods	

	and services	
2.	Overexploitation of forest resources e.g. overgrazing, wanton logging etc	
3.	Loss of endangered /threatened species	
4.	Encroachment onto forest land by settlements or agriculture	
5.	Rise in poverty levels amongst the communities	
6.	Lack of incentives for the communities' conservation efforts	
7.	Impacts of Climate Change Mitigation	
8.	Increasing need for energy source from fuel wood, charcoal etc.	
9.	Uncoordinated sectoral implementation approaches	
10.	Conflicts of interests in forest management	
11.	Weak administrative structures and institutional framework for conservation	

2. In your opinion, which among the following do you think are strengths and opportunities associated with devolution in the management of Eastern Mau forest?

No.	Strengths and opportunities of a devolved forest system	Tick where applicable
1.	Increased involvement of public and private stakeholders including communities through Community Forest Association (CFAs)	
2.	Local level management of forest resources	
3.	Greater public and communities' participation	
4.	Increased potential for benefit-sharing	

5.	Greater equity and equality among communities & persons including greater representation of women and youth in forest management	
6.	Enhanced public awareness potential by government and civil society	
7.	Enhanced bottom up decision making	
8.	Enhanced accountability	
9.	Harmonization of processes for participatory forest management	
10.	Increased collaboration opportunities in cross-border forest management	
11.	Improved dispute resolution	

6. How would you rate the following challenges with regards to private sector engagement in Eastern Mau Forest? **5** Seriously debilitating & prevents involvement, **4** Considerably serious making involvement difficult, **3** Unnecessarily difficult, but doable, **2** Not much of a challenge, easily resolved, **1** Not a factor at all.

Ser	Challenges for private sector engagement	Severity Score				
		1	2	3	4	5
1.	Bureaucracy					
2.	Infrastructure					
3.	Shortage of raw materials (e.g. water, wood, etc)					
4.	Licensing duration for forest industries					
5.	Forestry information for investors					
6.	Inadequate financial mechanisms to support forestry investment					

7.	Insufficient technical skills					
8.	Industry representation in decision making					
9.	Corruption					
Other, please specify						
12.						
13.						


7. The respondent is hereby assured that no personally identifiable information will be disclosed to a third party unless with the express permission of the respondent who is requested to voluntarily provide their contact information in the comment fields. Additionally, your responses will be combined with those of many others and summarized in a report to further protect your anonymity.

*Name of respondent (Optional)	
*Telephone Number (Optional)	
Name of Organization	
Organization Category National Government County Government NGO CBO Other, specify	
Constituency	
Ward	


Date of interview	
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Thank you very much for your time

1.4 APPENDIX III: RESEARCH PERMIT


REPUBLIC OF KENYA
National Commission for Science, Technology and Innovation
Ref No: **566798**

RESEARCH LICENSE




This is to Certify that Mr. DAVID OCHIENG WANDO of Kenyatta University, has been licensed to conduct research in Nakuru on the topic: ENVIRONMENTAL SECURITY AND GOVERNANCE IN RESILIENCE BUILDING IN EASTERN MAU FOREST COMMUNITIES, NAKURU COUNTY, KENYA for the period ending : 09/August/2022.

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W. Wambui
Director General
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