



NATIONAL DEFENCE UNIVERSITY-KENYA (NDU-K)

**PARTICIPATORY FOREST MANAGEMENT PRACTICES AND CLIMATE CHANGE
MITIGATION IN KENYA: A CASE OF KARURA FOREST ECOSYSTEM, NAIROBI
COUNTY**

JOHN KIPKEMOI RONO

ND601/0075/2023

**RESEARCH THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE
REQUIREMENT FOR THE AWARD OF MASTER OF ARTS IN NATIONAL
SECURITY AND STRATEGY OF NATIONAL DEFENCE UNIVERSITY-KENYA**

AUGUST 2024

DECLARATION

I hereby declare that this research thesis is my original work and has not been submitted for a Degree in any other University.

Signed  Date 06/09/2024

John Kipkemai Rono

Reg No: ND601/0075/2023

SUPERVISORS:

This research thesis has been submitted for examination with our approval as the University Supervisors.

Signed  Date 20/9/2024

Maj. (Dr) Cliff Obwogi

National Defence University-Kenya

Signed  Date 22/09/2024

Rotich Chepkirui Gladys, PhD

Jomo Kenyatta University of Agriculture and Technology-Kenya

DEDICATION

I dedicate this work to my family; Alice Rono, Tony MK Cheruiyot and Ivy Chebwogen Rono for their immense support, patience, and understanding during the entire coursework. May God bless them abundantly.

ACKNOWLEDGEMENT

I wish to express my heartfelt gratitude to my supervisors Maj (Dr) Cliff Obwogi, and Rotich Chepkirui Gladys, PhD for their invaluable guidance throughout my academic journey, which has led to the completion of this research. I extend my thanks to my immediate family, Friends of Karura CFA, KFS staff, fellow scholars, Kenya Forest service for the financial support and colleagues within the broader KDF community for their support and encouragement during my research endeavors.

I am profoundly thankful to the Kenya Defence Forces and the National Defence University-Kenya (NDU-K) for allowing me to gain new knowledge and insights. I am grateful to the Commandant of the National Defence College (NDC-K), the dedicated faculty, and the diligent library staff, as well as the entire NDC-K community for their unwavering support and for fostering a conducive learning environment.

To all those who have contributed in any way, I extend my wholehearted appreciation. Your assistance has been invaluable, and I am truly grateful. May you all be blessed.

TABLE OF CONTENTS

DEDICATION	iv
ACKNOWLEDGEMENT.....	v
LIST OF TABLES.....	ix
LIST OF FIGURES	x
OPERATIONAL DEFINATION OF TERMS	xi
LIST OF ABBREVIATIONS AND ACRONYMS.....	xii
ABSTRACT	xiii
CHAPTER ONE.....	1
1.0 Introduction	1
1.1 Background of the Study	1
1.2 Statement of the Problem	3
1.3 Research Objectives	4
1.3.1 General Objective.....	4
1.3.2 Specific Objectives	5
1.4 Research Questions	5
1.5 Justification of the Study	5
1.5.1 Policy Justification	5
1.5.2 Academic Justification.....	6
1.6 Significance of the Study.....	6
1.7 Assumptions of the Study.....	7
1.8 Scope and Limitations of the Study	7
1.8.1 Scope of the Study.....	7
1.8.2 Limitations of the Study	8
CHAPTER TWO.....	9
LITERATURE REVIEW.....	9
2.0 Introduction	9
2.1 Empirical Review of Literature.....	9
2.1.1 Participatory Forest Management Practices and Climate Change Mitigation	9
2.1.1.1 PFM Practices and Climate Change Mitigation in Africa Since 1990	11
2.1.1.2 Participatory Forest Management Practices and Climate Change Mitigation in Karura Forest Ecosystem Kenya	14
2.2 Participatory Forest Management Regulatory Framework and Climate Change Mitigation in Kenya	18

2.3 Impacts of Participatory Forest Management practices and Climate Change mitigation in Kenya.....	21
2.4 Theoretical Framework	24
2.4.1 Common Pool Resource theory.....	25
2.4.2 Environmental Governance and Policy Theory.....	27
2.5 Conceptual Framework	29
2.6 Chapter Summary	30
2.7 Literature Gaps	31
CHAPTER THREE	32
RESEARCH METHODOLOGY	32
3.0 Introduction	32
3.1 Research Design	32
3.2 Area of Study.....	32
3.3 Target Population.....	33
3.4 Sampling Procedure	34
3.5 Sample Size Determination.....	34
3.6 Data Collection Instrument.....	35
3.7 Instrument Validity	36
3.8 Instrument Reliability.....	36
3.9 Data Analysis and Presentation.....	37
3.10 Ethical Considerations	38
CHAPTER FOUR	40
STUDY FINDINGS AND DISCUSSIONS	40
4.0 Introduction	40
4.1 Response Rate.....	40
4.2 Demographic Characteristics	41
4.3 Participatory Forest Management Practices and Climate Change Mitigation in Karura Forest Ecosystem	46
4.4 Analysis of Participatory Forest Management Regulatory Framework and Climate change Mitigation	51
4.5 Evaluation of Impacts of Participatory Forest Management Practices and Climate change Mitigation	71
4.6 Analysis of Inferential Statistics	83
4.7 Multiple Regression Analysis	84
4.8 Analysis of Variance	85

4.9 Regression Coefficients	85
CHAPTER FIVE	90
SUMMARY, CONCLUSION AND RECOMMENDATIONS	90
5.0 Introduction	90
5.1 Summary of the Findings	90
5.1.1 Participatory Forest Management Practices and Climate Change Mitigation in Karura Forest Ecosystem	90
5.1.2 Participatory Forest Management Regulatory Framework and Climate Change Mitigation in Karura Forest Ecosystem.....	90
5.1.3 Impacts of Participatory Forest Management implementation and Climate change mitigation in Karura Forest Ecosystem.....	91
5.2 Conclusion.....	91
5.2.1 Contribution to Knowledge.....	92
5.2.2 Implications to Theory.....	92
5.2.3 Implications to Practice	93
5.2.4 Policy Implications	93
5.3 Recommendations	93
5.4 Suggestions for Further Studies	94
REFERENCES	95
Appendix I: Questionnaire	102
Appendix II: Interview Guide.....	107
Appendix III: NDU-K Research Authorization.....	109
Appendix IV: NACOSTI Permit	110
Appendix V: KFS Authorizations.....	112
Appendix VI: Map of the Study Area	114
Appendix VII: Krejcie and Morgan (1970) Table Scale	115

LIST OF TABLES

Table 3.1: Sample Size Distribution.....	35
Table 4.1: Response Rate.....	40
Table 4.2: Model Summary	74
Table 4.3: ANOVA	75
Table 4.4: Coefficients.....	76

LIST OF FIGURES

Figure 2.1: Conceptual Framework.....	30
Figure 4.1: Age Distribution of Respondents.....	42
Figure 4.2: Gender Distribution of Respondents.....	44
Figure 4.3: Years of Involvement in Conservation	45
Figure 4.4: Extent of Agreement with Participatory Forest Management Motivation.....	47
Figure 4.5: Efficacy of PFM through Community Involvement	48
Figure 4.6: Awareness Levels of Participatory Forest Management.....	49
Figure 4.7: Levels Communication Channels	50
Figure 4.8: Alignment of Participatory Forest Management with Climate Change and other Frameworks.....	52
Figure 4.9: Efficacy of Stakeholder Roles in Participatory Forest Management.....	57
Figure 4.10: Government and Partners Cooperation on Success of Participatory Forest Management.....	58
Figure 4.11: Training and Capacity Building Accessibility.....	60
Figure 4.12: Lack of Awareness Impact on Participatory Forest Management.....	61
Figure 4.13: Barriers to Successful Participatory Forest Management	63
Figure 4.14: Role of Legislation, Training and Conflict Resolution in PFM Success	64
Figure 4.15: Government Bureaucratic Processes Impact on Timely Implementation of Participatory Forest Management	66
Figure 4.16: Conflict of Interest Impediment in Participatory Forest Management Success	67
Figure 4.17: Socio-cultural Impacts on Participatory Forest Management Collaboration	69
Figure 4.18: Environmental Impacts of Participatory Forest Management.....	72
Figure 4.19: Equity in Participatory Forest Management.....	74
Figure 4.20: Sense of Ownership and Responsibility in Participatory Forest Management	76
Figure 4.21: Impacts of AIGAS on Reducing Forest Resources Dependency	78
Figure 4.22: Overall Positive Impact of Participatory Forest Management Practices	79
Figure 4.23: Significance of Enforcement of Regulations and Guidelines in Participatory Forest Management.....	81
Figure 4.24: Heteroscedasticity Plot.....	81

OPERATIONAL DEFINATION OF TERMS

Biodiversity Conservation:	Refers the protection, management, and restoration of diverse ecosystems and species within a given area (Macdonald, 2023).
Climate Change Mitigation:	Refers to efforts aimed at reducing or preventing the emission of greenhouse gases and minimizing the effects of climate change and in the context of the Karura Forest Ecosystem in Kenya, climate change mitigation strategies implemented through participatory forest management include activities such as reforestation, afforestation, and sustainable forest management practices (Jonathan & Leonie, 2022).
Community Resilience:	Refers to the capacity of local communities to withstand and recover from environmental, social, and economic shocks and stresses (Plough, 2021).
Livelihood:	Refer to the various means and activities through which individuals and households in the vicinity of forests obtain the necessities of life (Tikina & Innes, 2016).
Participatory Forest Management:	Refers to a collaborative approach involving local communities, stakeholders, and authorities in the sustainable management and conservation of forest resources (Abebe, 2022).
Sustainable Forest Management:	Refers to the responsible stewardship of forest resources to meet present and future societal needs while maintaining ecosystem health and integrity (Tikina & Innes, 2016).

LIST OF ABBREVIATIONS AND ACRONYMS

AIGAs	Alternative Income-Generating Activities
CFA	Community Forest Association
CPR	Common Pool Resource
FKFCFA	Friends of Karura Forest Community Forest Association
GoK	Government of Kenya
IPCC	Intergovernmental Panel on Climate Change
KFS	Kenya Forest Service
KI	Key Informant
KPFMP	Karura Participatory Forest Management Plan
NACOSTI	National Commission for Science, Technology and Innovation
NGO	Non-Governmental Organization
NTFP	Non-Timber Forest Products
PAD	People Abled Differently
PFM	Participatory Forest Management
SPSS	Statistical Package for Social Science
UNFCCC	United Nations Framework Convention on Climate Change

ABSTRACT

Participatory Forest Management (PFM) is an approach of involving community and other stakeholders in sustainable forest resource management. It involves collaboration in all aspects including making decision to improve conservation and the socio-economic conditions of the forest adjacent communities. This study examined PFM practices and climate change mitigation: A case of Karura forest ecosystem, Nairobi county-Kenya. The study focused on biodata of respondents, PFM practices and climate change mitigation, PFM regulatory framework and climate change mitigation, and an evaluation of impact of PFM implementation and climate change mitigation in Karura Forest ecosystem. The research involved diverse stakeholders, including the Friends of Karura Forest Community Forest Association (FKFCFA) and achieved an 83.5% response rate. The respondents' demographic distribution reflected a collaborative approach, with diverse age categories (18-25 to over 56 years) and a balanced gender representation (44% male, 56% female). The varied years of involvement in conservation efforts emphasize the richness of experience within the community, showcasing a collaborative network crucial for addressing climate change challenges in Karura Forest. The study's findings regarding the aspects PFM indicate a strong correlation (96%) between PFM practices and climate change mitigation efforts, emphasizing its role in rehabilitating degraded ecosystems. The research reveals a positive outlook on community involvement and the alignment of PFM with global climate change mitigation goals. Analysis regulatory framework of PFM highlights the effectiveness of stakeholder role allocation (68%) and positive cooperation between the government and partner organizations (85%). However, challenges such as communication gaps and conflicting interests underscore the need for continuous improvement. Lack of awareness (33%) and significant barriers, including lack of funding (40%) and policy constraints (36%), necessitate targeted interventions to ensure the success of PFM practices. The evaluation of upshots of this approach demonstrates PFM's transformative role. The forest cover for Karura Forest Ecosystem has increased significantly, from 89.83% in 2010 to 91.042% in 2023, showcasing its effectiveness in conservation and climate change mitigation. PFM implementation has positively influenced biodiversity, climate change mitigation, and social equity, with a cumulative positive rating of 93%. The study identifies successful economic empowerment practices and a sense of ownership and responsibility among local communities, resulting in reduced illegal activities. Indeed, PFM practices in Karura Forest Ecosystem has proven effective in climate change mitigation, biodiversity conservation, and social equity. The collaborative efforts involving diverse stakeholders and the integration of traditional ecological knowledge contribute to its success. Strengthening communication, promoting gender equality, addressing awareness gaps, seeking alternative funding, and addressing challenges associated with income-generating activities will foster attainment of sustainability in PFM practices to mitigate Climate Change in Karura Forest Ecosystem. Further research is suggested to explore additional factors influencing PFM practices success and long-term impacts on climate change mitigation.

CHAPTER ONE

1.0 Introduction

The chapter presents the background to the study which discusses the Participatory Forest Management (PFM) practices and climate change mitigation in Kenya. A case of Karura Forest Ecosystem, Nairobi City County. It offers the Statement of the problem; the study objectives; research questions; justification of the study; significance of the study; research hypothesis; scope and limitations of the study. Here the background understanding of PFM practice and climate change mitigation is articulated.

1.1 Background of the Study

Participatory Forest Management involves empowering local communities to be active participants in forest conservation and management decisions. This collaborative approach has the potential to improve forest health and enhance carbon sequestration, thereby contributing to national climate change mitigation goals. PFM practices emerge as a promising approach, as explored in a study by Mwangi et al. (2020). According to Griscom et al. (2017) this collaboration can lead to improved forest health and enhanced carbon sequestration, thereby contributing to national climate change mitigation goals. Climate change mitigation strategies encompass actions that reduce greenhouse gas emissions and enhance natural carbon sinks. Forests play a crucial role in mitigating climate change by absorbing and storing atmospheric carbon dioxide.

In Latin America, specifically in Mexico's Mayan Peninsula, ejidos (communally owned lands) have successfully adopted participatory forest management (PFM) practices to manage their forests sustainably (Hernández-Aguilar et al., 2020). These efforts have led to notable increases in forest cover and carbon storage, highlighting the significant potential of PFM for climate change mitigation. This approach not only preserves biodiversity but also enhances community livelihoods by promoting sustainable use of forest resources, thereby contributing to both environmental and socio-economic benefits.

California's redwood forests in the United States of America (USA) have seen successful collaborative forest management efforts involving local communities, Non-governmental

Organizations (NGOs), and government agencies, significantly reducing wildfire risk and promoting sustainable logging practices (Cheng et al., 2018). These initiatives not only protect the forest ecosystem but also maintain and enhance its capacity to store carbon. By fostering cooperative management and sustainable practices, these efforts contribute to both ecological conservation and climate change mitigation, demonstrating the benefits of inclusive forest stewardship.

In Europe, Sweden's boreal forests have benefited from PFM initiatives involving local communities and forest owners. These initiatives have led to improved forest management practices that prioritize biodiversity conservation and carbon sequestration (Angelstam et al., 2019). This approach ensures the long-term health and sustainability of the forests, which is crucial for mitigating climate change. By integrating local knowledge and stakeholder collaboration, Sweden's PFM efforts enhance both ecological resilience and carbon storage capacity.

Nepal's Community Forestry Program in the case of Asia has seen local communities managing forests for decades (Ojha et al., 2020). This program has significantly improved livelihoods and demonstrably increased forest cover and carbon storage, thereby contributing to climate change mitigation efforts. By empowering local communities to take an active role in forest management, the program fosters sustainable practices that enhance both environmental and socio-economic outcomes, showcasing the effectiveness of community-based approaches in addressing climate challenges.

Indigenous communities in Papua New Guinea of Oceania, have long practiced sustainable forest management. Initiatives have been built upon this traditional knowledge by incorporating PFM principles to further enhance forest conservation and carbon sequestration (Carmenta et al., 2019). This collaborative approach not only empowers local communities but also promotes climate change mitigation. By merging traditional practices with modern PFM strategies, these initiatives support ecological sustainability and strengthen community resilience against environmental changes.

In Africa, Ethiopia's Tigray region has implemented PFM to manage degraded communal forests (Berhanu et al., 2021). This approach has led to increased forest cover, improved soil health, and enhanced carbon storage capacity, showcasing the potential of PFM for climate change mitigation.

By involving local communities in sustainable forest management practices, these efforts contribute to ecological restoration and resilience, demonstrating the significant benefits of PFM for both environmental sustainability and climate action in Africa.

Kenya, is a country characterized by varied ecosystems, and is very vulnerable to the hostile impacts of climate change (Kogo *et al.*, 2021). The country's forests, including the mangrove and the expansive montane forests play an important role in regulating ecosystem services and preserving biodiversity. Kenya recognizes the important role of forests in climate change mitigation and as a source of livelihoods for locals. The country has therefore embarked on PFM practices to involve local communities in forest conservation work (Thygesen *et al.*, 2016).

Kenya's Karura Forest, a crucial green space in Nairobi, exemplifies this potential. The forest faces degradation threats, but initiatives like the Karura Forest Management Plan (2016-2020) promote PFM, with stakeholders like the Karura Community Forest Association collaborating on conservation efforts (Kimutai & Watanabe, 2016). Studying PFM practices in Karura provided valuable insights into how community involvement can contribute to climate change mitigation by improving forest health and carbon storage capacity.

1.2 Statement of the Problem

The PFM practices and climate change mitigation in the Karura Forest Ecosystem, Nairobi City County, Kenya, has not been studied and documented. Various other research practices have investigated the effectiveness of PFM including reforestation, afforestation, biodiversity conservation, community engagement and the socio-economic benefits such as income generation and poverty alleviation. These research efforts have provided valuable insights into the role of PFM on both local livelihoods and forest conservation in Forest Ecosystems, contributing to broader discussions on conservation strategies in Kenya and beyond.

Irrespective of the efforts, forest ecosystems face major challenges and threats in deforestation, extinction of important tree species, degradation and destruction of ecosystems and important water towers in Kenya (Brandon, 2014). Additionally, climate change has caused erratic rain patterns which cannot be predicted resulting into droughts and drying up of water sources and trees. The drought has led to forest fires (Nitschke *et al.*, 2017).

Communities continue to suffer the negative impacts of climate change. In Kenya communities suffer from poverty, poor access to safe water for livestock and household use, and food insecurity (Muigua, 2014). These households do not have access to affordable source of fuel for cooking and therefore depend on firewood collected from the forests. Further, these communities engage in charcoal production as a livelihood option, which exacerbates deforestation and degradation of land. Evidence suggests that charcoal production has led to deforestation of large tracts of wooded savannah. Aerial studies have indicated that charcoal production, among other activities, has taken a serious toll on some of Kenya's few remaining closed canopy forest areas (Gathaara, 1999).

The critical challenge lies in ensuring the long-term health and carbon sequestration capacity of the Karura Forest ecosystem for effective climate change mitigation. While initiatives like the Karura Forest Management Plan promote PFM practices, further research is needed within the context of this specific ecosystem. The discussion revolved around evaluating the effectiveness of these practices in empowering local communities and stakeholders, and how this collaborative approach can best be leveraged to address threats like degradation and enhance carbon storage within the Karura Forest. By understanding the specific challenges and opportunities of PFM in Karura, strategies can be developed to optimize this approach for mitigating climate change through a healthy and resilient forest ecosystem.

1.3 Research Objectives

1.3.1 General Objective

The general objective of the study was to examine effect of Participatory Forest management practices on climate change mitigation in Kenya: A case of Karura forest ecosystem, Nairobi County.

1.3.2 Specific Objectives

The following are the specific objectives of this study;

- i. To assess Participatory Forest Management initiatives effectiveness towards climate change mitigation in Karura Forest ecosystem.
- ii. To analyze Participatory Forest Management practices regulatory framework for climate change mitigation in Karura Forest ecosystem.
- iii. To evaluate the impact of Participatory Forest Management practices towards climate change mitigation in Karura Forest ecosystem.

1.4 Research Questions

The following research questions guided the study:

- i. What is the effectiveness of Participatory Forest Management practices for climate change mitigation in Karura Forest ecosystem?
- ii. How does the regulatory framework influence Participatory Forest Management practices for climate change mitigation in the Karura Forest ecosystem?
- iii. What are the impacts of Participatory Forest Management practices on climate change mitigation in the Karura Forest ecosystem?

1.5 Justification of the Study

1.5.1 Policy Justification

The importance of this study is underscored by the pivotal role that forests assume in the global climate change discourse. Forests are vital carbon sinks, absorbing substantial quantities of atmospheric carbon dioxide through the process of photosynthesis and subsequently storing carbon within their biomass. By elucidating the impact of PFM on carbon sequestration and storage, this study will hold potential implications for not only local climate change mitigation efforts but also the broader international effort to limit global temperature rise.

Furthermore, PFM practices are closely linked to socio-economic development and poverty alleviation in many African contexts. This study's exploration of the socio-economic impacts of

such practices in Kenya has the potential to inform policies and interventions that simultaneously address climate change and promote sustainable livelihoods.

The evaluation the impact of PFM implementation on climate change mitigation efforts within the Karura Forest ecosystem involves assessing the tangible outcomes and benefits resulting from PFM practices, such as carbon sequestration, biodiversity conservation, watershed protection, and community livelihood improvements, and their contribution to broader climate change mitigation goals. The identification of these factors can provide critical insights into the design and implementation of future practices, contributing to the refinement of strategies that enhance community engagement, foster local ownership, promote effective forest governance and climate change mitigation.

1.5.2 Academic Justification

This topic aligns itself with international efforts in understanding climate change mitigation strategies, because climate change is a global challenge with devastating impacts on ecosystems, people and economies. Karura Forest Ecosystem serves as a case for the study topic. Kenya has been challenged with deforestation and land degradation. Insights from this study can be applied in other contexts in other forests in Kenya.

There is existing research on the nexus between climate change and forest management, but there is no extensive research on the impact of PFM practices and climate change mitigation in Karura Forest. Therefore, the research findings will fill the knowledge gap. It will contribute towards capacity building in Kenya and foster international partnership.

1.6 Significance of the Study

The significance of this study was spreading to multiple stakeholders, policy makers, communities and forest managers. The study findings provided evidence-based insights into PFM practices and climate change mitigation. The beneficiaries of this were the community, local authorities, government agencies, and policymakers. The findings guided in the designing and implementation of projects and policies that maximize climate change mitigation. The study is adding valuable information to the set of strategies that African countries have been using to meet their emission

reduction targets. It is important that countries understand the specific impacts of PFM as they strive to meet their Nationally Determined contributions and other commitments.

Further, the study findings will influence policy formulation in PFM practices and broader national climate change policies. Policy enhancement could result in a more holistic approach in tackling climate change and promoting community empowerment as well as socio-economic development. Further, the study findings empower local communities with knowledge to buy-in and foster ownership of the forest. This eventually led to sustainable practices in forest management.

The study will add to the scientific understanding of how PFM approaches impact biodiversity conservation, forest carbon sequestration, and the general ecosystem services. These findings and knowledge could be disseminated to varied audiences such as researchers, practitioners, and organizations to facilitate cross-learning and inspire best practices towards the adoption of successful PFM models in Kenya and Africa. The significance of this research study spread outside academic research.

1.7 Assumptions of the Study

An assumption is unexamined belief (Orodho and Kombo, 2003). The study had various assumptions. It is assumed that PFM practices will potentially impact climate change mitigation in Kenya through improved carbon sequestration and enhanced ecosystem services. The study assumes that for PFM practices to be effective, there must be meaningful community engagement towards better forest conservation. Additionally, the study assumes that policy frameworks at national and regional level on forestry, climate change are important in shaping the implementation of PFM practices. Finally, the study assumed that the respondents understood the research tools, synthesized, and responded appropriately.

1.8 Scope and Limitations of the Study

1.8.1 Scope of the Study

Geographically, the study focused on Karura Forest Ecosystem; a successful PFM model in Kenya. The study was conducted starting August 2023. The study specifically investigated the impact of PFM practices and climate change mitigation. This entailed quantifying changes in carbon stocks

and forest cover in Karura forest Ecosystem. The study further explored the socio-economic impacts of PFM; how it affects livelihoods and community well-being.

The research study analyzed PFM practices regulatory framework in Kenya. Factors such as policy support, community engagement and external influences in shaping PFM implementation and outcomes. This study involved a wide range of stakeholders including the local community, Kenya Forest Service, relevant government departments, agencies, ministries and other partners in conservation.

1.8.2 Limitations of the Study

The data collection phase of this study was expected to encounter difficulties. The participants in the study were anticipated to face time constraints, hindering their ability to provide thorough responses to the inquiries. This challenge was attributed to the fact that the study focused on engaging employees from the Kenya Forest Service, members of FKFCFA, and various partners. However, this issue was addressed by apprising the respondents of the substantial significance and importance of the data being gathered and by having a simplified friendly questionnaire. Additionally, the participants were briefed on the ethical expectations associated with their consent to partake in the study, thereby resolving the potential obstacle posed by their busy schedules.

Some respondents were hesitant to share information due to concerns about revealing sensitive organizational strategies related to forest utilization, protection, and management. To address this, the researcher obtained permission from the relevant forest management agency Kenya Forest service and ensured respondent confidentiality by offering the option to either disclose or withhold their names on the questionnaires.

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

In order to review the empirical evidence relating to PFM practices responsible for mitigation of climate change variabilities, the following thematic areas were interrogated; PFM initiatives and climate change mitigation, PFM regulatory framework and the impact of Participatory Forest management practices and climate change mitigation in Karura Forest ecosystem.

2.1 Empirical Review of Literature

2.1.1 Participatory Forest Management Practices and Climate Change Mitigation

One of the major threats facing Africa is climate change, which disrupts agriculture, water resources, and economies. Healthy forests are crucial for mitigating this threat by regulating the climate and absorbing carbon dioxide. PFM has emerged as a promising approach for forest conservation in Africa (Agrawal, 2001). By involving local communities in decision-making, PFM fosters practices that build resilience and adaptation to climate change (Tesfaye et al, 2015). This study examined the effectiveness of PFM in mitigating climate change through improved forest health and carbon storage in Kenya's Karura Forest ecosystem. The study analyzed existing research on PFM's effectiveness, evaluated the relevant regulatory framework, and assessed the positive outcomes of these practices. Additionally, the study explored the theoretical underpinnings that guide this research on PFM and climate change mitigation

Ethiopia's experience has a growing evidence of PFM, that it can significantly bolster efforts to combat climate change. PFM empowers local communities to be involved in tree planting (afforestation) and forest restoration. This not only increases forest cover but also enhances the forest's ability to absorb and store carbon dioxide, a key greenhouse gas. Studies in Ethiopia (Siraj et al., 2018) suggest that PFM leads to greater carbon sequestration compared to government-controlled forests (Ameha et al., 2016). This highlights the potential of PFM as a climate change mitigation strategy by promoting healthy forests that act as crucial carbon sinks, ultimately reducing atmospheric greenhouse gas concentrations.

A key challenge to mitigating climate change is maximizing the carbon sequestration potential of forests. The Kenya Forest Service (KFS) addresses this by involving local communities in forest management (Ge *et al.*, 2023). PFM promotes sustainable practices like selective logging and reforestation, which maintain healthy forests that effectively store carbon. These practices not only protect existing carbon stocks in trees and soil but also allow for expansion of forested areas, further enhancing overall carbon sequestration and mitigating climate change.

Climate change mitigation is a crucial aspect of PFM practices in the Karura Forest ecosystem. PFM fosters responsible land use that prioritizes carbon sequestration alongside the social and economic benefits forests provide according to Kimutai et al, 2016. Local communities invested in sustainable forest management become stewards of the land, actively involved in designing management plans. These plans can integrate practices like agroforestry, beekeeping, and sustainable herbal medicine harvesting, all of which diversify income sources and enhance food security. More importantly, these practices contribute significantly to increased carbon sequestration, a key strategy for mitigating climate change (Kimutai et al, 2016).

While PFM strengthens community resilience to climate change impacts through knowledge sharing and capacity building, its core focus in Karura Forest should be maximizing carbon storage through improved forest health. This can be achieved by actively engaging communities in reforestation, restoration efforts, and controlling soil erosion. Ultimately, a healthy and resilient Karura Forest, fostered by PFM, provides vital ecosystem services that benefit both the environment and the well-being of surrounding communities.

The fight against climate change hinges on our ability to enhance natural carbon sinks like forests. PFM emerges as a powerful tool in this fight, as evidenced by successful case studies around the world. India's Joint Forest Management program, for example, demonstrates how empowering local communities in forest protection and management leads to increased carbon sequestration alongside economic benefits. Similarly, Nepal's PFM program showcases the potential for PFM to achieve both ecological and economic advantages through sustainable forest management. Even in Cameroon, involving local communities in forest resource management has resulted in significant carbon sequestration gains, highlighting the critical role PFM can play in mitigating climate change (Ewane, 2024). These examples highlight the immense potential of PFM not only for climate change mitigation but also for building community resilience in the face of a changing environment.

2.1.1.1 PFM Practices and Climate Change Mitigation in Africa Since 1990

Since 1990, PFM has emerged as a promising approach for climate change mitigation in Africa by promoting community involvement in forest conservation. However, the effectiveness of PFM hinges on crucial factors like community involvement, awareness levels, and communication channels. Studies acknowledge the potential of PFM, but highlight the need for genuine community involvement (Agrawal, 2001; Sunderlin *et al.*, 2005). While many African nations have PFM policies, the depth of community participation often falls short (Larson & Ribot, 2014). However, some initiatives involve tokenistic participation, where communities are consulted but lack decision-making power or equitable benefit sharing as noted by Ribot *et al.* (2006).

Effective PFM requires communities to understand the threats posed by climate change and the role of healthy forests in mitigation (Persha *et al.*, 2018). Studies suggest varying levels of awareness across Africa. While some communities possess traditional ecological knowledge, others lack a comprehensive understanding of climate change (Hou-Jones, 2012). The effectiveness of PFM initiatives in different African contexts hinges on the level of climate change awareness within the target communities.

Open and effective communication channels are critical for building trust and collaboration in PFM (Agrawal, 2001). While many African nations have established PFM frameworks, the efficacy of communication channels employed within them is often unclear. There is need to assess how information flows between forest management authorities and communities. Further, evaluating the communication channels employed in specific African PFM contexts is crucial for their success in achieving climate change mitigation goals through effective forest management.

Climate change is a complex phenomenon that has evolved significantly to the present. The Intergovernmental Panel on Climate Change (IPCC) has been a key organization in assessing and synthesizing scientific knowledge on climate change. In 1990, there has been a clear and consistent upward trend in global temperatures. The IPCC reports indicate that each of the last three decades has been successively warmer than any preceding decade since 1850 (IPCC AR6 WG1). The Greenhouse gas emissions, primarily carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), have continued to rise. Human activities, such as the burning of fossil fuels and deforestation, are major contributors to these emissions (IPCC AR6 WG1).

The global mean sea levels have been rising since 1990, primarily due to the melting of glaciers and ice sheets, as well as the thermal expansion of seawater. This poses risks to coastal communities and ecosystems (IPCC AR6 WG1). Further there is a growing body of evidence linking climate change to an increase in the frequency and intensity of extreme weather events, including heatwaves, hurricanes, floods, and droughts (IPCC AR6 WG1).

Global warming, as highlighted in the IPCC's latest report (AR6 WG2), has thrown ecosystems into disarray. From changes in where species live to disrupted flowering and migration patterns, the impacts are widespread. To combat this, international efforts to address climate change have ramped up since the 1990s. The Kyoto Protocol (1997) and the Paris Agreement (2015) stand as key milestones in this fight, aiming to limit global warming and build resilience for our planet's climate (United Nations Framework Convention on Climate Change (UNFCCC); Paris Agreement).

The impacts of climate change pose significant challenges to societies worldwide. Adaptation strategies, including sustainable forest and land management and the development of climate-resilient strategies, are increasingly recognized as essential (IPCC AR6 WG2). This calls for continuous collaboration globally to reverse the devastating effects caused by this phenomenon.

Africa faces a critical climate threat in terms of change. Its far-reaching consequences disproportionately impact the continent, particularly its most vulnerable sector – agriculture, the backbone of food security. Studies by Serdeczny *et al.* (2017) show that climate change weakens agricultural systems, leading to precarious food supplies. This instability triggers a domino effect; increased rural-urban migration. In these crowded informal settlements, residents face heightened risks of flooding, infectious diseases, and rising food prices. Since most African economies rely heavily on agriculture, disruptions caused by climate change like erratic rainfall, droughts, and increased pests and diseases have a devastating impact on crop and livestock yields, jeopardizing food security across the continent. The urgency of the situation demands innovative and resilient agricultural practices to overcome these exacerbated climate challenges.

The threat of water scarcity in Africa is looming due to climate change. Erratic rainfall patterns and rising temperatures, as documented by DeNicola *et al.* (2015), are key drivers of this crisis. While some argue there's no direct link between climate change and water scarcity (Mukheibir,

2010), most agree it significantly worsens existing challenges. This lack of water poses a significant burden on communities. It limits water available for households, agriculture, and sanitation, potentially leading to health problems. To address these challenges, Africa needs integrated water management strategies that promote sustainable water access.

Rising temperatures and other climate changes are fueling the spread of vector-borne diseases like malaria and dengue fever across sub-Saharan Africa (Thomson & Stanberry, 2022). These diseases can be a burden in countries with inadequate healthcare facilities. Promoting and strengthening health facilities and the healthcare systems is a crucial undertaking. The rising of sea levels caused by climate change is a danger to the communities living in the coastal regions. According to Lindsey (2017), there have been increased incidences of rising sea levels with the rate increasing significant since 1993 to date (Lindsey, Rebecca, 2021). Rising sea levels cause erosion and flooding leading to displacement. Governments should invest in technologies such as early warning systems and climate resilient infrastructures.

Biodiversity such as wildlife and vegetation have been affected by climate change. Drought causes inadequate water availability for wildlife animals. It also causes drying and diminishing of vegetation, iconic wildlife species in Africa, e.g. elephants and rhino face the danger of losing their habitats and their migration patterns. Wildlife living in different habitats adapt differently. Climate conditions affect these lives therefore, determining cultures and traditions (Mashwani, 2020). Enhancing wildlife conservation efforts and restoration of habitats can save Africa's biodiversity.

Existing inequalities, particularly for marginalized groups like people with disabilities, women, and children, are worsened by climate change. These groups often lack full participation in decision-making, hindering their ability to adapt to climate impacts (Nnoko-Mewanu *et al.*, 2021). To build resilience, inclusive policies and programs that empower women, youth, and people with disabilities are crucial.

In Zimbabwe, there exists a concerted effort to foster harmonious cohabitation between communities and elephants, as emphasized by Ngorima *et al.* (2020). This initiative not only underscores the ecological significance of elephants but also recognizes their intrinsic value to local ecosystems and cultural heritage. Through education and community engagement, Zimbabwean authorities aim to cultivate a mindset of coexistence, wherein communities

understand the importance of preserving these majestic creatures and actively participate in the protection of ecosystem and these animals. By promoting a sense of stewardship, Zimbabwe endeavors to mitigate human-elephant conflicts and safeguard the well-being of both humans and wildlife.

The approach further advocated by Ngorima et al. (2020) reflects a broader paradigm shift in conservation efforts, one that acknowledges the interconnectedness of humans and the environment. Rather than viewing elephants solely as potential threats or nuisances, communities are encouraged to recognize them as integral components of the natural landscape, deserving of respect and protection. By fostering empathy and understanding, Zimbabwe aims to cultivate a sustainable coexistence model wherein human activities and wildlife conservation are not mutually exclusive but rather mutually reinforcing. In doing so, the nation aspires to not only preserve its rich biodiversity but also promote a more holistic and inclusive approach to conservation that prioritizes the well-being of all stakeholders involved.

2.1.1.2 Participatory Forest Management Practices and Climate Change Mitigation in Karura Forest Ecosystem Kenya

The concept of PFM has been used to manage forest resources for many years in the developing countries (Wily and Mbaya 2001; Agrawal *et al.*, 2008; Koech *et al.*, 2009; Mbuvi *et al.*, 2009); Wambusya *et al* 2012.) Through this concept, there are guidelines on how people with direct stake in a forest can take part in management and decision-making. PFM is now an important approach in biodiversity conservation and empowering the local communities. Climate change mitigation necessitates strategies that enhance natural carbon sinks like forests. PFM practices, where local communities are involved in decision-making, hold promise for improving forest health and carbon sequestration (Griscom *et al.*, 2017). However, the effectiveness of PFM hinges on factors like community involvement, awareness levels, and communication channels.

Karura Forest ecosystem; several studies highlight the importance of genuine community involvement in PFM success (Agrawal, 2001; Ojha *et al.*, 2020). Kimutai and Watanabe (2016) acknowledge the existence of the Karura Community Forest Association, indicating a potential step towards community involvement. However, a critical review is needed to assess the depth of this involvement. Do community members have decision-making power, or are they merely

consulted? Are the benefits of forest conservation equitably shared, or do they primarily accrue to external stakeholders? Evaluating the level and nature of community involvement in Karura's PFM is crucial for its effectiveness in climate change mitigation.

Community awareness regarding the threats posed by climate change and the role of healthy forests in mitigation is essential for PFM success (Persha *et al.*, 2018). Research on PFM in other contexts (Hernandez-Aguilar *et al.*, 2020) highlights the importance of educational programs to raise awareness. Limited information exists on the extent of such initiatives within the Karura Forest community. Understanding the current awareness level of the community regarding climate change and the role of Karura Forest in mitigation is vital. Are there targeted educational programs in place? Is there a gap between the information provided and the community's needs? Addressing these questions will help determine the effectiveness of PFM in Karura for climate change mitigation.

Effective communication channels are vital for fostering trust and collaboration between communities and forest management authorities (Agrawal, 2001). While the Karura Forest Management Plan (2016-2020) suggests stakeholder collaboration, the specific communication channels employed remain unclear. Research is needed to assess the efficacy of these channels. Are they accessible and inclusive for all community members? Do they facilitate a two-way flow of information, allowing community concerns and knowledge to be incorporated into decision-making? Evaluating the communication channels employed in Karura's PFM is crucial for its success in addressing climate change through effective forest management.

In Kenya, PFM is an approach that is widely used to empower local communities towards beneficial and sustainable forest management. According to a research study conducted in Mt. Elgon Forest, the surrounding communities improved the condition of the forest as they gained in their livelihoods in production of honey, traditional herbs, vegetables and other food products from the forest (Mbeche *et al.*, 2021). Through PFM, communities have been involved in anti-poaching efforts and reforestation practices. Further in Kenya, local communities, government agencies and other stakeholders are actively involved in decision making in forest management. The Kenya Climate change act, 2023 (Amended) provides for Community Forest Associations (CFAs) in forest management practices which have a role in climate change adaptation and mitigation

(Naeku, 2020). Collaborative efforts between communities and government agencies have contributed to better resource management and increased social cohesion.

Active community involvement in forest resource protection and surveillance has resulted into a decrease in illegal logging and poaching. PFM practices have enhanced local communities' participation in decision-making processes, leading to improved livelihoods and reduced conflicts over forest resources.

PFM has encouraged sustainable resource utilization practices, including non-timber forest product harvesting and ecotourism. PFM promotes community-based Ecotourism ventures through nature walks, birdwatching and other forest sustainable tourism ventures. This has opened doors for training as forest guides, and hospitality, towards sustainable forest tourism (Ogweno, 2021). Revenue from ecotourism is shared amongst the participating communities. These practices have generated income for local communities while reducing pressure on timber resources.

The Participatory Forest Management (PFM) practices and their role in climate change mitigation within the Karura Forest Ecosystem in Kenya above offers a strong foundation, but there are areas where the analysis could be further developed to provide a more nuanced and comprehensive understanding.

The discussion effectively situates PFM within the broader context of sustainable forest management and climate change mitigation. It underscores the importance of community involvement, awareness, and communication as key factors that influence the success of PFM practices in Karura Forest. The emphasis on genuine community involvement is particularly well-placed, as it highlights the need to assess whether local communities truly have decision-making power or are merely consulted without substantial influence. This focus on the depth of community involvement is crucial for understanding how effectively PFM can contribute to climate change mitigation.

However, the analysis could benefit from a deeper exploration of the power dynamics at play within the community. For instance, it would be valuable to examine the specific mechanisms that ensure community voices are heard and considered in management decisions. Additionally, it

could delve into the distribution of benefits from forest conservation, questioning whether these benefits are equitably shared among all community members or if certain groups, such as external stakeholders, reap more significant rewards.

The discussion on community awareness and education is another strong point, as informed communities are more likely to participate effectively in forest management. However, the analysis could be enhanced by providing more detail on existing educational initiatives within Karura Forest. It would be beneficial to assess the scope and impact of any ongoing programs and to examine whether there is a gap between the information provided to the community and their actual needs. Addressing this gap would be crucial for tailoring educational programs to be more effective.

Effective communication channels are essential for fostering trust and collaboration between communities and forest management authorities, and the discussion rightly acknowledges this. However, it could offer a more detailed evaluation of the specific channels used in Karura Forest. For example, are these channels accessible to all community members, including those in marginalized or remote areas? How do they facilitate a two-way flow of information, and are there mechanisms in place for community feedback to be incorporated into decision-making? The analysis could also explore potential barriers to effective communication, such as language differences or technological challenges, and how these might be overcome.

While there are references of successful PFM initiatives in other Kenyan forests, such as Mt. Elgon, it could benefit from a more direct comparison with Karura Forest. What lessons can be drawn from these other initiatives, and how can they be applied to improve PFM practices in Karura? Additionally, it would be useful to explore whether there are specific challenges unique to Karura Forest, given its urban location that might require different strategies compared to more rural forest areas.

The legislative framework including the Kenya Climate Change Act is discussed, but could offer a more detailed analysis of how these policies are being implemented in Karura Forest. Are there any gaps between policy and practice, and how might these be addressed to enhance the effectiveness of PFM in climate change mitigation? The role of local governance structures in

implementing PFM practices is also worth exploring. How do local government agencies collaborate with community forest associations, and what challenges or successes have emerged from these collaborations?

Finally, the mentions of sustainable resource utilization practices have been explored, such as non-timber forest product (NTFP) harvesting and ecotourism, but could provide more detail on the specific impacts of these practices in Karura Forest. For instance, how has ecotourism been developed in Karura, and what has been its economic and environmental impact? The analysis could also explore the potential for expanding these sustainable practices. Are there untapped opportunities for further diversifying income-generating activities within the forest? How might these activities be developed to benefit more community members while ensuring the long-term sustainability of the forest?

All the above offers a solid foundation for understanding the role of PFM in climate change mitigation within the Karura Forest Ecosystem. However, it could be strengthened by providing a deeper analysis of community involvement, education initiatives, and communication channels, as well as by offering specific recommendations for improving PFM practices. By addressing these areas, this critique would present a more comprehensive and actionable analysis of PFM's potential in Karura Forest.

2.2 Participatory Forest Management Regulatory Framework and Climate Change Mitigation in Kenya

PFM offers potential for climate change mitigation in Kenya by promoting responsible forest management involving communities in decision-making and resource use (Ojha *et al.*, 2020). However, literature reveals both the potential and challenges associated with PFM in the Kenyan context. Stakeholder roles and collaboration are crucial for PFM success (Mbeche *et al.*, 2021). While studies like Thygesen *et al.* (2016) highlight successful collaboration between communities and government agencies in specific cases, challenges persist. Mbeche *et al.* (2021) point out a lack of clarity regarding user rights and responsibilities, leading to conflicts. Training and capacity building for communities are essential to equip them with the knowledge and skills for sustainable forest management (Mwangi *et al.*, 2020). However, limited access to information remains a barrier, hindering effective participation (Ewane, 2024).

Legislative frameworks and policy clarity are critical for PFM (GoK, 2016a; GoK, 2016b). While Kenya has established legal frameworks for forest conservation and climate change mitigation, Naeku (2020) identifies issues with implementation. Bureaucratic processes can be lengthy and complex, hindering timely decision-making (Thygesen *et al.*, 2016). Additionally, conflicting interests between stakeholders, such as commercial logging and community needs, pose significant challenges (Ogweno, 2021). Socio-cultural factors also influence PFM effectiveness. Traditional knowledge and practices can contribute to sustainable management (Carmenta *et al.*, 2019). However, cultural norms and power dynamics within communities can sometimes exclude certain groups from participation (Agrawal, 2001)

PFM represents a paradigm shift in forest conservation by placing local communities at the center of decision-making and management processes. In Kenya, PFM has emerged as a strategy to address deforestation, biodiversity loss, and degradation while enhancing community livelihoods. In Kenya, amongst the key catalyst to PFM is Community involvement and ownership. PFM in Kenya has thrived due to the active engagement of local communities in forest management. By involving communities in planning, resource allocation, and monitoring, PFM practices have led to enhanced stewardship and a sense of ownership over forest resources.

Kenya has favourable Policy Support and Legal Framework. Kenya's forest policy reforms have incorporated PFM principles, emphasizing community-based management. Legislative changes have empowered communities to participate in decision-making processes, enabling them to benefit from forest resources while contributing to their conservation. PFM in Kenya has caused traction for International Collaboration and Funding. International organizations and donors have played a pivotal role in supporting PFM practices in Kenya. Collaborative partnerships have brought technical expertise, funding, and capacity-building opportunities that bolster PFM implementation and outcomes.

PFM has been hindered by inadequate capacity. Limited technical knowledge and skills among local communities. These limitations have posed challenges to effective PFM implementation. Capacity-building efforts are crucial to ensure that communities can actively engage in sustainable forest management practices. PFM in Kenya has also been affected by the Conflicting Interests and Power Dynamics. PFM often intersects with various stakeholder interests, including

commercial logging and agriculture. Competing demands for forest resources have resulted in conflicts and power struggles that undermine collaborative efforts. The complex administrative and institutional framework in Kenya's forest sector has hindered streamlined PFM implementation. Fragmented responsibilities and lack of coordination between government agencies and communities have led to inefficiencies.

The Participatory Forest Management (PFM) regulatory framework and its role in climate change mitigation above provides valuable insights but could benefit from further refinement to present a more clear and comprehensive understanding.

The analysis does a commendable job of balancing perspectives, highlighting both the potential benefits and the challenges of PFM in Kenya. It rightly acknowledges the importance of community involvement and ownership in forest management, noting that Kenya's legal and policy frameworks have been supportive of these principles. The recognition of the critical roles played by various stakeholders, such as local communities, government agencies, and international collaborators, underscores the complexity and collaborative nature of successful PFM initiatives.

However, exploring deeper into the specific mechanisms through which PFM contributes to climate change mitigation is critical. While it is mentioned that PFM promotes responsible forest management, it would be beneficial to look into how this translates into tangible climate benefits, such as increased carbon sequestration or reduced emissions from deforestation. Additionally, the analysis could be enriched by a more detailed examination of the socio-cultural factors that influence PFM's effectiveness. For example, understanding how traditional knowledge systems interact with modern conservation practices, and identifying specific cultural norms or power dynamics that may hinder inclusive participation, would provide a more comprehensive view.

The discussion on stakeholder roles is a strong point, but it could be expanded to clarify the dynamics between different interest groups, such as commercial loggers and local communities. A deeper exploration of how these conflicts manifest, and potential strategies for resolving them, would add depth to the discourse. While international collaboration and funding are noted as positive influences, the analysis could also consider potential downsides, such as dependency on external funding or the imposition of external agendas that may not align with local priorities.

Although the early documented discussion on PFM acknowledges Kenya's supportive legal frameworks, it could offer a more in-depth analysis of the specific challenges related to policy implementation. Identifying the bureaucratic hurdles that impede PFM effectiveness and providing examples or case studies of these issues would enhance the analysis. Furthermore, the role of monitoring and enforcement in implementing PFM policies could be examined more closely to highlight gaps and potential areas for improvement.

The discussion also correctly identifies capacity limitations as a challenge but could go further in exploring how these limitations might be addressed. It would be useful to discuss specific types of training or capacity-building initiatives that have been successful elsewhere and consider how these could be adapted to Kenya's context. Additionally, exploring the role of technology and innovation, such as digital tools or remote sensing technologies, in supporting PFM efforts could offer fresh insights into overcoming these capacity challenges.

While the narrative on PFM effectively identifies several challenges, it would benefit from a more solutions-oriented approach. Offering concrete recommendations for policy reforms, improved stakeholder collaboration, or innovative capacity-building approaches would make the analysis more actionable. Moreover, incorporating recent developments or emerging trends in PFM, such as recent policy changes or international agreements, would provide a more current perspective on the issue.

The comment on the documented literature above lays a strong foundation for understanding the regulatory framework of PFM in Kenya and its potential role in climate change mitigation. However, by providing a deeper analysis of specific issues, clarifying stakeholder dynamics, and offering concrete solutions, PFM narrative could be made more comprehensive and insightful.

2.3 Impacts of Participatory Forest Management practices and Climate Change mitigation in Kenya

In Kenya, PFM has emerged as a strategy to address deforestation and promote sustainable forest management (Ototo & Vlosky, 2018). While PFM offers potential benefits for climate change mitigation through increased forest cover (Griscom et al., 2017), its effectiveness hinges on addressing environmental, social, and economic aspects.

Environmental impacts of PFM in Kenya are mixed. Studies suggest PFM can lead to improved forest cover and biodiversity (Ameha et al., 2016; Kimutai & Watanabe, 2016). However, concerns remain. Ewane (2024) highlights challenges in community participation in tree planting, potentially hindering effective reforestation efforts. Additionally, deforestation due to factors outside PFM's control, like population growth, can undermine progress (Gathaara, 1999).

Equity and a sense of ownership are crucial for PFM success (Ojha et al., 2020). Mbeche et al. (2021) emphasize understanding user participation to ensure all community members feel empowered and responsible for forest management. Unequal benefit distribution or exclusion of certain groups can lead to resentment and hinder long-term sustainability.

Livelihood diversification through alternative income-generating activities (AIGAs) can incentivize forest conservation within PFM (Abebe, 2022). However, research on AIGAs in Kenya is limited. Evaluating successful AIGA examples from other regions, while considering the Kenyan context, could be beneficial (Persha et al., 2018).

Effective enforcement of regulations is essential for PFM to achieve its goals (Mwangi et al., 2020). Kenya's legal framework includes the Forest Conservation and Management Act (2016) and the Kenya Climate Change Act (2016) (GoK, 2016). However, enforcing these regulations can be challenging, particularly in remote areas (Naeku, 2020). Further research is needed to understand how to strengthen enforcement mechanisms and ensure compliance.

PFM has been implemented in various forested areas to address social, economic and environmental concerns. PFM projects often allow local communities to engage in alternative income-generating activities (IGAs) like beekeeping, eco-tourism, Non-Timber Forest Products (NTFPs) collection, and small-scale agroforestry. This diversification of livelihoods helps reduce dependence on wood forest products alone (Blomley et al 2009).

Through activities like ecotourism, harvesting of NTFPs, and sustainable logging, local communities can generate income. This can lead to an increase in the overall economic well-being of participating communities. By organizing themselves into community-based organizations or cooperatives, communities can access markets more effectively. This leads to better prices for their forest products and potentially improved economic conditions (Kumar et al, 2015).

PFM programs often include training and capacity-building practices. This equips local community members with skills related to sustainable forest management, business development, and marketing, which can have positive economic impacts beyond the forest sector (Mbuvi et al 2009). Likewise, PFM has various environmental benefits. PFM emphasizes sustainable and conservation-oriented forest management practices. This can lead to the protection of biodiversity by preserving habitats, reducing illegal logging, and curbing destructive practices (Behr et al 2012)

Under PFM, communities are often involved in reforestation and afforestation activities. This helps in restoring degraded areas, sequestering carbon, and maintaining ecosystem services. Proper forest management practices, like erosion control measures and planting of cover crops, can lead to improved soil health and reduced erosion (Kitula, 2022). These benefits both the forest ecosystem and downstream communities that rely on clean water sources.

By managing forests sustainably, PFM contributes to mitigating climate change. Forests act as carbon sinks, and their conservation and sustainable management help reduce greenhouse gas emissions (Newton et al, 2015). Engaging local communities in the management process can lead to a sense of ownership and responsibility. This often results in reduced conflicts over forest resources and a decrease in illegal logging and other destructive activities (Reboredo, 2013)

PFM can lead to the development of eco-tourism practices, which provide economic incentives for communities to protect and preserve their local ecosystems(Ogilo,2015).It's important to note that the effectiveness of PFM can vary depending on factors such as local governance structures, levels of community engagement, and external support. Additionally, monitoring and evaluation mechanisms are crucial for ensuring that PFM practices deliver the intended economic and environmental benefits (Mbeche et al 2021)

The Participatory Forest Management (PFM) practices and their impacts on climate change mitigation in Kenya offers a comprehensive and balanced analysis, yet there are areas where it could be enhanced to provide a more robust understanding.

It is commendable for its broad coverage, touching on environmental, social, and economic dimensions of PFM. By integrating various studies and sources, such as those by Ototo & Vlosky (2018) and Griscom et al. (2017), it lends credibility to the discussion. The analysis is

particularly effective in highlighting both the potential benefits of PFM, such as improved forest cover and biodiversity, and the challenges, including issues related to community participation and the enforcement of regulations.

Similarly, the discussion of social impacts, particularly regarding equity and community ownership, could be enriched by exploring the specific social dynamics in Kenya, such as ethnic or socio-economic factors that might influence PFM outcomes.

The economic dimension of PFM, particularly the role of alternative income-generating activities (AIGAs), is acknowledged, but there is lack of research on this topic in Kenya. To strengthen this section, a comparative analysis of successful AIGA initiatives from other regions could offer insights that might be applicable in the Kenyan context.

The challenges associated with PFM, such as deforestation driven by factors beyond the control of PFM initiatives and the difficulties in enforcing regulations, are well identified. However, it could be more impactful if it also discussed potential solutions or strategies to address these issues. Drawing on successful examples from other regions or previous studies could provide valuable recommendations.

Additionally, while the importance of monitoring and evaluation is mentioned, this aspect could be expanded to include specific methodologies or frameworks that are used to assess the success of PFM initiatives.

Finally, the inclusion of recent developments in PFM practices and policies would make the discourse more current and relevant. Climate change and forest management are dynamic fields, and incorporating the latest research or policy changes could provide a more up-to-date perspective. These enhancements would make PFM conversation more comprehensive and insightful.

2.4 Theoretical Framework

PFM practices and climate change mitigation are interconnected fields that intersect at the interface of environmental sustainability, community engagement, and policy implementation. The theoretical framework for understanding this relationship involves integrating concepts from

Common Pool Resource and environmental governance and policy theories. By grounding research on PFM practices and climate change mitigation within a sturdy theoretical framework, it becomes possible to analyze the complexities of these topics, identify key drivers and barriers, and develop effective strategies for achieving sustainable outcomes.

2.4.1 Common Pool Resource theory

This study is guided by the Common Pool Resource (CPR) theory. This theory has evolved over time, and used in various disciplines such as environmental science, political science, and economics. The beginning of CPR theory can be traced back to work of Garrett Hardin, the father of the concept, “tragedy of the commons” in 1968. This concept highlighted the potential overuse and degradation of common resources as a result of self-interested behavior. The theory was advanced by Elinor Ostrom (2008), in his groundbreaking research in the late 20th and early 21 centuries. Ostrom pioneered research on CPR management where he came up with principles and conditions to enable communities and stakeholders of a shared resource to avoid tragedy of the commons. Ostrom’s work stressed on the significance of local governance and institutions in resource management.

It is therefore solid to state that; the Common Pool Resource Theory offers an ideal framework for analyzing the impact of PFM practices and climate change mitigation in Kenya due to various reasons. Firstly, the theory emphasizes on the role of community governance and collective action in managing shared resources such as forests. This theory is used to analyze how communities make collective decisions, make rules and allocate benefits for sustainable utilization of the forest resources and carbon markets.

Secondly, CPR theory provides insights in to designing of effective institutions for management of shared resources such as forests. Through this theory, communities can identify the institutional arrangements and rules to facilitate effective forest management practices hence enhanced climate change mitigation outcomes.

Thirdly, CPR theory relates with the importance of local knowledge and community participation in resource management. Therefore, the theory will be applied to explore how local knowledge and active community involvement can contribute towards forest conservation and carbon storage.

Further, the theory helps in addressing potential conflicts and challenges in forest resource management. The study analysed how conflicts over forest resource use and sharing of benefits can be addressed, influencing the efficiency of climate change mitigation efforts by stakeholders.

The theory offers a more nuanced understanding of how communities can collectively manage and govern shared resources. However, the theory has some delimits. It may not capture all the socio-political influences of forest management in Kenya. Factors such as power dynamics, policy frameworks, and external influences are very useful in PFM, but may not be addressed by the theory. PFM is very dynamic in nature due to the evolving practices and responses in climate change conditions in Kenya. This may not be fully captured by the theory. Further, this theory may not adequately address the complexity and the scale of climate change mitigation efforts in Karura forest, which involve national and county governance structures, international agreements and many other stake holders, beyond the friends of Karura forest.

Common Pool Resource theory is a very useful framework for analyzing the impact of PFM practices and climate change mitigation in Kenya, in terms of collective action, community governance, and institutional designs. This theory should be combined with other theories to provide frameworks for addressing the mentioned limitations and complexities of the research topic.

To further CPR theory, the Environmental Management and Coordination Act (EMCA) of 1999, revised in 2015, plays a pivotal role in regulating the management of resources in Kenya by establishing a legal framework that aligns with the principles of Common Pool Resource (CPR) Theory. This act emphasizes the importance of sustainable resource management and environmental protection, which are crucial for the effective application of CPR Theory. Through its provisions, EMCA, 2015 facilitates the establishment of community-based organizations and committees that can adopt CPR Theory's emphasis on community governance and collective action in managing shared resources such as forests (Government of Kenya, 2015).

It is, therefore, imperative to state that the Common Pool Resource Theory offers an ideal framework for analyzing the impact of Participatory Forest Management (PFM) practices and climate change mitigation in Kenya

2.4.2 Environmental Governance and Policy Theory

The environmental governance and policy theory have evolved over decades and has been shaped by various disciplines including environmental science. This theory lacks specific timelines but has key developments as indicated by different timings. The theory became more popular in the late 20th century when environmental issues gained traction when scholars such as Partelow *et al.* (2020) started using it to analyze the role of policies and institutions and stakeholders in environmental management. Through Partelow work on governance of pooled resources such as forests, the significance understanding of how communities can collectively manage shared resources was increased.

The Constitution of Kenya 2010, the Forest Conservation and Management Act (FCMA) 2016, and the County Government Act of 2012 collectively establish a comprehensive framework for environmental governance and policy, which aligns with the Environmental Governance and Policy Theory. This theory provides a useful lens through which to understand the dynamics of participatory forest management (PFM) and climate change mitigation efforts in Kenya.

The Constitution of Kenya 2010 lays the foundation for environmental governance by recognizing the right of every person to a clean and healthy environment. It mandates the state and every person to cooperate in the protection and conservation of the environment and natural resources. The Constitution also emphasizes public participation in decision-making processes, which is crucial in PFM and resonates with the theory's focus on stakeholder engagement and collaboration across different levels of governance.

The FCMA 2016 reinforces the constitutional mandate by providing detailed provisions for the conservation and management of forests. It emphasizes the creation of community forest associations, fostering collaboration between local communities and government agencies. This act ensures that policies and institutions are in place to manage forest resources sustainably and equitably, which supports the Environmental Governance and Policy Theory's emphasis on the role of institutions and policy frameworks in evaluating and enhancing the effectiveness of PFM practices.

County Government Act of 2012 empowers county governments to manage natural resources within their jurisdictions, promoting a decentralized approach to environmental governance. It facilitates multi-level governance and coordination between national and county governments, aligning with the theory's focus on multi-level interactions in PFM and climate change practices. The act also underscores the importance of integrating local knowledge and priorities into policy-making processes, which is crucial for the successful implementation of PFM initiatives.

The Environmental Governance and Policy Theory, in conjunction with the Constitution of Kenya 2010, FCMA 2016, and the County Government Act of 2012, provides a robust framework for analyzing and improving PFM practices and climate change mitigation efforts in Kenya. While the theory highlights the importance of stakeholder engagement, policy coherence, and the distribution of power and resources, it also acknowledges the challenges in policy implementation, enforcement, and the evolving nature of environmental policies and priorities.

In the context of the study on the impacts of PFM practices and climate change mitigation in Kenya, the theory provides a framework to understand how stakeholders such as communities, governments, private sector, international organizations, intergovernmental organizations and others can collaborate and engage in decision making to achieve climate change mitigation goals of a forest. Further, the theory emphasizes on institutions and policy frameworks that are useful in assessing the effectiveness of PFM practices. Researchers can use this framework to design, analyse and enforce policies on forest conservation and carbon sequestration. The theory helps in policy integration and coherence by guiding in evaluating how PFM aligns with climate change policies in Kenya and exploring whether the policies are mutually enforcing. The theory considers the multi-level governance in PFM at regional, international and national climate change practices.

While this theory explores the roles of various actors, including government agencies, NGOs, and local communities, in shaping environmental policies and practices, it has setbacks in that it may not capture all the dynamics of decision-making processes in PFM, where there are diverse stakeholders with varied interests. However, the theory provides insights into the effectiveness of policy implementation, the distribution of power and resources, and the influence of institutional arrangements on PFM outcomes.

The theory addresses policy effectiveness in collective resource management but may not fully cover the challenges of policy implementation such as enforcement and compliance. Likewise, as the theory acknowledges power dynamics, it may not undo power imbalances and inequalities in PFM in Kenya. Finally, the theory may not account for the evolving policies, changing government priorities, international agreements and socio-economic changes. The environmental governance and policy theory is instrumental in interactions, institutions and policies that shape environmental policies and governance. In this study the theory helps in understanding stakeholder engagement, policy coherence, in PFM practices and climate change mitigation in Kenya.

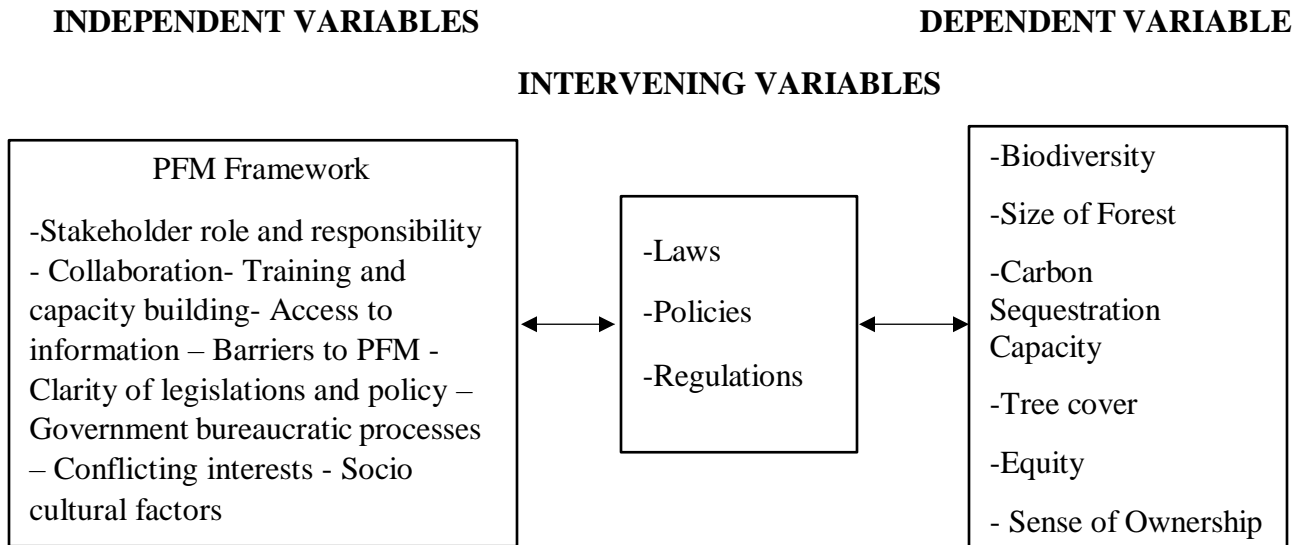
To strengthen the statement on the limitations and applications of the Environmental Governance and Policy Theory in the context of Participatory Forest Management (PFM) and climate change mitigation in Kenya, the following sources provide relevant insights; A study by Dyer et al. (2014) highlights the difficulties faced in policy implementation, particularly in enforcement and compliance, within environmental governance frameworks. This study underscores the complexities and local conditions that affect how policies are carried out effectively.

Further, Ribot and Larson (2012) discuss how decentralization policies, like those in PFM, often fail to address underlying power imbalances and inequalities. They argue that power dynamics can impede equitable resource distribution and community participation, aligning with the theory's limitations in rectifying these issues

Finally, according to an article by Ostrom (2010), the dynamic nature of socio-economic and political contexts, along with changing priorities and international agreements, presents challenges for static policy frameworks. This perspective supports the notion that environmental governance theories must adapt to remain relevant and effective in the face of evolving circumstances.

2.5 Conceptual Framework

Figure 2.1: Conceptual Framework



Source: *Researcher, 2024.*

A conceptual framework figuratively summarizes the relationship between study variables (Mugenda and Mugenda, 2009). The depicted figure 2.1 illustrates the connection between the study variables, PFM practices and climate change mitigation and their indicators. This study was based on the premise that effective climate change mitigation relies on the coaction of PFM practices, regulatory framework and implementation. The anticipated outcomes of this research were; the overall reduction in greenhouse gas emissions, enhanced biodiversity conservation, and improved livelihood of the forest adjacent communities in Karura Forest Ecosystem.

2.6 Chapter Summary

In summary, PFM involves local communities in forest conservation decisions. Healthy forests absorb carbon dioxide, a greenhouse gas. The study examines how PFM can improve forest health and carbon storage in Karura Forest. Successful PFM hinges on genuine community involvement, awareness of climate change threats, and effective communication channels. The document highlights the need to assess these factors in Karura forest ecosystem PFM practices. On the other hand, PFM has proven successful in other parts of Kenya. Communities have improved forest conditions, participated in anti-poaching efforts, and benefited from sustainable practices like

ecotourism. There is need to emphasize on the importance of evaluating community involvement, awareness, and communication in Karura's PFM for effective climate change mitigation.

Further, PFM offers a chance to fight climate change by involving local communities in responsible forest management. This approach has both advantages and disadvantages. On the positive side, PFM can lead to increased forest cover and biodiversity if communities are empowered and participate meaningfully. It can also improve livelihoods through alternative income sources like beekeeping or selling forest products. Effective enforcement of regulations is crucial for success. Challenges include unclear user rights and responsibilities, limited knowledge and skills within communities, and complex bureaucratic processes. Unequal benefit distribution or exclusion of certain groups can also undermine PFM's effectiveness. Theories like Common Pool Resource theory can help understand how communities can manage shared resources like forests. Environmental Governance and Policy theory looks at how governments, communities and others collaborate to achieve environmental goals. PFM has the potential to be a successful strategy for climate change mitigation in Kenya, but addressing social, economic and environmental aspects is crucial for its long-term success.

2.7 Literature Gaps

The significance of this study lies in its potential to bridge a notable gap in the existing literature, wherein the upshots of PFM practices and climate change mitigation in Kenya remains insufficiently explored. This study seeks to address this gap by elucidating the varied contributions of PFM practices and climate change mitigation, thus advancing the discourse on sustainable development and climate resilience within the Kenyan context.

CHAPTER THREE

RESEARCH METHODOLOGY

3.0 Introduction

Research methodology enumerates the methodological approach the study adopted in order to achieve the objectives stated in chapter one. Herein, numerous sections are included. First, the study design and the reason for its choice are presented. This is followed by a description of the target population, along with the presentation of sampling techniques, validity and reliability measures, data collection, presentation methods, and ethical considerations.

3.1 Research Design

The descriptive survey design allows for the comprehensive exploration and documentation of key variables and relationships (Creswell & Poth, 2017). The descriptive survey research design served as the guiding framework for the study. This design facilitated the systematic collection and analysis of quantitative and qualitative data to describe the current status, trends, and characteristics of PFM practices, their influence on climate change mitigation, and implications to the local community, government agencies, and policymakers. Through descriptive survey research design, the study employed mixed methods approach utilizing qualitative and quantitative instruments of surveys and interviews. The study was able to assess various dimensions of PFM practices, including community engagement, regulatory framework, forest conservation practices, carbon sequestration activities, and socio-economic impacts. Within the context of PFM in the Karura Forest Ecosystem the design provided valuable insights for informed decision-making and policy development aimed at enhancing climate change mitigation efforts in Kenya's forested areas.

3.2 Area of Study

The study area focused on the Karura Forest Ecosystem, located within Nairobi City County, Kenya. (Appendix VI)

Karura Forest Reserve is located in the northern part of Nairobi City County, with its boundaries forming a rectangle from UTM 37M 254354m E 9864755m S at the northwest corner to 262196m E 9861072m S at the southeast corner. It is part of the Nairobi River basin (KFPFMP, 2021-2026).

The forest is divided into three sections by Limuru and Kiambu Roads. The western section, known as Sigiria, is bordered by a marked boundary with New Muthaiga to the west, Gigiri/Rosslyn to the north (along the Thigiri River, a tributary of the Getathuru River), Limuru Road to the east, and Getathuru River to the south. The middle section is bordered by Limuru Road, Muthaiga North and Runda to the west, Rui-Ruaka River, Huruma village, a road and residential estates to the north, Kiambu Road to the east, and Getathuru River to the south. The eastern section, Mazingira, is bordered by Kiambu Road to the west, Thika Road to the east, and Muthaiga Golf Club to the south, to which it extends (KFPFMP, 2021-2026).

It is a critical urban forest reserve spanning approximately 1,041 hectares and serving as a vital green space in the heart of Nairobi. The ecosystem is characterized by a diverse range of flora and fauna, including indigenous tree species, wildlife, and bird species. Karura Forest plays a significant role in providing ecosystem services such as carbon sequestration, water regulation, and recreational opportunities for local residents and visitors. However, the forest faces various challenges, including encroachment, illegal logging, and degradation, necessitating effective management approaches such as PFM to ensure its conservation and contribute to climate change mitigation efforts.

3.3 Target Population

The group of individuals to whom the inferences of the study findings can be related is considered the target population (Banerjee & Chaudhury, 2010). Thacker (2020) further elaborates that within a target population; there is an accessible population that comprises the individuals who may be reached to participate in the study. The target population for the study included: The Friends of Karura CFA, conservationists involved directly in the tree growing and conservation activities in the Karura Forest Ecosystem. Others were resident association community opinion leaders, Youth groups, schools' non-governmental actors, self-help groups, government ministries, departments and agencies who have participated in rehabilitation efforts of Karura Forest Ecosystem, identified as the 400 FKFCFA members and 13 partners(Safaricom, NCBA, Magnet Ventures, Athi Works

Agency, Assup, Tree Biotechnology Program trust, DCI Mazingira Block, River café, KFEET, County Forest conservator, Forest station manager, Ward administrator-Nairobi county and Friends of Karura Forest).

3.4 Sampling Procedure

Sampling for this study was conducted using a purposive sampling approach, which involved selecting participants based on their specific characteristics and expertise relevant to the study's objectives. The target population comprised various stakeholders involved in the management and conservation of the Karura Forest Ecosystem, including members of The Friends of Karura CFA, conservationists, community opinion leaders, youth groups, schools, non-governmental organizations, self-help groups, and government agencies. From this target population, a sample of participants was strategically chosen to ensure representation from key groups actively engaged in PFM and climate change mitigation efforts within the ecosystem. The sampling process involved identifying and inviting individuals who possessed in-depth knowledge and experience related to the study's focus, aiming to gather diverse perspectives and insights that would enrich the analysis of the impact of PFM practices and climate change mitigation in the Karura Forest Ecosystem.

3.5 Sample Size Determination

Karura Forest was purposively selected as a success story in PFM in Kenya. This forest has variations in community characteristics since it is located in Nairobi's capital where people from different communities and cultural backgrounds participate at different levels of engagement with different governance structures. Published tables (Krejcie and Morgan (1970) in *Appendix VII* was used to determine the sample size. The identified target population of 400 FKFCFA members in the published tables referred gave a sample size of 196 CFA members and 13 partners as illustrate in table 3.1.

Table 3.1: Sample Size Distribution

Category	Target Population	Sample Size
Friends of Karura CFA: Conservationists in Karura CFA, Resident Association Community Opinion Leaders	400	196
FKFCFA Management: Government Ministries Departments and Agencies, Partners	13	13
Total	413	209

Source: *Researcher, 2024.*

Therefore, the sample population was 209.

3.6 Data Collection Instrument

The study employed a variety of data collection instruments to comprehensively explore the impact of PFM practices and climate change mitigation in the Karura Forest Ecosystem, Nairobi City County, Kenya. Firstly, survey questionnaires were distributed to members of The Friends of Karura CFA, conservationists, community opinion leaders, youth groups, schools, non-governmental organizations, self-help groups, and government agencies involved in forest management activities within the ecosystem. These questionnaires were designed to collect quantitative data on participants' perceptions, attitudes, and practices related to PFM and climate change mitigation, providing a broad overview of stakeholder perspectives.

Secondly, semi-structured interviews were conducted with selected individuals representing various stakeholder groups identified in the survey. These interviews allowed for in-depth exploration of participants' experiences, challenges, and recommendations regarding PFM practices and their impact on climate change mitigation in the Karura Forest Ecosystem. The semi-structured nature of the interviews provided flexibility for probing into specific areas of interest while also allowing participants to share their unique insights and experiences. Through these interviews, qualitative data were gathered to complement the quantitative findings from the survey

questionnaires, offering a richer understanding of the complexities surrounding PFM and its potential contributions to climate change mitigation efforts in the study area.

3.7 Instrument Validity

The study ensured the validity of its research instruments through a thorough and systematic approach. Content validity was achieved by meticulously developing the research instruments, such as the key informant interview guide and questionnaire, through an extensive review of relevant literature on PFM and climate change in similar contexts, following the recommendations of Cook & Beckman (2006). Expert feedback from researchers, review by the research supervisors and educators were solicited to ensure that the instruments comprehensively covered pertinent domains and accurately captured the intended constructs. Furthermore, pilot testing was conducted with a small sample of participants to evaluate the clarity, comprehensibility, and relevance of the questions, leading to necessary refinements to enhance the content validity of the instruments. Additionally, concurrent validity was established, as advocated by Cooper & Schindler (2003), by comparing the responses obtained from the research instruments with other established measures on PFM practices and climate change mitigation, confirming consistency and accuracy in assessing the intended constructs.

The researchers' supervisors also assisted in assessing the aspects the instrument was meant to measure in order to determine the suitability in obtaining information accurately.

3.8 Instrument Reliability

To ensure the reliability of the research instruments used in the study, various methods were employed. Firstly, the internal consistency reliability of the questionnaire was evaluated utilizing Cronbach's alpha coefficient, a widely recognized measure of reliability according to Malhotra (2004). This involved administering the questionnaire to a subset of participants and computing Cronbach's alpha to gauge the degree to which items within the questionnaire consistently assessed the same construct. An acceptable Cronbach's alpha value of 0.71 was achieved, indicating satisfactory reliability. Additionally, test-retest reliability, was examined by administering the questionnaire to a different group of participants at two distinct time points and comparing their responses to ensure consistency over time. Moreover, inter-rater reliability for the key informant

interview guide was established by having multiple interviewers conduct interviews independently, followed by a comparison of their findings for concordance. These measures collectively ensured the reliability of the research instruments, affirming that they consistently and accurately measured the intended constructs and thereby bolstering the credibility of the study outcomes.

3.9 Data Analysis and Presentation

Data analysis is the process of examining what has been gathered in a survey or experiment and making deductions and inferences (Runkler, 2020). The data analysis process in the study involved a systematic and rigorous approach to derive meaningful insights from the collected data regarding the impact of PFM practices and climate change mitigation in the Karura Forest Ecosystem. Quantitative data obtained from survey questionnaires were analyzed using Statistical Package for Social Sciences (SPSS) software. Descriptive statistics on frequencies and percentages were computed to summarize participants' responses regarding the practices related to PFM and climate change mitigation.

Through a survey that was conducted, 135 responded in a questionnaire to assess PFM practices, the regulatory framework, and implementation impacts on climate change mitigation. Multiple linear regression analysis was conducted to ascertain whether there was a positive correlation ($R = 0.758$) between PFM practices, regulatory framework, and implementation, explaining 56.8% of the variation in climate change mitigation. The analysis of variance (ANOVA) was conducted to indicate whether all three PFM factors were statistically significant predictors ($p < .001$) of climate change mitigation. The regression coefficient table was adopted to indicate if a unit increase in PFM practices, regulatory framework adherence and PFM implementation resulted in positive changes as revealed of 0.524 and 0.434 on climate change mitigation, respectively. Multicollinearity and autocorrelation tests were adopted to confirm if there were significant issues, with the heteroscedasticity test meant to identify potential inconsistency in error terms.

Inferential statistics; correlation analysis was employed to explore relationships between different variables, such as the relationship between community engagement, regulatory framework and implementation in PFM activities and perceived effectiveness in climate change mitigation. Additionally, qualitative data from semi-structured interviews were analyzed using thematic

analysis techniques, where responses were coded and categorized into themes and patterns to identify commonalities, differences, and emerging trends related to impacts PFM practices on climate change mitigation. The integration of quantitative and qualitative findings allowed for a comprehensive understanding of the study's research questions and facilitated the triangulation of results to enhance the validity and reliability of the study outcomes.

In terms of data presentation, the study employed various methods to effectively communicate the findings to the intended audience. This included the use of tables, charts, and graphs to visually represent quantitative data, making it easier for readers to interpret key trends and patterns. Qualitative findings have been presented through thematic summaries or direct quotations from interview participants, providing rich contextual insights into stakeholders' perspectives on PFM practices and climate change mitigation in the Karura Forest Ecosystem. Additionally, the study utilized narrative descriptions to provide an overarching summary of the main findings and their implications for theory, practice, and policy.

3.10 Ethical Considerations

Ethical considerations in the study were paramount to protect the rights and well-being of participants. The study sought research approval from the National Defence University –Kenya, a research permit from the National Commission for Science, Technology and Innovation (NACOSTI) and Kenya Forest Service research authorization. Further, informed consent was essential, ensuring that all participants were fully aware of the study's purpose, procedures, potential risks, and benefits before agreeing to participate. This included obtaining consent for both data collection and dissemination of findings, respecting participants' autonomy and right to withdraw from the study at any time without repercussion.

Additionally, measures were taken to ensure the confidentiality and anonymity of participants, particularly in qualitative data where direct quotes were used. Identifying information was either omitted or anonymized to protect participants' privacy. Moreover, researchers upheld principles of respect and cultural sensitivity when engaging with diverse stakeholder groups, acknowledging and valuing their perspectives, beliefs, and practices related to forest management and climate change. Sensitivity was also exercised in discussing potentially controversial topics such as land

use conflicts or environmental degradation, ensuring that participants' voices were represented accurately and respectfully in the research findings.

Furthermore, researchers took proactive steps to minimize any potential harm or discomfort to participants and the environment. This involved conducting research in a manner that minimized disruption to the natural ecosystem of the Karura Forest and adhered to local regulations and guidelines for environmental conservation and research activities. Additionally, efforts were made to ensure that research activities did not exacerbate existing tensions or conflicts within the community regarding forest management practices. Clear communication and transparency were maintained throughout the research process to foster trust and collaboration with local stakeholders. Lastly, researchers committed to the responsible and ethical dissemination of findings, ensuring that research outputs were shared with relevant stakeholders in a timely and accessible manner, and that credit was given appropriately to all contributors.

CHAPTER FOUR

STUDY FINDINGS AND DISCUSSIONS

4.0 Introduction

The chapter presented the findings of a study that evaluated of PFM practices and climate change mitigation in Kenya. A case of Karura Forest Ecosystem, Nairobi City County. Data collection methods included surveys and interviews. Data analysis was done both quantitatively and qualitatively to fulfill the study objectives.

4.1 Response Rate

The study sought to understand survey responses as illustrated in table 4.1

Table 4.1: Response Rate

Category	Sample	Responded	Response Rate
CFA and other stakeholders (Survey Respondents)	196	129	67%
KFS Management and Partners/NGO's (Interview Informants)	13	13	100%
Total	209	142	83.5%

Source: *Researcher, 2024.*

In this study, the response rates varied between the different categories of participants, with the Category "CFA and other stakeholders" achieving a response rate of 67% among survey respondents, while the Category "KFS Management and Partners/NGO's" attained a 100% response rate among interview informants. The overall response rate for the entire sample was calculated at 83.5%. The 67% response rate among survey respondents from the CFA and other stakeholders' category, while not exceptionally high, is still acceptable and indicative of a reasonably good level of engagement from this group. Given the challenges often associated with survey research, including potential respondent fatigue or reluctance to participate, a 67% response

rate demonstrates a solid effort in capturing perspectives from a diverse range of stakeholders involved in PFM practices within the Karura Forest Ecosystem.

On the other hand, the 100% response rate achieved among interview informants from the KFS Management and Partners/NGO's category is particularly noteworthy. This perfect response rate indicates a high level of cooperation and willingness to engage with the research process among this group. The fact that all 13 intended interview informants participated in the study reflects a strong commitment from key stakeholders directly involved in forest management and conservation efforts within the ecosystem. This high response rate not only enhances the representativeness and validity of the qualitative data obtained from this category but also underscores the importance and relevance of the research topic to the KFS Management and its partners, highlighting their proactive involvement in contributing to the study's objectives and outcomes. Overall, while the response rates varied across categories, the combined response rate of 83.5% for the entire sample indicates a satisfactory level of engagement and participation from the various stakeholders involved in the study.

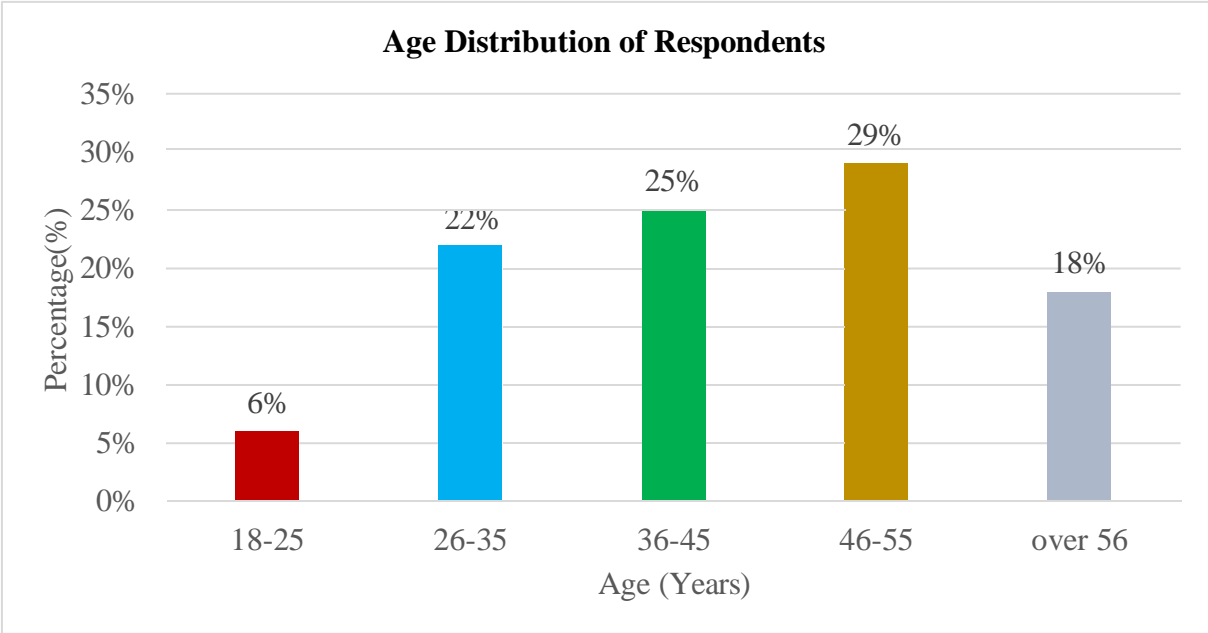
4.2 Demographic Characteristics

Studying the age, gender, and years involved in conservation of respondents was significant in this study for several reasons. Firstly, demographic characteristics such as age and gender influence individuals' perceptions, attitudes, and behaviors towards PFM and climate change mitigation efforts. For example, older individuals with more experience in conservation activities might have a deeper understanding of the challenges and opportunities associated with PFM, while younger participants might have fresh perspectives and innovative ideas. Similarly, gender dynamics also played a role in shaping attitudes towards forest management, as women and men had different roles, responsibilities, and priorities related to environmental conservation. By analyzing age and gender demographics, the study identified potential differences in stakeholder perspectives and tailored interventions or policies to address specific needs and preferences, thereby enhancing the effectiveness and inclusivity of PFM practices in the Karura Forest Ecosystem.

Furthermore, examining the years involved in conservation activities provided valuable insights into the level of experience and expertise among respondents, which influenced the quality and effectiveness of their contributions to PFM and climate change mitigation efforts. Individuals with

longer involvement in conservation activities possessed a deeper understanding of ecological processes, community dynamics, and policy frameworks relevant to forest management, allowing them to make more informed decisions and recommendations. Conversely, individuals with fewer years of involvement benefited from capacity-building practices and targeted support to enhance their knowledge and skills in conservation practices. By assessing the years involved in conservation, the study identified opportunities for capacity-building interventions, mentorship programs, and knowledge exchange practices to empower stakeholders and strengthen their capacity to contribute meaningfully to PFM practices in the study area. Figure 4.1 illustrates on age distribution of respondents.

Figure 4.1: Age Distribution of Respondents



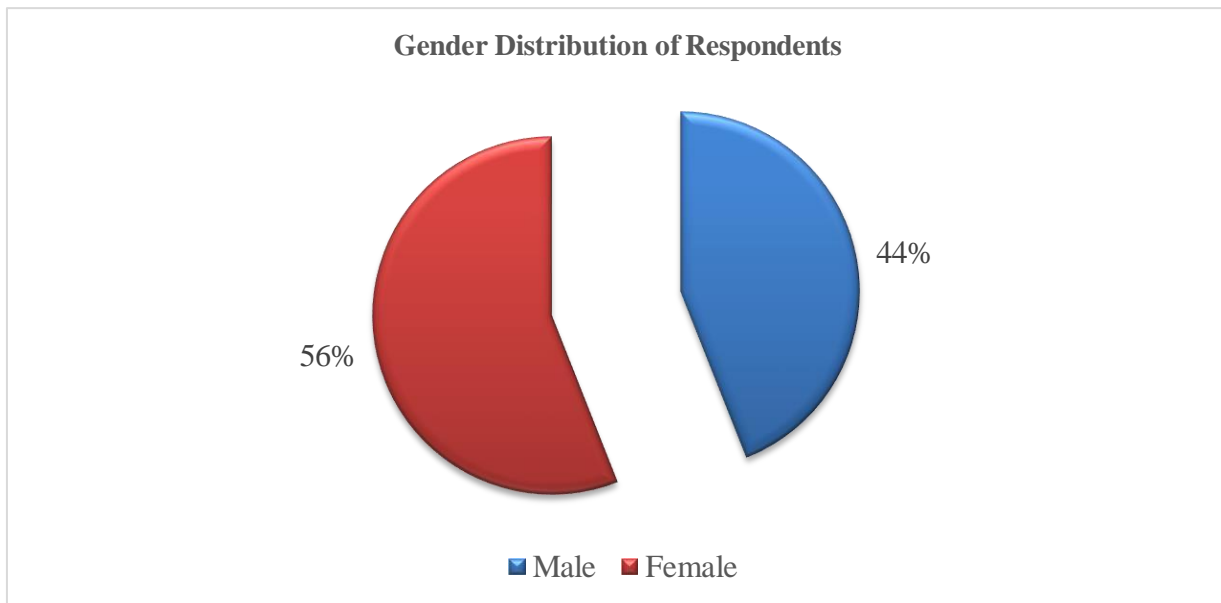
Source: *Researcher, 2024.*

The age distribution of respondents in the study provided valuable insights into the diversity of perspectives and experiences within the context of PFM practices and its potential impact on climate change mitigation. Each age category, ranging from 18-25 years to over 56 years, played a unique role in contributing to the continuum of knowledge, experience, and commitment towards climate change mitigation through PFM. The youthful respondents (18-25 years) brought fresh perspectives and innovative ideas, while those aged 26-35 years were active contributors actively

engaged in conservation activities. The age category of 36-45 years represented established stewards who likely had considerable experience in PFM practices and could provide valuable insights into effective strategies. Similarly, the age group of 46-55 years comprised seasoned advocates who may have had a deep understanding of policy frameworks and community dynamics relevant to environmental conservation. Finally, respondents over 56 years represented experienced custodians who had witnessed the evolving dynamics of environmental conservation and PFM over the years. This diversity ensured that responses and strategies for climate change mitigation through PFM were not only innovative but also rooted in the wisdom of those who had extensive experience in the field, thereby contributing to the sustainability of PFM practices in the Karura Forest Ecosystem.

The collaborative efforts across different age groups highlighted in the study underscored the importance of intergenerational knowledge exchange and cooperation in fostering sustainable climate change mitigation and environmental conservation practices. As Karura Forest continues to be a focal point for PFM practices, leveraging the diverse perspectives and experiences across age categories creates a sustainable legacy for climate change mitigation and environmental conservation. The active involvement of youth ensures the continuity of conservation efforts and the infusion of new ideas, while the expertise of older generations provides valuable guidance and insight based on years of experience. This collaborative approach not only strengthens PFM practices but also enhances community resilience and adaptive capacity in the face of climate change challenges. Figure 4.2 illustrates on gender of respondents.

Figure 4.2: Gender Distribution of Respondents



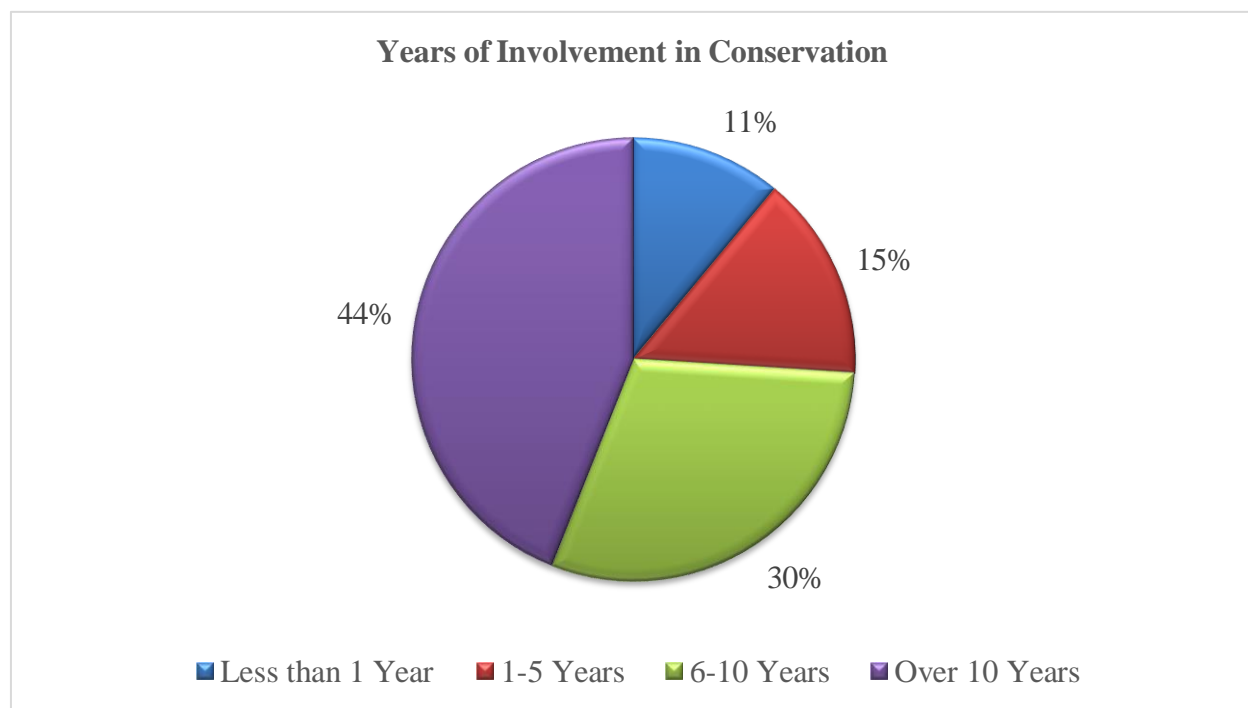
Source: *Researcher, 2024.*

The relatively balanced gender distribution among respondents, with a majority 44% identified as male and 56% as female, was significant as it reflected an inclusive approach to PFM in the context of Karura Forest. This balance highlighted the recognition of the importance of diverse voices and perspectives in environmental conservation efforts. Achieving near gender parity in participation was a positive indication of the involvement of both men and women in research on PFM activities in Karura Forest Ecosystem, which was crucial for ensuring the effectiveness and sustainability of conservation practices. This gender-inclusive approach not only promoted diversity but also fostered collaboration and cooperation among different stakeholders, ultimately leading to more holistic and effective strategies for addressing the challenges posed by climate change in the forest ecosystem.

Recognizing and leveraging the strengths of both genders in PFM activities in Karura Forest led to a more comprehensive and resilient approach to addressing the impacts of climate change. Women, for instance, often play key roles in community-based conservation efforts, including resource management and sustainable livelihood practices, while men contribute through their knowledge of traditional ecological practices and leadership roles. By promoting gender equality, inclusivity, and active participation in environmental conservation, efforts could be strengthened

to ensure a sustainable and equitable future for Karura Forest and beyond. Encouraging the meaningful participation of both men and women in decision-making processes related to PFM not only enhanced the effectiveness of conservation practices but also contributed to the empowerment and well-being of local communities. Therefore, the balanced gender distribution among respondents underscored the importance of promoting gender equality and inclusivity in environmental conservation efforts for the long-term sustainability of Karura Forest. Figure 4.3 illustrates on years of involvement in conservation.

Figure 4.3: Years of Involvement in Conservation



Source: *Researcher, 2024.*

The distribution of respondents based on their years of involvement in conservation efforts for PFM research in Karura Forest underscored the diversity and richness of experience within the field of conservation. The breakdown of respondents revealed that majority at 44% had over 10 years of involvement, 30% had 6-10 years, 15% had 1-5 years, and 11% had less than 1 year of experience. This range of experience levels among respondents was significant as it represented a spectrum of perspectives, skills, and insights that could contribute to the overall effectiveness of PFM practices in addressing climate change challenges. The distribution highlighted the

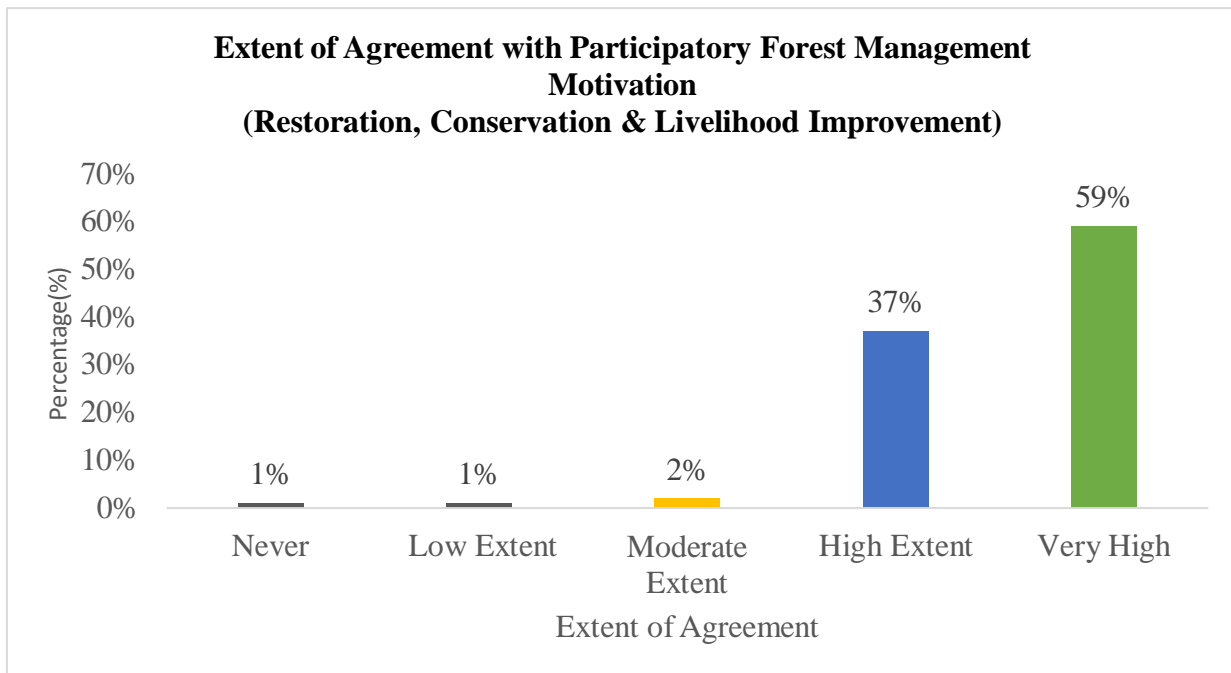
coexistence of seasoned veterans with extensive knowledge and newcomers with fresh perspectives, creating a dynamic and collaborative environment for environmental conservation in Karura Forest.

The potential link between the years of involvement in conservation and climate change mitigation lay in the likelihood of individuals to contribute at different levels. Those with less than 1 year of experience brought innovation, individuals with 1-5 years bridged theory and practice, those with 6-10 years translated experience into effective strategies, and those with over 10 years preserved traditional knowledge. This diversity emphasized the necessity for collaborative efforts that leveraged the collective impact of individuals with varying levels of experience to comprehensively address the complex challenges posed by climate change in the context of PFM. The combination of fresh ideas and well-established practices resulted in a more adaptive and robust approach to climate change mitigation, making the collaborative engagement of individuals with different years of involvement a crucial aspect of sustainable environmental conservation in Karura Forest.

4.3 Participatory Forest Management Practices and Climate Change Mitigation in Karura Forest Ecosystem

The study sought to establish the PFM practices and climate change mitigation in the Karura Forest Ecosystem in Kenya. Through a comprehensive examination of respondents' views and stakeholder interviews, the research investigated the underlying motivations that led to the adoption of PFM as a strategy to address climate change challenges in Karura Forest Ecosystem. By analyzing the PFM practices, framework, socio-economic and environmental contexts, the study provided valuable insights into the rationale behind the implementation of the strategy in the Karura Forest Ecosystem. In an inquiry on the core practices of PFM in Karura Forest Ecosystem and its link to climate change mitigation and livelihood improvement, the degree of acceptance of respondents on stated views were sought through the aid of a Likert Scale. Figure 4.4 illustrates on extent of agreement with PFM practices.

Figure 4.4: Extent of Agreement with Participatory Forest Management Motivation



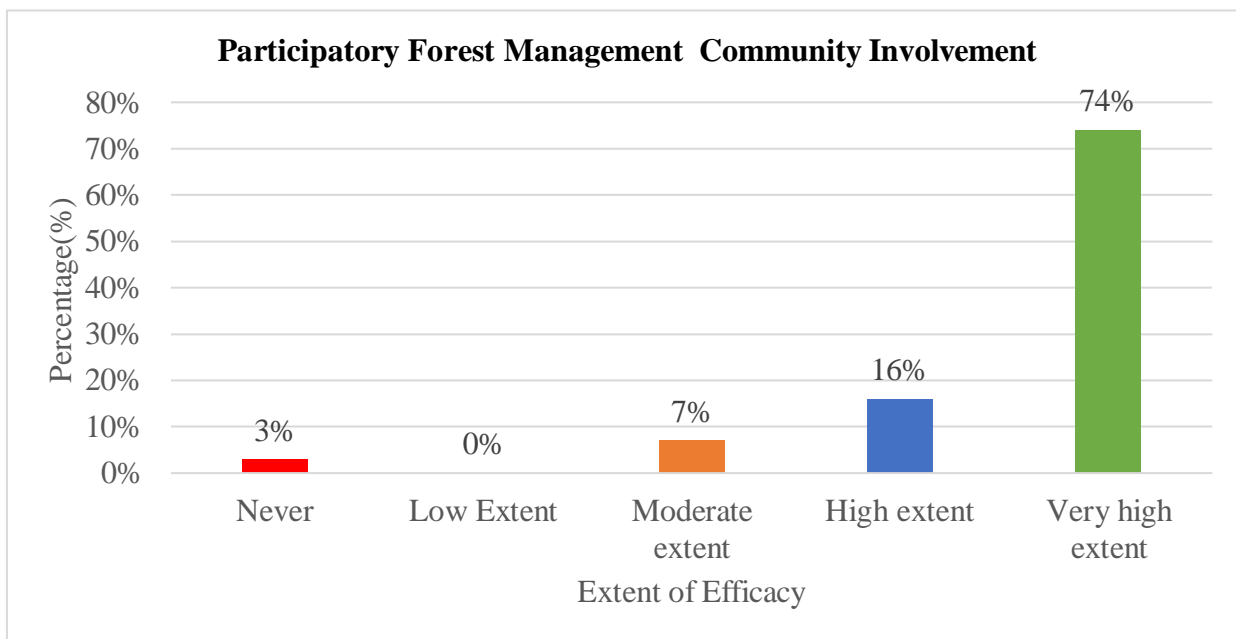
Source: *Researcher, 2024.*

The majority of respondents (59%) perceived to a "Very High" extent that the primary reason for introducing PFM in Karura was to address the restoration of degraded areas, conservation, and livelihood improvement. Additionally, 37% indicated a "High Extent" of agreement, highlighting a substantial collective acknowledgment of the motivations behind PFM in Karura. The scale of agreement reflected a strong consensus among respondents regarding the interconnectedness of PFM practices and climate change mitigation efforts. This acknowledgment suggested a shared belief that the restoration of degraded areas, conservation, and livelihood improvement, as facilitated by PFM, collectively contributed significantly to climate change mitigation.

This underscores the recognition of PFM as a tool for restoring degraded areas within the Karura forest ecosystem. PFM has proven to be a tested mechanism to rehabilitate ecosystems that may have suffered from deforestation, habitat degradation, or other forms of environmental stress. The restoration of degraded areas directly contributes to climate change mitigation efforts by enhancing ecosystem resilience, promoting carbon sequestration through reforestation efforts, and safeguarding biodiversity. These are crucial elements for mitigating the impacts of climate change.

It is of great importance to recognize and build upon the shared understanding among respondents to strengthen the implementation of PFM practices in Karura Forest Ecosystem. By addressing challenges and seizing opportunities, there is potential for the continued success of PFM as a vital tool in climate change mitigation while concurrently improving the livelihoods of local communities within the Karura Forest Ecosystem. Further, the study sought to understand the PFM regulatory framework in Karura Forest Ecosystem. Figure 4.5 illustrates on efficacy of PFM through community involvement.

Figure 4.5: Participatory Forest Management Community Involvement

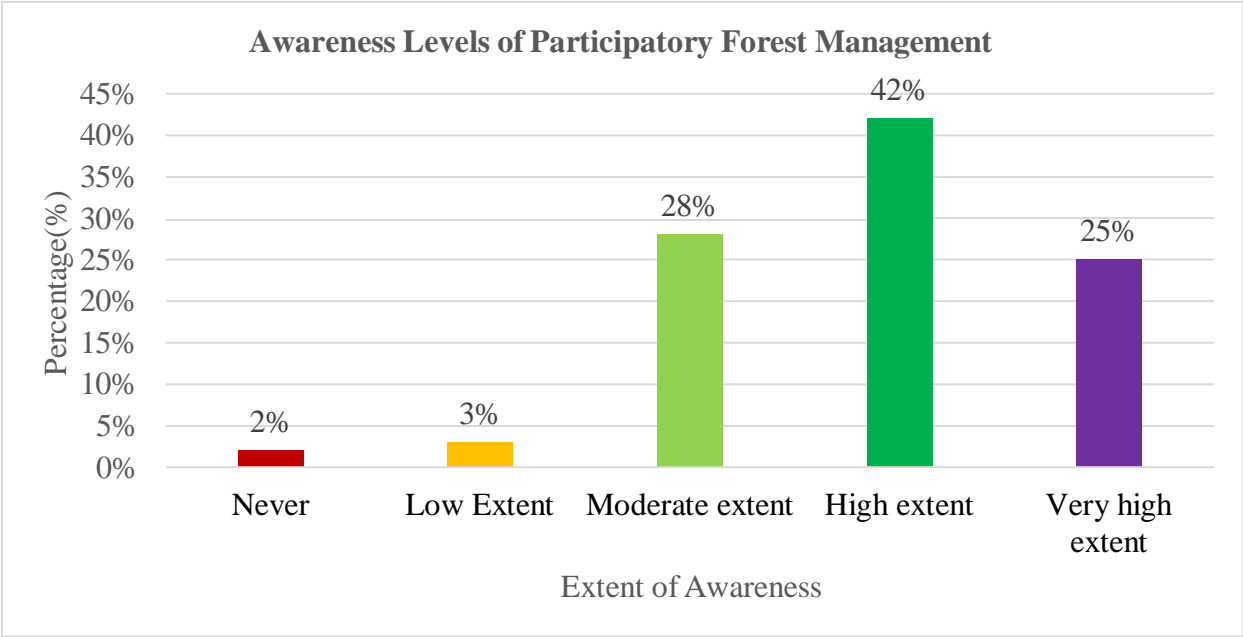


Source: *Researcher, 2024.*

The overwhelming response (74%) of the respondents rated the PFM community involvement as of "Very High Extent," 16% as "High Extent," and 7% as "Moderate Extent." This signifies a strong collective belief in the positive impact of community involvement in PFM to mitigate climate change. This resounding endorsement suggests a shared conviction that the engagement of local communities plays a pivotal role in the success of climate change mitigation efforts. The high percentage of respondents who rated the PFM communities' involvement as "Very High Extent" indicates a widespread recognition of the significant contributions that community involvement makes towards sustainable forest management and climate change mitigation.

The recognition of the significance of local communities and their engagement in PFM reflects a shared commitment to fostering sustainable practices and resilience in the face of climate change impacts. There is a need for continued support for community-led practices, addressing challenges, and seizing opportunities to further enhance community involvement in PFM practices in Karura Forest Ecosystem as a crucial strategy to mitigate climate change. By acknowledging the importance of community involvement and providing support for their efforts, stakeholders can ensure the continued success of PFM practices in Karura Forest, ultimately contributing to broader climate change mitigation goals and fostering resilience within local communities. Figure 4.6 illustrates on awareness levels of PFM.

Figure 4.6: Awareness Levels of Participatory Forest Management



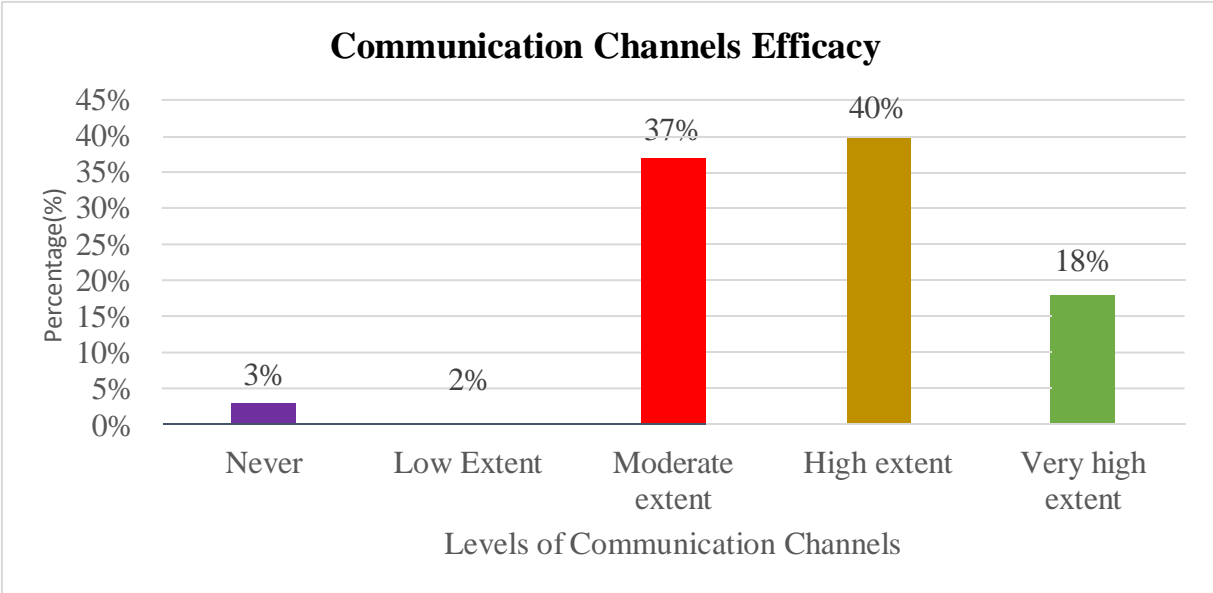
Source: *Researcher, 2024.*

The study indicated that a majority 42% of respondents rated the awareness level at a "High Extent," 27% perceived the awareness to be at a "Moderate Extent," while 23% rated awareness to be at a "Very High Extent". The respondents who viewed awareness to be low were 3%, and another 3% attested that there was no awareness at all. A significant proportion of local communities in Karura were aware of the connection between PFM practices and climate change mitigation. This suggests that a higher level of awareness empowered communities to actively

engage in sustainable practices, understand the impact of their actions on the environment, and contribute to the overall resilience of the forest ecosystem. It was a critical component in the broader strategy of climate change mitigation. The effectiveness of PFM practices relied on the awareness and understanding of community members regarding the link between their actions, forest management, and climate change mitigation.

Communities with a higher awareness level were more likely to participate in sustainable resource management practices, reducing deforestation, and promoting responsible forest resource use. The findings further showed that increased awareness empower communities to initiate and actively participate in conservation efforts, contributing to the overall health and resilience of the forest ecosystem. Finally, the communities who were well-informed are more likely to engage in reforestation efforts, leading to increased carbon sequestration and enhanced climate change mitigation. This underscores the importance of raising awareness among local communities on the connection between PFM practices and climate change mitigation, as it not only fosters informed decision-making but also encourages proactive involvement in conservation efforts, ultimately contributing to the sustainability of forest ecosystems and broader climate change mitigation goals. Figure 4.7 illustrates on communication channels efficacy.

Figure 4.7: Levels Communication Channels



Source: *Researcher, 2024.*

The study (Figure 4.7) indicated that a majority 40% of respondents perceived the communication channels to be of "High Extent," 37% perceived the effectiveness to be of a "Moderate Extent," and 18% perceived it to be of "Very High Extent". This suggests that a significant proportion of respondents considered the communication channels in PFM effective in conveying climate change information to local communities. The perceived effectiveness of communication channels has a high potential link to the success of climate change mitigation efforts within the PFM framework. It ensures that local communities are informed, engaged, and empowered to participate actively in sustainable practices that contribute to climate change resilience.

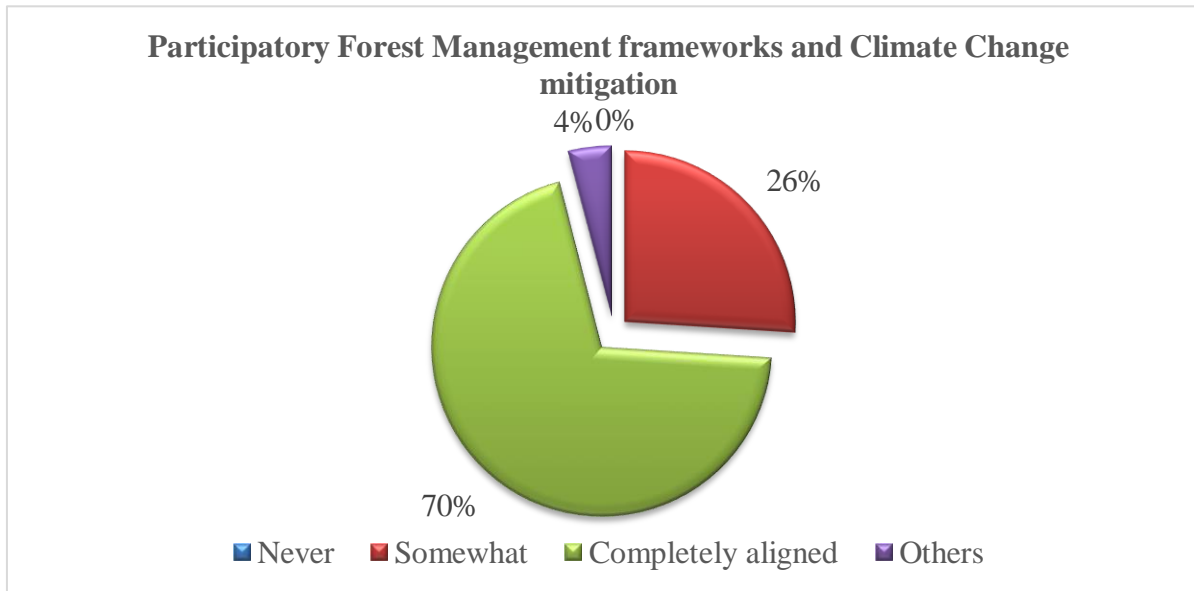
Effective communication plays a pivotal role in the success of climate change mitigation efforts. The ability to convey information clearly, engage diverse audiences, and foster understanding is essential for community participation and the adoption of sustainable practices. It ensures that local communities have access to accurate and relevant information, empowering them to make informed decisions that contribute to climate change mitigation. Figure 4.7 illustrates that Clear communication fosters community engagement, encouraging active participation in conservation practices, reforestation efforts, and sustainable resource management practices. The active involvement of local communities in the communication process builds a sense of ownership and responsibility, increasing the likelihood of successful climate change mitigation efforts.

However, challenges associated with the perceived effectiveness of communication channels exist. 3% of locals feel there is no effective communication, and another 2% rate the efficacy of the communication channels to be of "low extent." These could be the PFM participants facing challenges, including language barriers, limited access to technology, and varying levels of literacy. Opportunities lie in tailoring communication strategies to the specific needs and preferences of local communities, leveraging community-based practices, and incorporating feedback for continuous improvement. Effective communication is a key enabler in fostering community participation and achieving successful climate change mitigation within the PFM practices.

4.4 Analysis of Participatory Forest Management Regulatory Framework and Climate change Mitigation

Figure 4.8 illustrates on PFM regulatory frameworks and climate change mitigation.

Figure 4.8: Participatory Forest Management Regulatory Frameworks and Climate Change Mitigation



Source: *Researcher, 2024.*

The study indicated a strong consensus among respondents, with 70% stating that PFM regulatory frameworks in Karura was "Completely aligned" with climate change mitigation goals. This resounding endorsement suggested that a significant majority of respondents perceived a high level of congruence between local efforts and broader international objectives in addressing climate change. The overwhelming agreement on complete alignment signified a robust connection between PFM regulatory frameworks in Karura and climate change mitigation goals. This alignment was crucial for ensuring that local conservation practices contributed meaningfully to the broader effort of mitigating climate change impacts.

PFM regulatory frameworks when aligned with climate change goals, became a powerful tool in achieving broader objectives related to mitigating climate change. The success of local practices contributes to the overall resilience of ecosystems and support the attainment of international climate targets. The alignment contributes to carbon sequestration through activities like reforestation and sustainable forest management, directly supporting climate change mitigation efforts. It ensures that biodiversity conservation, a key component of global climate change

strategies, was actively pursued, safeguarding ecosystems thus enhancing their ability to adapt to climate-related challenges.

Karura PFM activities incorporated international best practices, adhered to established guidelines and legal frameworks, and collaborated with global conservation practices (KPFMP, 2021-2026). This was likely to influence effective governance structures and a commitment to implementing practices endorsed at the global level. Figure 4.8 illustrates that this engagement would contribute to global conservation practices, foster alignment, and create opportunities for knowledge exchange and leveraging resources to support local efforts in Karura PFM activities. The acknowledgment of complete alignment underscored the effectiveness of PFM in Karura as a model that not only benefited the local ecosystem but also actively contributed to global efforts in combating climate change. There is need for continued commitment to align PFM regulatory framework with local forest conservation practices, global objectives so as to attain sustainability and success of PFM in Karura in the face of climate change mitigation.

Further, majority of respondents noticed an increase in community involvement, emphasizing a positive trend in participation since the introduction of PFM in Karura. While some express uncertainty or note some challenges, the overall sentiment suggests progress in engaging various segments of the community, including marginalized groups, persons with disabilities, and women. According to an assessment of KPFMP for the period 2010-2015, 2016-2020, it was noted that: “All forestry contract work done in the forest is given out to women and other groups from those villages (KPFMP, 2021-2026). Engaging diverse groups, specifically the Persons Aabled Differently (PAD), ensures a more comprehensive approach to conservation, drawing on varied perspectives, experiences, and contributions to address the diverse challenges posed by climate change.

FKFCFA is in the forefront in ensuring inclusivity. The implementation status of KPFMP for the period 2010-2015, 2016-2020, showed that: “The Joint Committee and Karura Forest Environmental Education Trust (KFEET) jointly employed an education officer who takes school parties and special interest groups on educational tours of the forest. Thousands of school children visit the forest every year and get a chance to learn about forests and the environment thanks to a teaching program targeting different age groups. FKFCFA has set up a sponsored visit project for

underprivileged schools and orphanages, providing them with transport and lunch so that their pupils have a chance to visit the forest” (KPFMP, 2021-2026). In one of the Karura forest blocks (Sigiria), a 1.6 KM circuit for the physically challenged, “Matembezi Trail,” has been built (KPFMP, 2021-2026). This corroborates the several responses from respondents who highlighted the intentional efforts which have been made to involve marginalized groups and persons with disabilities in all aspects including the decision-making processes related to forest management.

However, Figure 4.8 illustrates that a few respondents have negative perceptions, particularly among marginalized groups, which might affect their active participation. Addressing the negative perceptions is crucial for breaking barriers and fostering active participation. A positive perception among marginalized groups contributes to more effective climate change mitigation strategies as they become part and parcel of the conservation process. Women's active involvement and leadership (Figure 4.2) contribute to more comprehensive and effective climate change mitigation strategies. They often bring unique perspectives and priorities that enrich the decision-making process. Engaging women in employment related to forest management not only promotes inclusivity but also empowers them economically, leading to improved community resilience to climate change impacts.

Respondents attributed the observed increase in community involvement (Figure 4.6) to awareness campaigns, education efforts, and a growing understanding of the importance of forest conservation. The positive changes were noted, particularly in terms of increased women's participation and general awareness about the significance of forest conservation. This is a greater booster to climate change mitigation in Karura.

In addition, majority of responses expressed a positive outlook on the integration of traditional ecological knowledge with modern scientific approaches in Karura. Participants emphasized the significance of blending citizen knowledge with science to ensure sustainable conservation. In an interview, a Key Informant (KI), said that:

Conservationists and local stakeholders had successfully devised strategies for restoring and preserving the forest. The connection between the community's involvement and the development of effective conservation strategies underscored the importance of inclusivity in managing natural resources.

(KI 1, 08 January 2024, FKFCFA Member, Karura Forest Office)

In the analysis of the verbatim quote, there is need to highlight on the importance of traditional ecological knowledge, considering it a key aspect where community involvement as indispensable. The reliance on the forest for herbs and cultural activities reflected the intertwined relationship between the community and the ecosystem. The emphasis on educating people about the importance of forest resources suggested a broader effort to promote awareness and sustainable practices. While the majority of responses were positive, there were a few reservations expressed. In view of this, another informant stated:

There has been lack of awareness or visibility regarding the integration of traditional knowledge with scientific approaches, suggesting that communication and outreach efforts need improvement to ensure that the benefits of this integration were widely understood and appreciated.

(KI 4, 09 January 2024, FKFCFA Member, Karura Forest Office)

Based on the voice, the connection between PFM in Karura and climate change mitigation was evident in responses advocating for planting indigenous trees. The recognition that indigenous trees were better conserved when there was collaboration between traditional knowledge and modern approaches emphasized the role of such practices in contributing to climate resilience. The intentional mindfulness in identifying traditional ecological knowledge and aligning it with scientific approaches reflected a holistic approach towards climate change mitigation. Remarks from an informant shed light on the importance of local perspectives through stating that:

Forest staff, originating from local communities, were highlighted as crucial contributors with extensive knowledge about the forest's history and ecosystem.

(KI 2, 08 January 2024, FKFCFA Member, Karura Forest Office)

Insight from the sentiments added a layer of authenticity and cultural sensitivity to the participatory management approach, reinforcing the idea that blending traditional and scientific knowledge was fundamental for effective forest restoration. The study revealed that integration of traditional ecological knowledge with modern scientific approaches in Karura appeared to be generally

effective, with positive contributions to PFM and climate change mitigation efforts. The engagement of the local community, acknowledgment of traditional practices, and collaborative strategies underscored the importance of a holistic approach. However, addressing the reservations expressed and ensuring wider awareness would have been essential for sustaining and enhancing the effectiveness of this integration in the long run.

Upon inquiry on the significance of the statements, a KI affirmed and said:

These individuals, coming from the surrounding communities, possess a deep-rooted connection to the forest, often spanning generations, which equips them with unparalleled insights into the forest's history, ecological dynamics, and biodiversity.

(KI 1, 6th February 2024, Karura, Nairobi City County)

The sentiment expressed in the statement highlighted the aspect of ownership. Additionally, another informant said that:

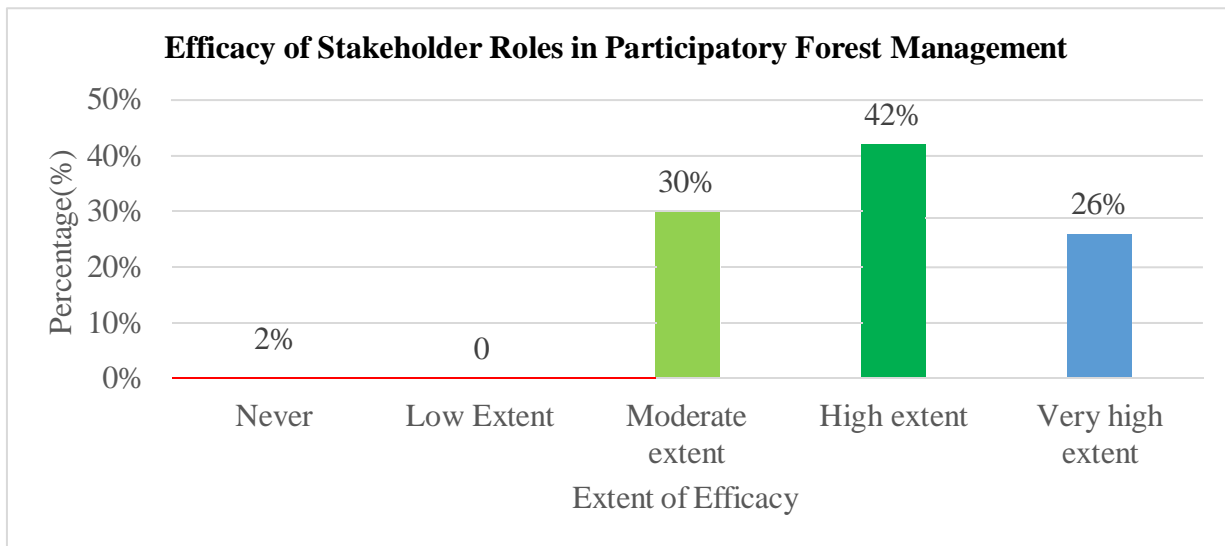
Their local knowledge is instrumental in effective forest management, including conservation practices, biodiversity monitoring, and sustainable resource utilization.

(KI 1, 7th February 2024, Karura, Nairobi City County)

The voice note in the statements underscores the importance of employing local staff within forest management roles due to their invaluable knowledge and understanding of the forest ecosystem.

The study systematically analyzed the hindrances to successful PFM in the Karura Forest Ecosystem in Kenya. Through a comprehensive examination of various factors and challenges, the research aimed to identify and understand the barriers that impede the effective implementation of PFM practices in the region. By scrutinizing issues such as governance structures, community engagement, resource allocation, and institutional support, the study provided valuable insights into the multifaceted challenges faced by PFM endeavors in Karura. Through this analysis, the research sought to inform and guide future interventions and policies aimed at addressing sustainability and success of PFM in Karura and similar ecosystems. In this view, the study sought to understand the efficacy of stakeholder roles in PFM. Figure 4.9 illustrates on efficacy of stakeholder roles in PFM.

Figure 4.9: Efficacy of Stakeholder Roles in Participatory Forest Management



Source: *Researcher, 2024.*

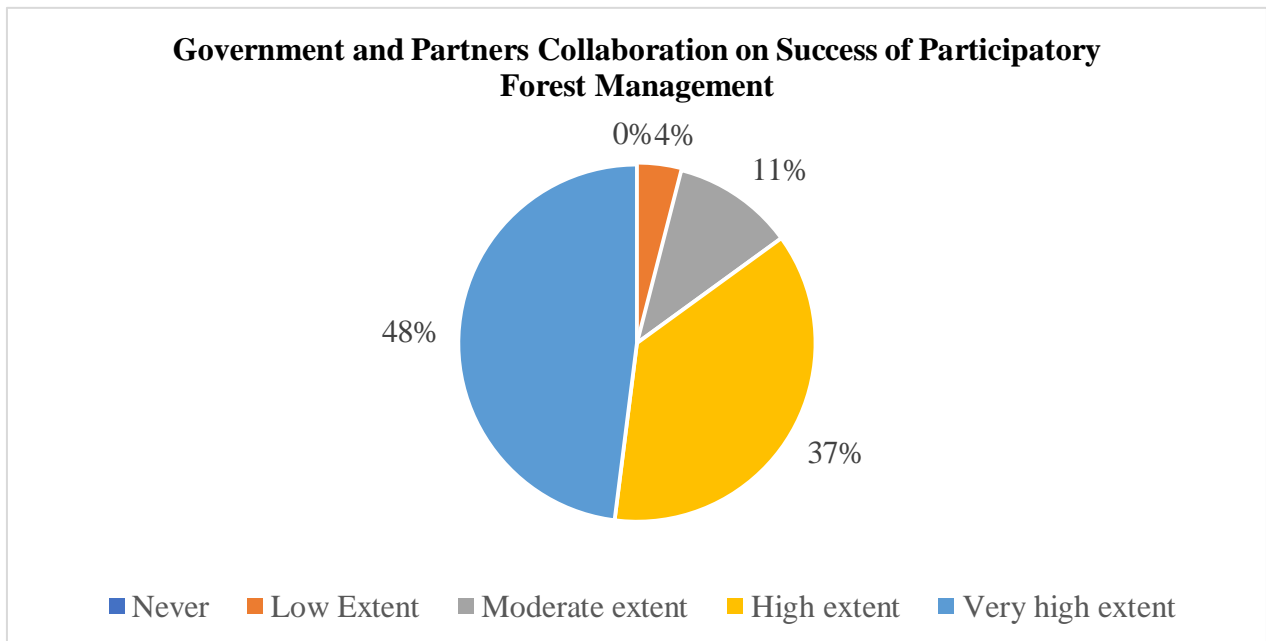
The study presents a nuanced view of the efficacy of stakeholder role and responsibility allocation in Karura's PFM. Respondents' opinions reveal a mixed perception, with a majority 42% rating the effectiveness as "High Extent," 26% indicating "Very High Extent," and 30% opting for "Moderate Extent." Interestingly, no respondents placed the effectiveness in the lower categories of "Low Extent," though 2% rated it as "Never". The positive ratings were likely influenced by the integration of traditional ecological knowledge with modern scientific approaches, affirmed by 73% of respondents, enhancing overall understanding and decision-making in PFM. Additionally, education efforts, and an emphasis on tree planting and conservation, as outlined in the Karura Participatory Forest Management Plan (KPFMP) 2021-2026, contribute to the perceived effectiveness of stakeholder roles.

While the majority view stakeholder roles positively, it's essential to recognize potential challenges, as indicated by the 30% "Moderate Extent" responses. These challenges involve communication gaps, differing stakeholder interests, and potential conflicts within the complex network of actors in PFM. Achieving a balance and fostering collaboration among stakeholders could be areas requiring attention to enhance overall effectiveness. The study also emphasized that effective stakeholder roles have direct implications for climate change mitigation, with positive

perceptions likely correlating with successful conservation and restoration activities, as well as the integration of indigenous knowledge for sustainable practices.

The overall positive perception of stakeholder roles and responsibility allocation acknowledged in KPFMP (2021-2026), reflected in the high and very high ratings suggests a prevailing sense of success in current practices. The study points to potential drivers, such as the integration of traditional knowledge and community involvement, but also highlights a moderate effectiveness of 30%, indicating room for improvement. Enhancing communication, addressing conflicting stakeholder interests, and fostering collaboration are identified as areas that could further improve the overall effectiveness of stakeholder roles. The positive link between effective stakeholder engagement and climate change mitigation underscores the broader significance of PFM in Karura in contributing to sustainable forest management. Continuous evaluation and adaptive management strategies are emphasized as key for ensuring the long-term success of PFM practices and climate change mitigation in the Karura forest ecosystem. Figure 4.10 illustrates on government and partners cooperation on success of PFM.

Figure 4.10: Government and Partners Collaboration on Success of Participatory Forest Management



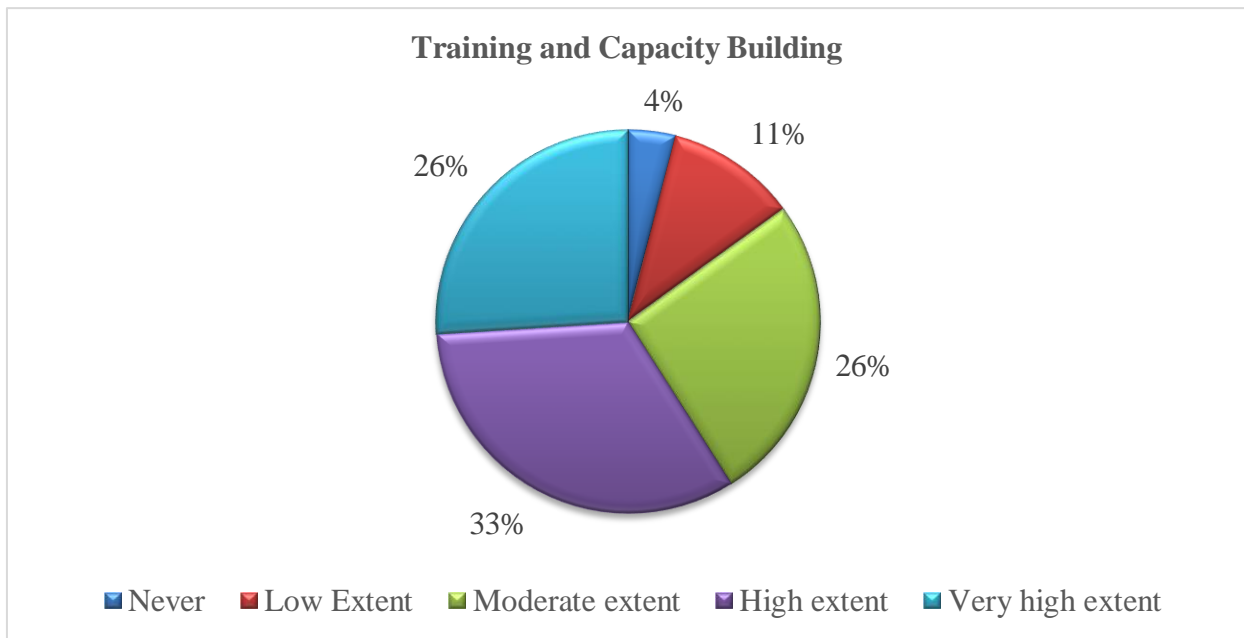
Source: *Researcher, 2024.*

The overwhelmingly positive ratings on the collaboration between the government, led by KFS, and partner organizations reflect a significant success in PFM collaboration in conservation activities in Karura Forest Ecosystem. The collaboration between these entities, as indicated by majority 48% of respondents rating it as having a "Very High Extent" and 37% indicating a "High Extent," underscores the crucial role of combined efforts in achieving conservation goals and climate change mitigation. The KPFMP for the period (2010-2015, 2016-2020) highlights the contribution of this cooperation in providing essential financial and technical resources necessary for effective conservation strategies, further reinforcing the positive perception of government and partner organization collaboration in Karura's PFM practices (KPFMP, 2021-2026).

The collaboration facilitates a comprehensive and coordinated approach to conservation, capitalizing on the strengths and expertise of both government institutions and non-governmental partners. By sharing responsibilities and leveraging complementary skills, the government and partner organizations can adopt a holistic management approach, addressing the diverse challenges within the Karura forest ecosystem. Such synergy creates an enabling environment for successful PFM practices, enhancing the effectiveness of conservation activities and contributing to broader climate resilience goals. Moreover, the alignment of these efforts with climate change mitigation objectives highlights the crucial role of PFM in sequestering carbon, regulating local climate conditions, and preserving biodiversity, thereby enhancing the overall resilience of the forest ecosystem and its capacity to mitigate climate change.

Financial and technical resources obtained through government and partner organization cooperation enable the implementation of various conservation strategies, including afforestation, reforestation, and sustainable forest management practices like beekeeping and ecotourism. These strategies not only contribute to the conservation of Karura forest but also have positive socio-economic impacts by providing opportunities for local communities and promoting sustainable livelihoods as noted in the KFS Report of 2021 (Mbeche *et al.*, 2021). Figure 4.11 illustrates on training and capacity building accessibility.

Figure 4.11: Training and Capacity Building



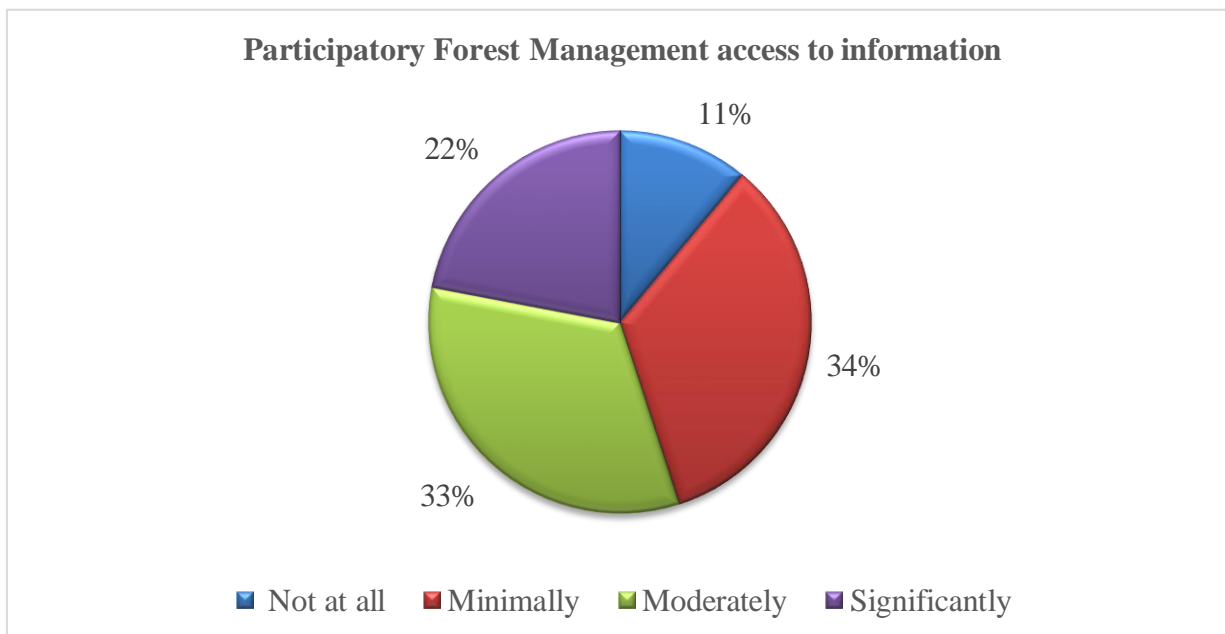
Source: *Researcher, 2024.*

The study's findings revealed a positive perception regarding the accessibility of training and capacity-building programs for local communities and stakeholders engaged in Karura Forest Ecosystem PFM practices. With majority 33% of respondents rating accessibility as "High Extent," 26% as "Very High Extent," and 26% as "Moderate Extent," the results suggested that considerable efforts had been made to ensure that training opportunities were available to community members and stakeholders involved in PFM. This positive assessment aligned with an evaluation of PFM activities in the KPFMP for the period (2010-2015, 2016-2020), which outlined the FKFCFA's education program and achievements, such as the preparation of a visitor's guide handbook, highlighting their commitment to education and capacity-building within PFM (KPFMP, 2021-2026).

The accessibility of training and capacity-building programs is crucial for empowering local communities and fostering their active and informed participation in PFM practices. The positive ratings suggested that the provision of accessible training contributed to building knowledge and skills necessary for effective PFM, supporting broader climate change mitigation goals. Training programs were instrumental in educating communities about sustainable forest management

practices, biodiversity conservation, and the role of trees in climate change mitigation. Equipping local communities and other stakeholders with the necessary knowledge and skills enhanced their ability to actively contribute to climate resilience. However, the study also highlighted low ratings and instances of no accessibility, indicating potential challenges in ensuring universal access. Tailoring training programs to address specific stakeholder and community needs including in the design and implementation processes could foster more inclusive and effective capacity-building efforts in PFM practices thus enhancing climate change mitigation. Figure 4.12 illustrates on PFM access to information framework.

Figure 4.12: Participatory Forest Management Access to Information



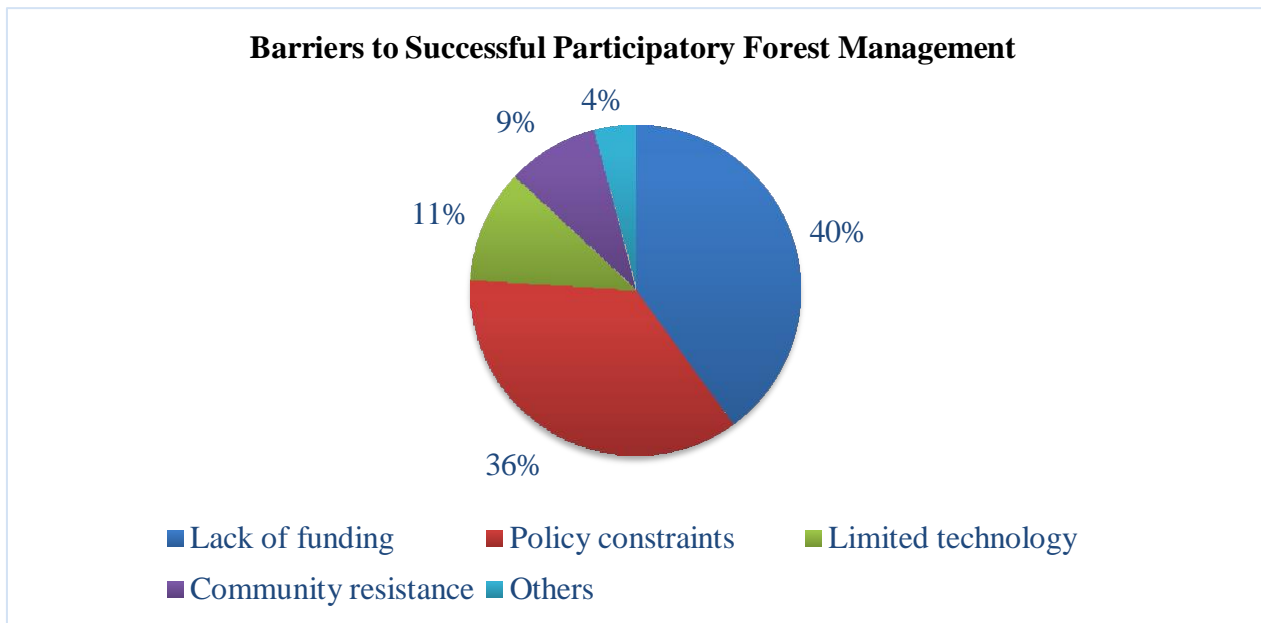
Source: *Researcher, 2024.*

The study responses revealed a varied perception regarding the PFM access to information in Karura forest ecosystem on the influence of access to information on PFM practices. 30% of the respondents rated the lack of access to information as having a "Moderate" impact, while 34% rated it as having a "Minimally" impact. Twenty-two percent of respondents rated it as "Significantly" impactful, and the remaining 11% rated it as having "Not at all" impact. These results suggest that while some local community members in Karura lack access to information about the benefits of PFM, others perceive the impact of this lack access to information differently.

This situation may arise where some awareness practices are in place but may not be reaching all segments of the local community effectively. Identifying and addressing the specific barriers to access to information will be crucial in designing interventions that resonate with the diverse needs and preferences of the community.

The lack of access to information among local communities about the benefits of PFM has direct implications for climate change mitigation efforts. Effective PFM is integral to mitigating climate change, given the role of forests in carbon sequestration, biodiversity conservation, and regulating local climate conditions. To enhance the sustainability of PFM practices in Karura, addressing the lack of access to information is crucial. This can be achieved through targeted access to information campaigns, community engagement practices, and the enhancement of integration of local knowledge and cultural practices into educational programs. Collaborating with local leaders, community influencers, and educational institutions can play a vital role in disseminating information effectively. Using diverse communication channels, including local languages and visual aids, can help bridge language and literacy barriers. It is imperative to enhance the involvement of the 11% of community members in the design and implementation of access to information programs to ensure cultural sensitivity and relevance. Figure 4.13 illustrates on barriers to successful PFM.

Figure 4.13: Barriers to Successful Participatory Forest Management

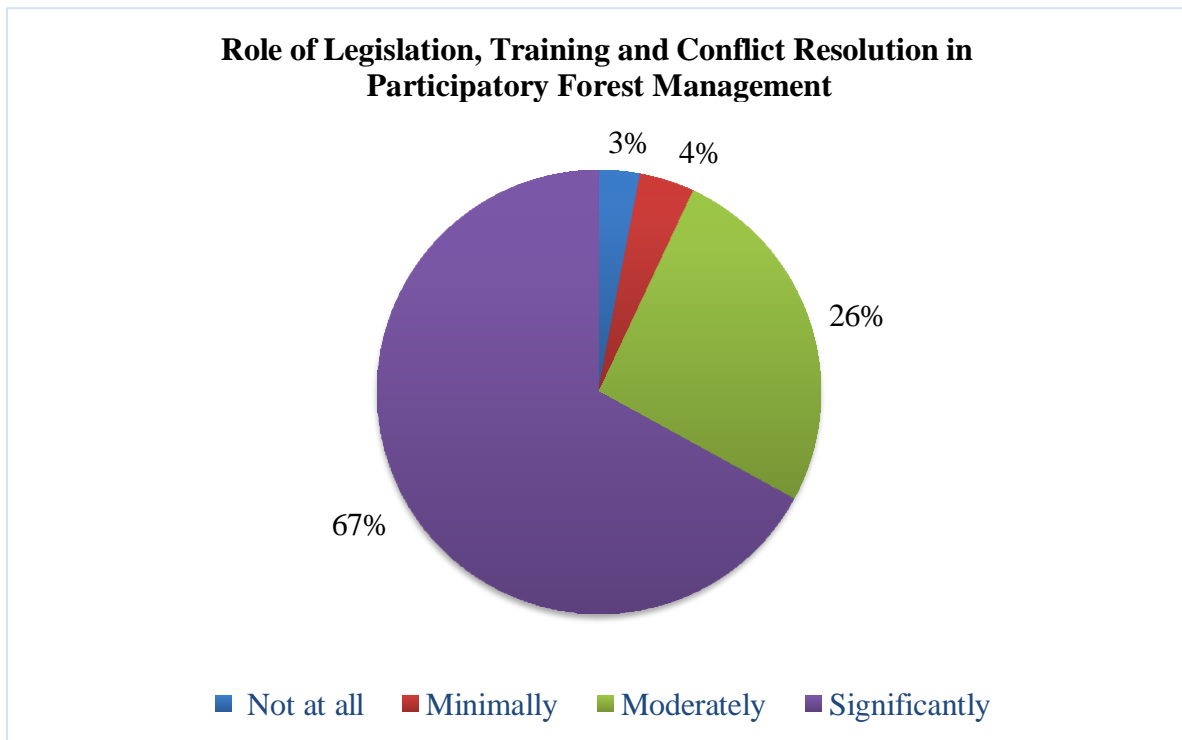


Source: *Researcher, 2024.*

The study indicated a diverse set of perceptions regarding the most significant barriers to successful PFM practices in Karura. Majority of respondents (40%) identified "Lack of funding" as the most significant barrier, emphasizing financial limitations hindering effective PFM. Funding is essential for implementing conservation activities, community and stakeholder capacity-building programs, and sustainable forest management practices. Overcoming this barrier may involve enhancing revenue, seeking alternative funding sources, engaging with external donors, and advocating for increased budget allocations from KFS for PFM practices (KPFMP, 2021-2026). Additionally, a substantial percentage attributed the barrier to "Policy constraints" at 36%, suggesting that existing policies may not adequately support or facilitate successful PFM. These constraints could include bureaucratic hurdles, conflicting regulations, or a lack of alignment between policies and community needs. Addressing these policy constraints would likely require advocacy, policy reform, and stakeholder collaboration to create an enabling environment for PFM to be sustainable and to attain its strategic goals and climate change mitigation in Karura Forest Ecosystem.

While a smaller percentage identified "Limited technology" as a barrier, it was still a noteworthy concern that may hinder the adoption of modern and efficient forest management practices. Addressing this barrier could involve providing training and resources to enhance technological literacy within local communities, enabling them to leverage available tools for better forest management. The recognition of "Community resistance" as a barrier suggested that there might be challenges in gaining the active participation and support of local communities in PFM practices. Identifying the root causes of resistance, engaging in community dialogue, and incorporating local perspectives into KPFMP are crucial steps in addressing this barrier and fostering a sense of ownership and collaboration (KPFMP, 2021-2026). Figure 4.14 illustrates on the role of legislation, training and conflict resolution in PFM regulatory framework.

Figure 4.14: Role of Legislation, Training and Conflict Resolution in Participatory Forest Management



Source: *Researcher, 2024.*

The responses from the study indicated a clear consensus among respondents regarding the critical importance of clear legislation and policies, adequate training, capacity building, and effective

conflict resolution mechanisms for the success of PFM in Karura. The highest percentage of respondents (67%) rated these elements as being of "Significant" importance. The "Moderately" important category followed at 26%, while the "Not at all" and "Minimally" categories each receive a low percentage of 3% and 4% respectively. The cumulative high percentage of 97% highlighted the significance of clear legislation and policies, suggesting a strong acknowledgment of the foundational role that legal frameworks play in successful PFM. Well-defined laws and policies provide a framework for sustainable forest management, delineate the rights and responsibilities of stakeholders, and create an enabling environment for community participation. Effective legal structures are essential for regulating forest resource use, preventing illegal activities, and fostering long-term conservation efforts, as endorsed by the approved KPFMP, 2021-2026. This is anchored in the forest management legislation in the FCMA, 2016.

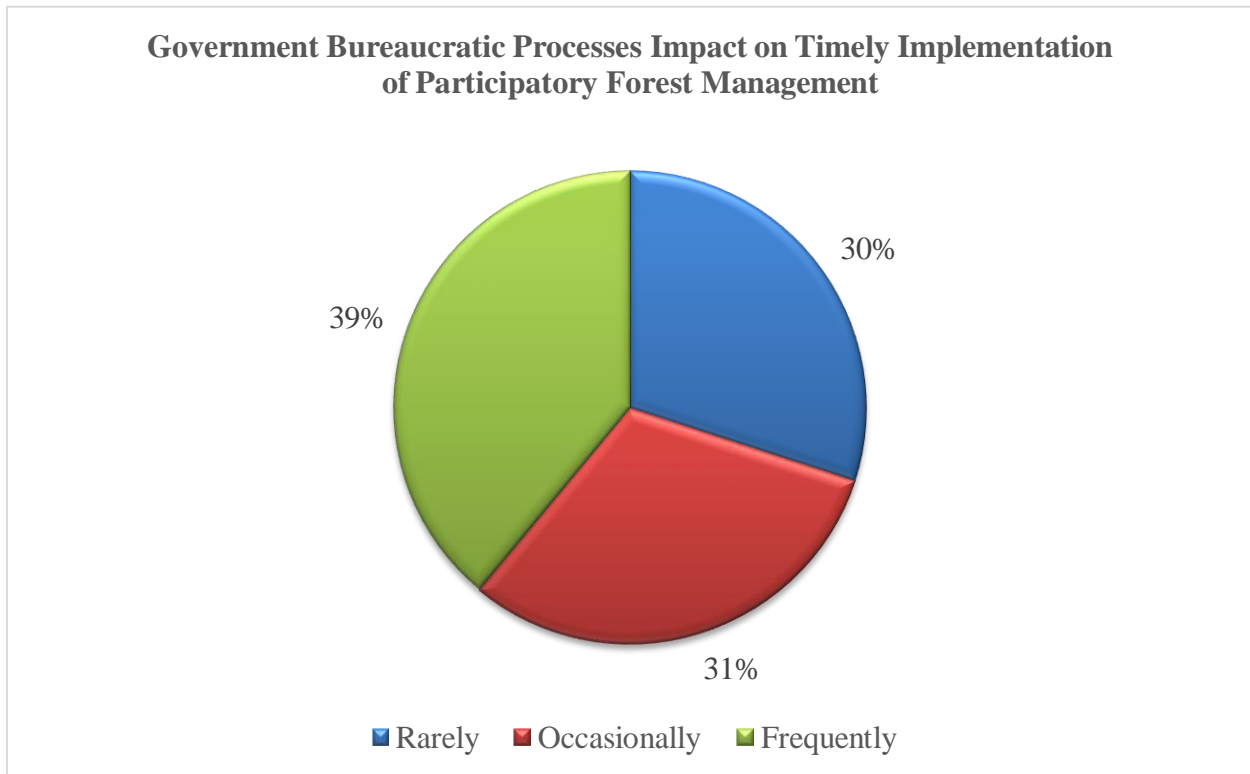
The parallel importance placed on training and capacity building underscores the recognition of knowledge and skills as integral components of successful PFM. Adequate training empowers local communities to actively participate in sustainable forest management practices. Building the capacity of community members enhances their understanding of ecological processes, strengthens their ability to implement sustainable forest conservation strategies, and fosters a sense of ownership in the conservation efforts. Well-trained individuals contribute to the overall success of PFM by ensuring informed decision-making and effective implementation of conservation activities to foster climate change mitigation efforts. This is backed by an assessment of the implementation of PFM activities in the KPFMP for the period (2010-2015, 2016-2020). In an interview, an informant opined that

Training and education have done a monumental job in the success of FKFCFA PFM activities. The equal emphasis on effective conflict resolution mechanisms highlights the acknowledgment that conflicts can arise in the dynamism of PFM. Establishing effective conflict resolution mechanisms is crucial for maintaining stakeholder collaboration, addressing disputes over resource use, and ensuring the sustained success of PFM practices. Effective conflict resolution mechanisms contribute to social cohesion, preventing disruptions that hinder climate change mitigation efforts, as championed by Professor Wangari Maathai in resolving conflicts in Karura Forest.

(KI 5, 09 January 2024, FKFCFA Management, Karura Forest Office)

Figure 4.15 illustrates on government bureaucratic processes impact on timely implementation of PFM.

Figure 4.15: Government Bureaucratic Processes Impact on Timely Implementation of Participatory Forest Management



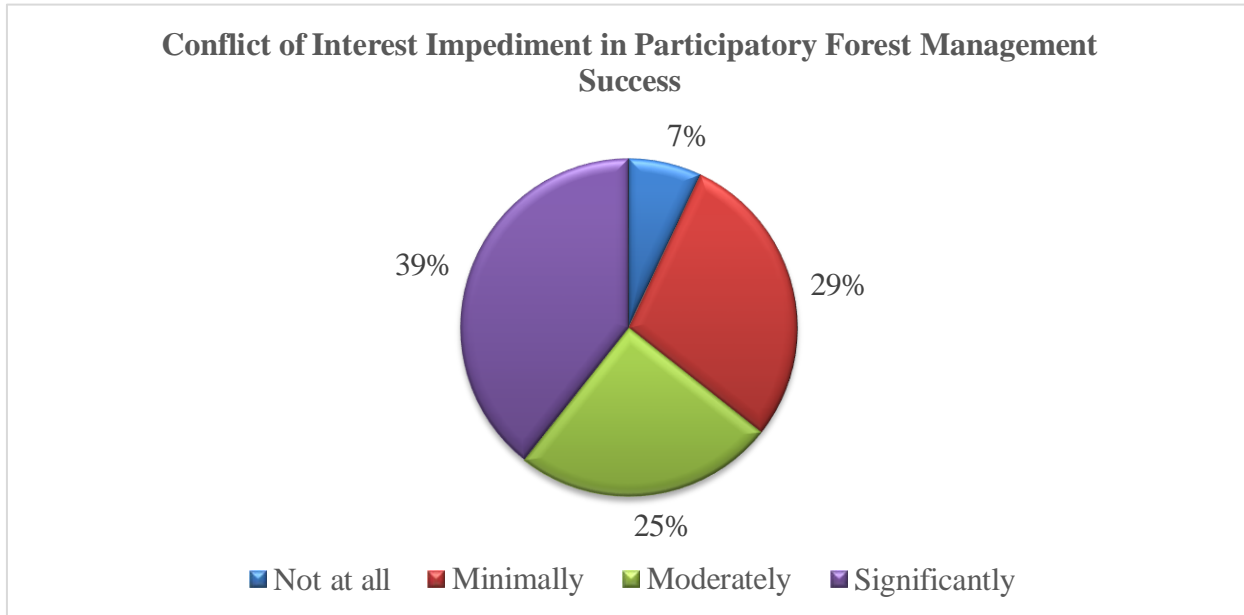
Source: *Researcher, 2024.*

The study showed a diverse perception regarding the significance of government bureaucratic processes in hindering the timely implementation of PFM practices in Karura Forest ecosystem. Majority of respondents (39%) categorize these processes as occurring "Frequently," (31%) considers them to occur "Occasionally," and 30%) perceives bureaucratic hindrances as happening "Rarely". The response indicating frequent hindrances suggests that bureaucratic processes may impede the timely implementation of PFM practices. The key informant number 5 commented that potential factors contributing to occasional hindrances may include procedural delays, administrative bottlenecks, prolonged decision-making processes, complex approval procedures,

inadequate coordination among government agencies involved in PFM, or resource allocation challenges.

Addressing bureaucratic challenges is crucial not only for ensuring timely PFM implementation but also for maximizing the positive impact on climate change mitigation efforts. Streamlining administrative processes, enhancing coordination among government agencies, and implementing reforms to reduce delays are essential steps toward fostering an enabling environment for successful PFM in Karura. Continuous evaluation, adaptive strategies, and stakeholder engagement will be crucial in navigating bureaucratic challenges and promoting effective climate-resilient forest management practices in Karura. It's essential to recognize the role of government bureaucratic processes in shaping the success of PFM practices, and proactive measures are necessary to mitigate their impact on timely implementation, ultimately contributing to the broader goals of sustainable forest management and climate change mitigation. Figure 4.16 illustrates on conflict of interest impediment in PFM success.

Figure 4.16: Conflict of Interest Impediment in Participatory Forest Management Success



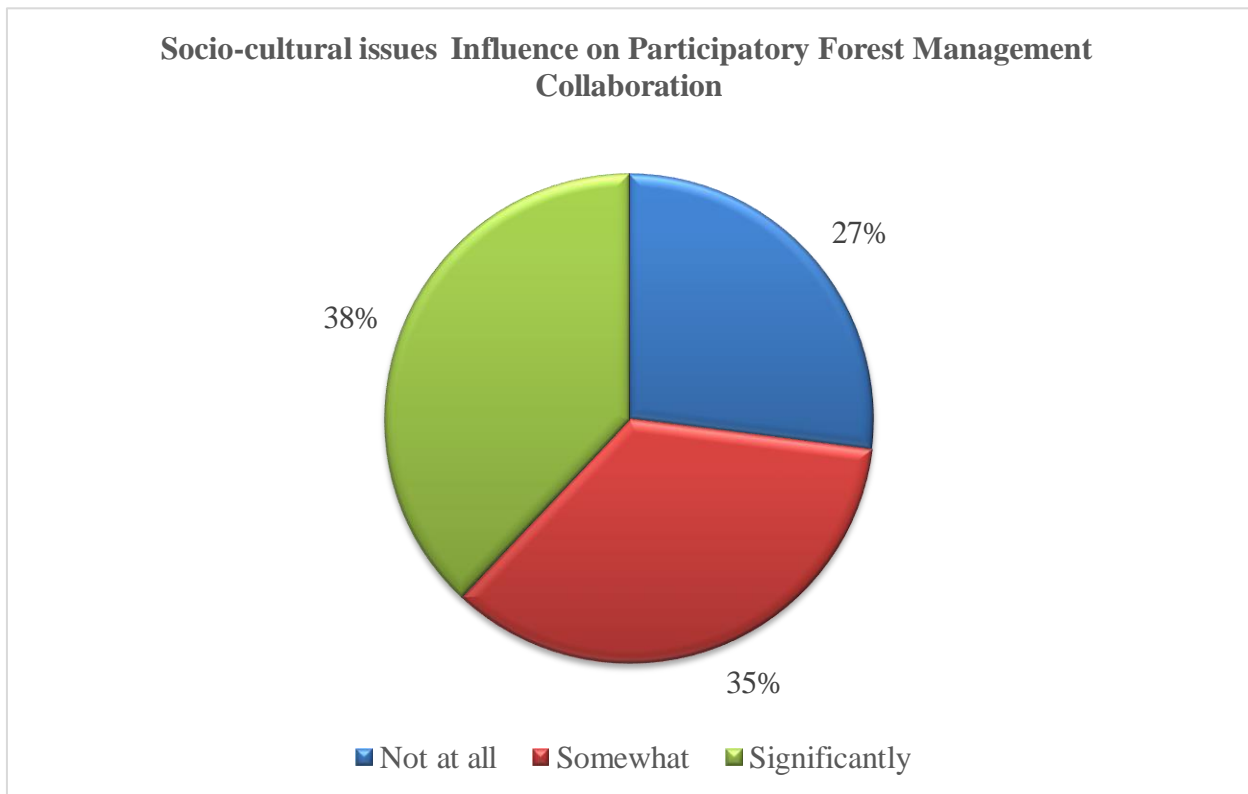
Source: *Researcher, 2024.*

The study results indicated a diversity of opinions regarding the impact of conflicting interests on the success of PFM in Karura Forest Ecosystem. While 7% believe that conflicting interests do

not impede success at all, the majority (39%) asserts that these conflicts significantly hinder progress. The intermediate categories; minimally (28%) and moderately (25%). Different stakeholders often have competing interests in the forest resource use, with local communities seeking livelihoods through consumptive use and agricultural expansion conflicting with conservation goals. Disputes over the distribution of benefits from forest resources, such as timber and non-timber products, can lead to tensions among stakeholders as noted in the KFS Report of 2018 (Ototo and Vlosky, 2018). Power imbalances, both within local communities and between communities and external actors, can fuel conflicts and hinder effective PFM activities. Ambiguities in legislation in Forest conservation and Management Act, 2016 related to benefit-sharing can create uncertainties, fostering conflicts among stakeholders. Further, disputes over land use, court cases and resource allocation can threaten the rich biodiversity of Karura Forest, impacting ecosystems and diminishing the forest's resilience to climate change.

The perceived impact of conflicting interests on the success of PFM practices in Karura Forest Ecosystem underscores the complexity of managing natural resources in a socio-economic context. The disparities in stakeholder interests and power dynamics can lead to conflicts that pose significant barriers to achieving sustainable forest management goals and climate change mitigation objectives. Effective conflict resolution mechanisms and stakeholder engagement strategies are essential to address these conflicts of interest and foster collaboration among diverse stakeholders. Additionally, clarifying legal frameworks and benefit-sharing arrangements can help mitigate uncertainties and promote equitable distribution of forest resources, thereby reducing tensions and enhancing the success of PFM practices. Figure 4.17 illustrates on the socio-cultural issues influence on PFM collaboration.

Figure 4.17: Socio-cultural issues influence on Participatory Forest Management Collaboration



Source: *Researcher, 2024.*

The study results indicated a diversity of perspectives regarding the impact of socio-cultural factors on collaboration in Karura. A significant portion (38%) perceives these factors as having a significant impact, while 35% believe in a somewhat impactful influence. Notably, 27% consider socio-cultural factors to have no impact at all. These varied opinions highlight the nature of the collaboration and underscore the importance of socio-cultural elements in PFM activities. Local traditions and beliefs that emphasize environmental conservation can positively influence collaboration, aligning community values with conservation goals. On the other hand, conflicts may arise if traditional practices are perceived as incompatible with external conservation practices.

Effective communication bridges cultural gaps and fosters understanding. When external agencies communicate in a culturally sensitive manner, collaboration tends to be more successful. Language

barriers and misunderstandings can hinder effective communication and coordination, thus negating the gains of PFM. Acknowledging the impact of these factors is crucial for designing effective strategies that foster collaboration, ensuring the success of practices aimed at both local well-being and global climate change mitigation goals. Through a clear understanding of community traditions, effective communication, and inclusive decision-making, collaboration can be strengthened, contributing to the sustainable management of Karura and serving as a model for broader climate change mitigation efforts.

The diverse perspectives on the impact of socio-cultural factors on collaboration in Karura Forest Ecosystem underscore the complexity of working within a socio-cultural context. Socio-cultural factors such as traditional beliefs, cultural practices, and community norms play a significant role in shaping attitudes and behaviors towards conservation efforts. Understanding and respecting these factors are essential for building trust and fostering effective collaboration between local communities and external partners. Additionally, addressing language barriers and promoting inclusive decision-making processes that incorporate local perspectives can enhance collaboration and ensure that PFM practices are culturally sensitive and locally relevant.

Further, the study responses generally portray a positive view of the improvements in stakeholder collaboration in Karura since the initiation of PFM in 2010. In an interaction with an informant on the topic, the informant said:

There is an increase in mutual understanding among stakeholders, suggesting that over time, stakeholders have developed a better comprehension of each other's roles, expectations, and contributions to forest management.

(KI 3, 08 January 2024, FKFCFA Member, Karura Forest Office)

Additionally, another informant stated that:

The improvement in collaboration is ongoing, with increased interest from external stakeholders in partnering with FKFCFA in Karura PFM activities. This positive trend is supported by an assessment in the implementation status of KPFMP for the period (2010-2015 and 2016-2021), stating that FKFCFA's good governance has attracted widespread support and made it a model for other CFAs in the country.

(KI 6, 10 January 2024, FKFCFA Management, Karura Forest Office)

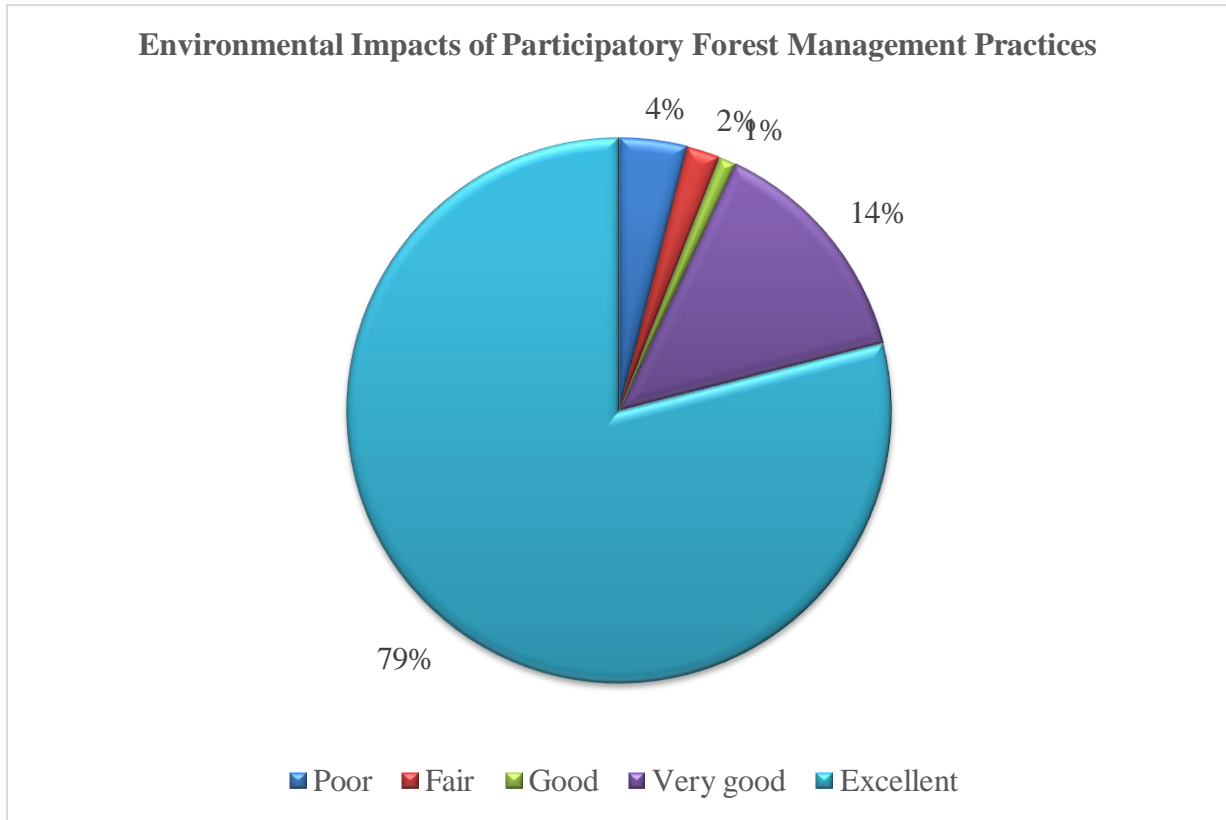
Informed by the sentiments, improvements in stakeholder collaboration in Karura contribute to more effective conservation measures, enhancing the forest's capacity to sequester carbon and playing a vital role in mitigating climate change. The increased interest from external stakeholders can bring additional resources, expertise, and support for climate change mitigation practices. Collaboration with external agencies facilitate access to funding for sustainable practices and technologies, further strengthening Karura's position as a model for successful PFM practices.

The study responses also indicate a positive view on the resolution of conflicts among stakeholders in Karura. Several respondents affirmed that conflicts have been successfully resolved through mediation and peaceful means, attributing the positive transformation of the forest to figures like Professor Wangari Maathai. References to conflict resolution mechanism suggest that there are established structures dedicated to addressing disputes and fostering cooperation. Successful resolution of conflicts has the potential to enhance the engagement of local communities in climate change mitigation practices, such as active participation in reforestation and sustainable resource management. The study recognizes the challenges and ambiguities present, emphasizing the importance of continuous efforts to address remaining issues and ensure that conflicts do not hinder the progress of climate change mitigation practices in Karura Forest Ecosystem.

4.5 Evaluation of Impacts of Participatory Forest Management Practices and Climate change Mitigation

This study employed a multi-dimensional approach to assess the influence of PFM practices on both the natural environment and the local communities dependent on the forest resources and climate change mitigation in Karura Forest Ecosystem. Through rigorous data collection and analysis, the study examined various parameters, including changes in forest cover, biodiversity conservation, carbon sequestration, water resources, as well as socio-economic indicators like livelihoods, income generation, and community empowerment. By integrating ecological and socio-economic perspectives, the study aimed to provide a holistic understanding of the overall impact of PFM practices on the Karura Forest Ecosystem, offering valuable insights for sustainable forest management strategies and policy formulation to mitigate climate change. Figure 4.18 illustrates on the environmental impacts of PFM practices.

Figure 4.18: Environmental Impacts of Participatory Forest Management Practices



Source: *Researcher, 2024.*

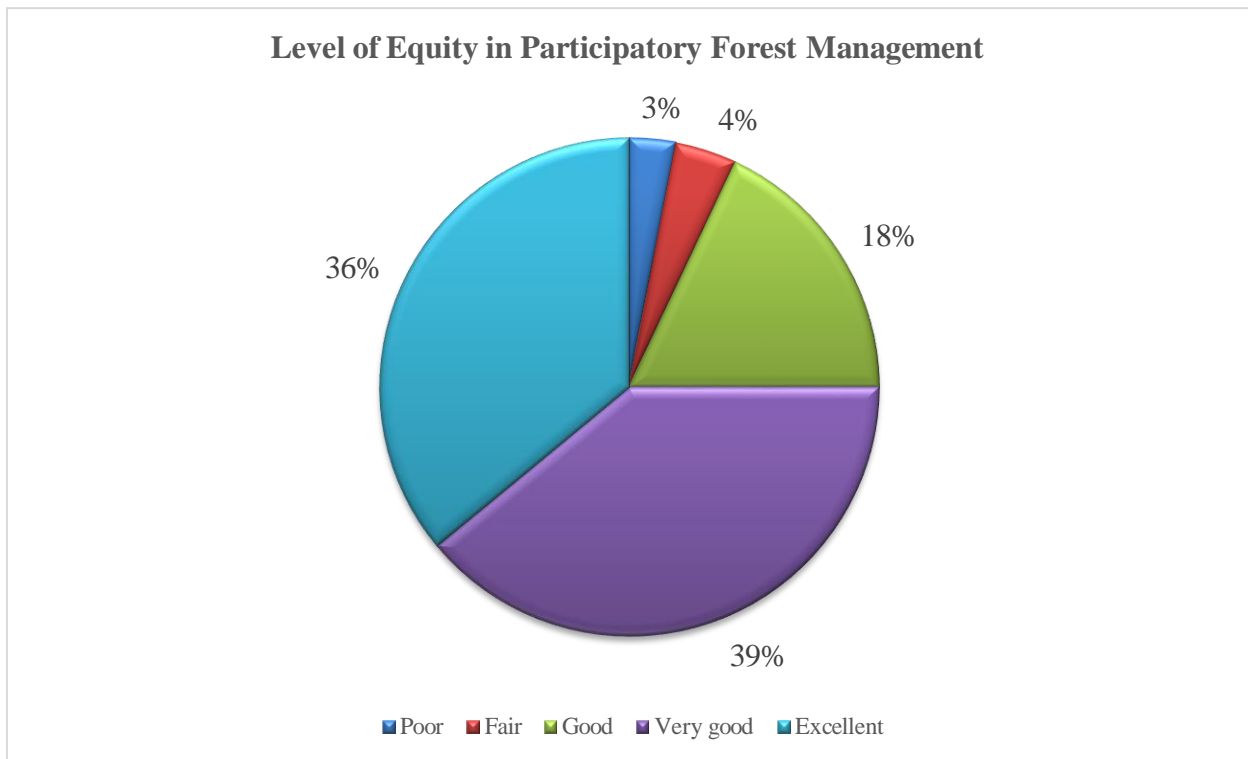
One of the key components of PFM practices in Karura was its remarkable positive influence on biodiversity and ecosystem health. Through the participatory approach, local communities and other stakeholders were empowered to actively engage in conservation efforts, resulting in increased biodiversity and the restoration of degraded ecosystems. The study's rating for this aspect, deemed "Excellent" at 79%, reflected the widespread acknowledgment of the significant impact of PFM on biodiversity in the Karura forest ecosystem. This is corroborated by an assessment which was done by the KFS Forest Information Management System (FIS) department. There was an increment in forest cover from 89.83% in 2010 to 91.042% in 2023 (KFS Report, 2023). This is affirmed by an assessment of status of implementation of Karura Participatory Forest management plans (KPFMP for the period (2010-2015, 2016-2020). It was noted that; 143 ha of degraded plantation and indigenous sites in the Karura forest Ecosystem have been cleared of invasive species and planted with suitable indigenous species (KPFMP, 2021-2026).

The list of bird species increased from 113 to 220 according to Nature Kenya which organizes regular bird-watching visits (KFPPMP, 2021-2026). The Indigenous orchids which had disappeared from the forest through poaching and were reintroduced with help from the Kenya Orchids Society have been thriving and spreading in the forest. In some strategic locations there are nine motion-activated day and night cameras which continue to reveal animal species never recorded before in the forest had been recorded and too shed knowledge on their abundance. These include striped jackal, palm civet and clawless otters. The abundance of wildlife, in general, has increased significantly in the absence of poaching. Animals have become much less shy of people and are easily seen adding value to visits to the forest. The Colobus monkey project continues to be very successful as their population has reached 184 individuals from 142 introduced in 2014. The project has been showcased at international primatology meetings, increasing Karura's visibility globally. Two pairs of African crowned eagles have returned and have successfully nested and fledged chicks in the forest testifying to the recovering health of the ecosystem. (KFPPMP, 2021-2026)

A study of the carbon-storing capacity of Karura Forest Ecosystem was carried out by an ICRAF sponsored student, and the results showed that the carbon-storing capacity of Karura averages at 37.62t/ha (KFPPMP, 2021-2026). The PFM initiated restored area of 143ha can be estimated to have stored carbon amounting to 5,379.66 tonnes. This is attributed to community and partners involvement in rehabilitation and conservation. These demonstrations corroborates the pivotal role of PFM practices in ecosystem restoration which enhance climate change mitigation fostering environmental resilience.

By actively involving local communities and partners, PFM practices promotes the sustainable use of forest resources, effectively preventing deforestation and promoting afforestation. This holistic approach not only contributed to carbon sequestration but also helped in maintaining local climate patterns and reversing the adverse effects of climate change on vulnerable communities. The success stories within Karura Forest Ecosystem, underscore the positive impact of PFM on biodiversity and ecosystem health. Figure 4.19 illustrates on level of equity in PFM.

Figure 4.19: Equity in Participatory Forest Management



Source: *Researcher, 2024.*

The level of social equity in PFM practices in the Karura forest ecosystem appeared to be generally positive, according to the study results. The majority of respondents expressed confidence in the achievement of social equity through PFM practices, with a cumulative positive rating of 93%. This high rating reflected the acknowledgment that PFM activities had positively impacted local communities in Karura, with a majority respondents rating it as "Very good" at 39%, "Excellent" at 36%, and "Good" at 18%. This suggested that PFM practices had effectively contributed to fostering social equity among communities by addressing historical disparities and empowering local residents through decision-making processes.

One key dimension of social equity within the PFM framework was community participation and influence in decision-making processes (Figure 4.5). By actively involving community members, PFM ensured that diverse perspectives were considered, thus empowering local residents and addressing historical disparities in access to and control over forest resources. Additionally, PFM had created livelihood opportunities and generated income for local communities, as indicated by

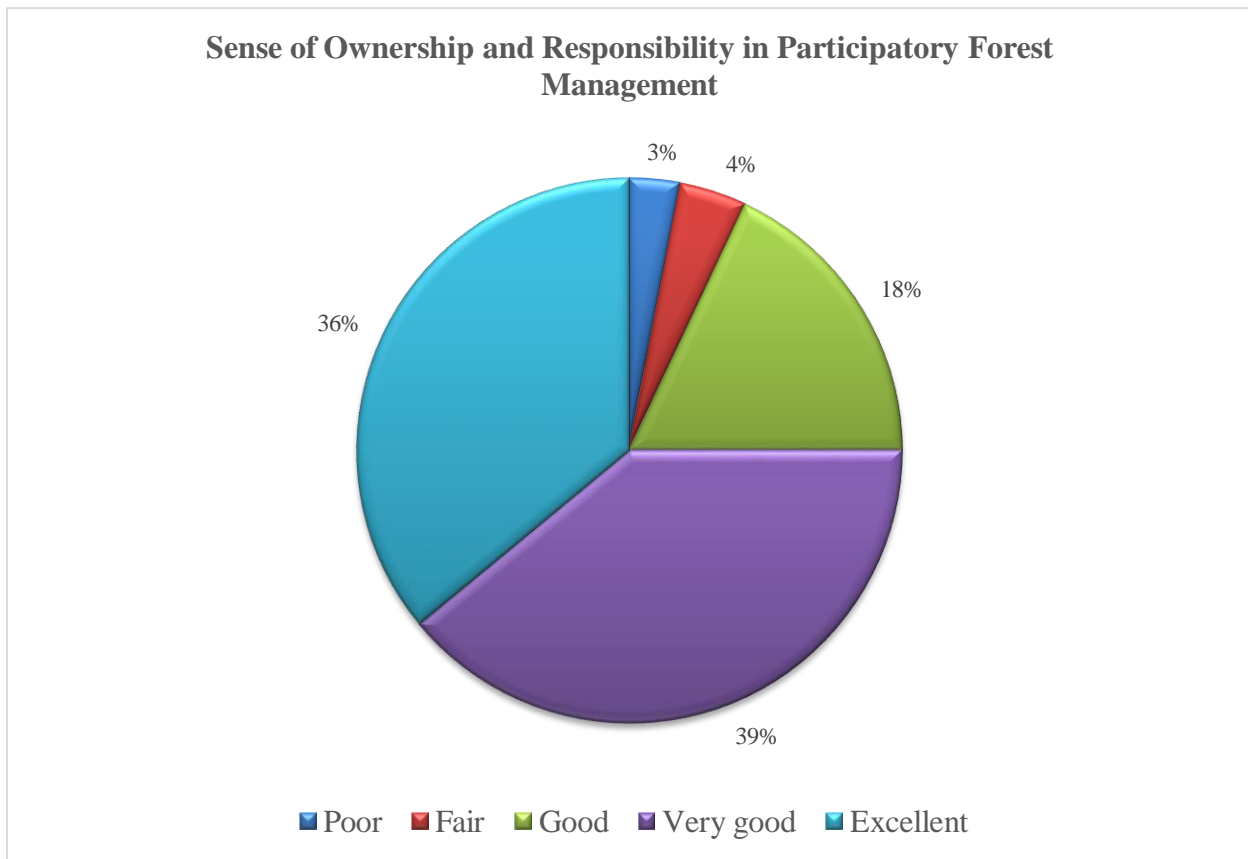
the positive rating. Sustainable non-consumptive practices like beekeeping and eco-friendly ecotourism activities, Promotion of low or no impact, ecosystem-friendly ecotourism activities and amenities in the forest; like walking, running, biking have been initiated(KFPMP,2021-2026).This prevents over-exploitation of resources, contributing to the regeneration of flora and fauna an indicator of achievement of climate change mitigation goal in Karura forest ecosystem.

Moreover, economic empowerment through employment opportunities and a transparent bursary program has been set up by FKFCFA to support children of the local community with secondary school fees payment. Records indicate over 100 candidates have benefited so far (FKFCFA REPORT/KPFMP, 2021-2026).All these gains have improved the economic well-being of local residents, reducing dependency on unsustainable forest exploitation and creating a more balanced distribution of economic gains among different community members.

Social equity is closely tied to gender inclusivity and social justice. The positive rating (Figure 4.2) suggests that there is equal participation of all genders.PFM practices in Karura have addressed gender disparities by actively promoting the inclusion of women in decision-making processes and providing equal opportunities for both men and women in benefiting from forest resources (KPFMP, 2021-2026). This approach not only aligns with principles of social justice but also enhances the effectiveness of climate change mitigation efforts by ensuring that the benefits of PFM practices are distributed equitably among different demographic groups. The perceived success in achieving social equity may also be linked to transparent and fair benefit-sharing mechanisms. The local communities are well-informed about how benefits are distributed and have a say in these processes, it can contribute to a more positive perception of social equity.FKF scholarships is a classic example (KPFMP for the period (2010-2015, 2016-2020).

However, a minority of respondents rated social equity as "Poor" at 3% and "Fair" at 4%, indicating the need for continued efforts to address disparities and ensure that the benefits of PFM practices reached all members of the community. Figure 4.20 illustrates on the sense of ownership and responsibility in PFM practices.

Figure 4.20: Sense of Ownership and Responsibility in Participatory Forest Management



Source: *Researcher, 2024.*

One of the fundamental objectives of PFM practices was to instill a sense of ownership and responsibility among local communities and stakeholders in the quest for the conservation of the Karura forest ecosystem. The study revealed a substantial cumulative support for a sense of ownership, with a cumulative 93% rating. This high rating, including "Excellent" at 36%, "Very good" at 39%, and "Good" at 18%, indicated a widespread acknowledgment that engaging local communities and other partners in the PFM process effectively fostered a feeling of ownership and responsibility.

By involving local residents in decision-making and management processes, PFM practices created a sense of ownership and shared responsibility for the well-being of the forest. This shared responsibility and sense of ownership has been instrumental in curbing illegal logging and other destructive activities, as community members tend to protect a resource they perceived as their

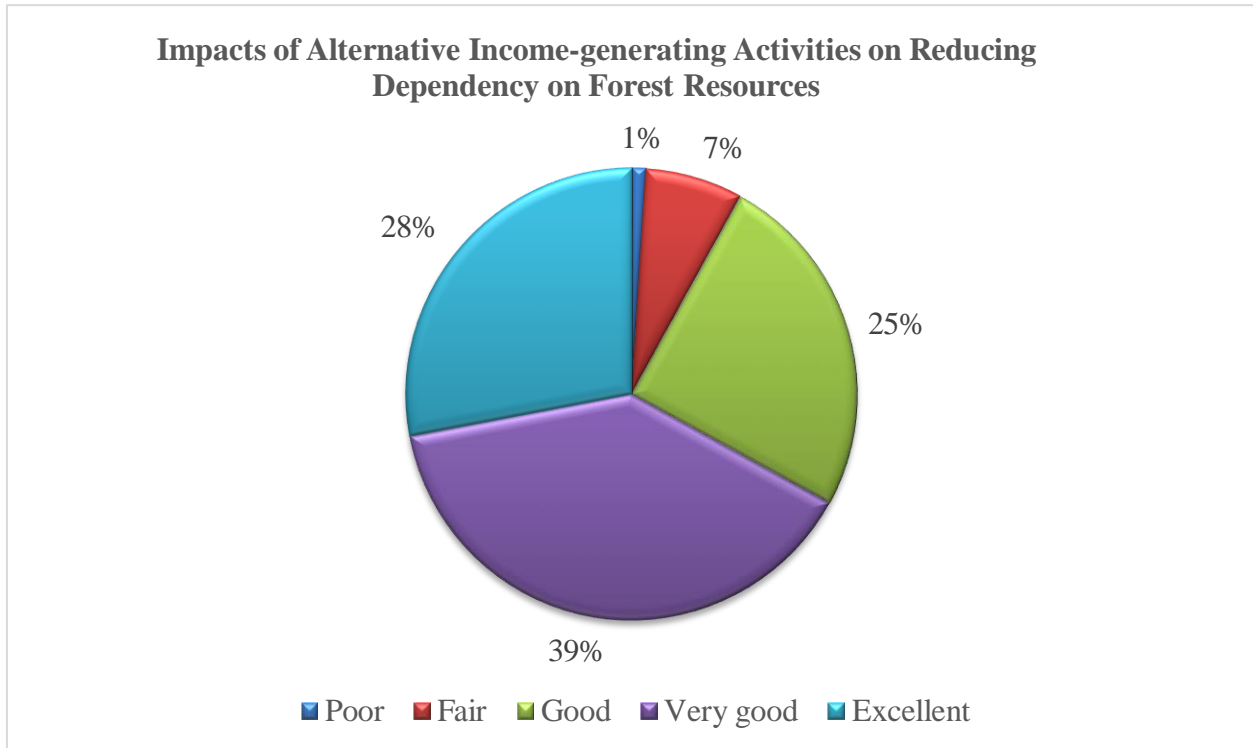
own. This finding underscored the critical role of sense of ownership in community engagement and achievement of sustainable forest management practices.

According to an assessment of implementation status of Karura Participatory Forest management plans (KPFMP for the period (2010-2015, 2016-2020), the following was noted; “due to the vast improvement in security and infrastructure in Karura, the number of visitors to the forest has grown significantly over the last ten years and has reached an average of nearly 40,000 a month from practically none in 2009. Karura is now the number 3(three) attraction to visit in Nairobi according to Trip advisor and it has been awarded a “Certificate of Excellence” for five years running (KFPFMP, 2021-2026).

The vast majority of visitors are Kenyans showing that there is real national ownership of Karura forest which has been dubbed "the people's forest". People come in large numbers to walk, jog, cycle or just enjoy being in a natural setting. An attractive website has been designed and is regularly updated and populated with interesting articles. The Facebook page Friends of Karura Forest is very active and has attracted so far over 23,000 page-likes”. This association is very positive ownership sign (KPFMP, 2021-2026).

Security incidents are extremely rare in Karura Forest. There have been no alarming incidents in the forest since it has been open to the public fostering sense of ownership (KFPMP, 2021-2026). Additionally, the reduction in illegal logging and other destructive activities was evident (KFPFMP, 2021-2026), with local community and stakeholder involvement significantly contributing to the prevention of unsustainable practices that harm the forest ecosystem. This active engagement in the PFM process not only preserved the biodiversity of the forest but also protected the ecosystem's ability to sequester carbon, thereby contributing to climate change mitigation efforts. Figure 4.21 illustrates on the impacts of alternative IGAs on reducing dependency on forest resources.

Figure 4.21: Impacts of AIGAs on Reducing Forest Resources Dependency



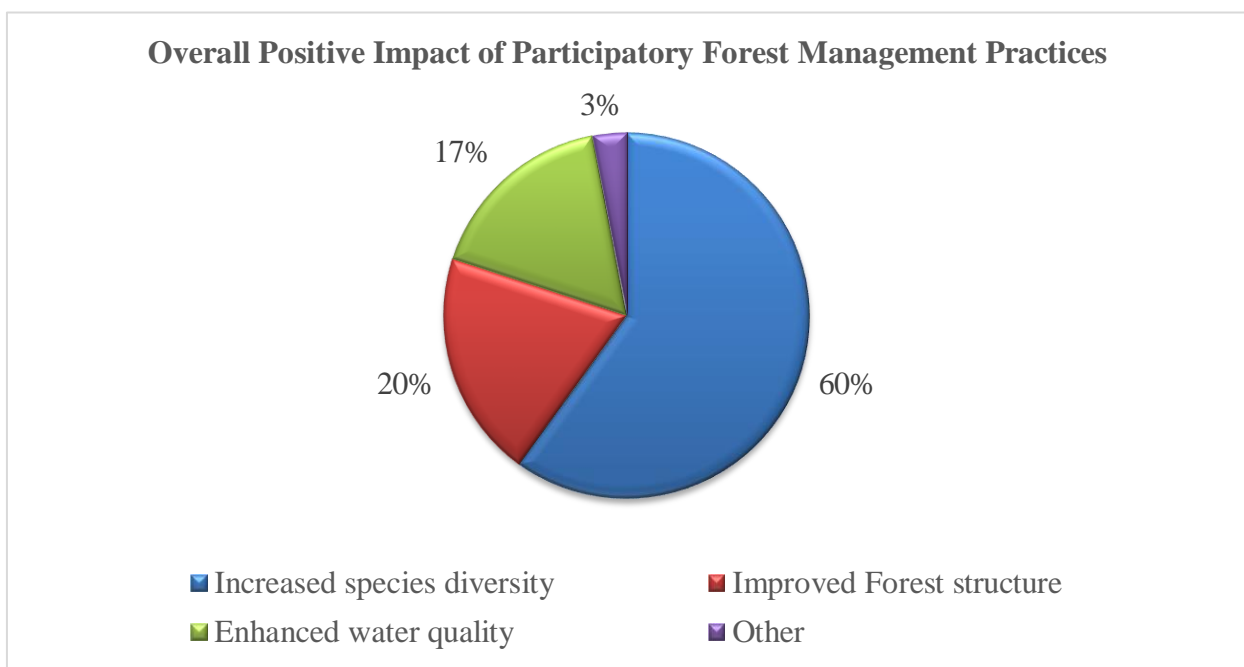
Source: *Researcher, 2024.*

The study results on the upshots of alternative IGAs in Karura portrayed a positive trend, indicating that these practices have been successful in diversifying local economies and reducing reliance on the forest for livelihoods. With majority rating of "Very good" at 39%, "Excellent" at 28%, and "Good" at 25%, stakeholders acknowledged the effectiveness of IGAs in mitigating dependency on extractive forest resources. The introduction of beekeeping and job creation practices have contributed significantly to this reduction in dependency, as evidenced by the employment of 101 permanent staff by the Joint Committee through FKFCFA and the awarding of monthly contracts worth KES 1.2 million to the local community. These practices not only provide viable alternatives but also alleviate pressure on forest resources, thus promoting sustainable forest management practices in Karura Forest Ecosystem.

By providing communities with sustainable alternatives like tree nursery seedling production, and eco-tourism, the introduction of IGAs has helped mitigate the pressure on forest resources, ensuring the long-term sustainability of the ecosystem. This diversification of livelihood activities

contributes to the overall health and resilience of the forest ecosystem, thereby supporting effective climate change mitigation efforts. However, the acknowledgment of "poor and fair" ratings at 8% cumulatively indicates that challenges exist alongside opportunities associated with IGAs. Addressing these challenges and capitalizing on opportunities is crucial to maximize the positive impacts of alternative income activities, further strengthening the link between reduced dependency on forest resources and effective climate change mitigation in Karura. Figure 4.22 illustrates on the overall positive impact of proper FMPs.

Figure 4.22: Overall Positive Impact of Participatory Forest Management Practices



Source: *Researcher, 2024.*

The overall positive impact of PFM practices, particularly through participatory approaches, was evident in the restoration of degraded areas and the promotion of biodiversity in the Karura forest ecosystem. The high rating of 60% for increased species diversity reflected the acknowledgment that PFM played a significant role in promoting biodiversity. Additionally, 20% of respondents recognized the improved forest structure resulting from PFM practices, while 17% acknowledged enhanced water quality as a crucial indicator of positive changes in Karura. This was exemplified by the rehabilitation of degraded forest areas through reforestation with suitable indigenous tree species (KFS Report, 2022). Diverse ecosystems were more resilient to pests, diseases, and

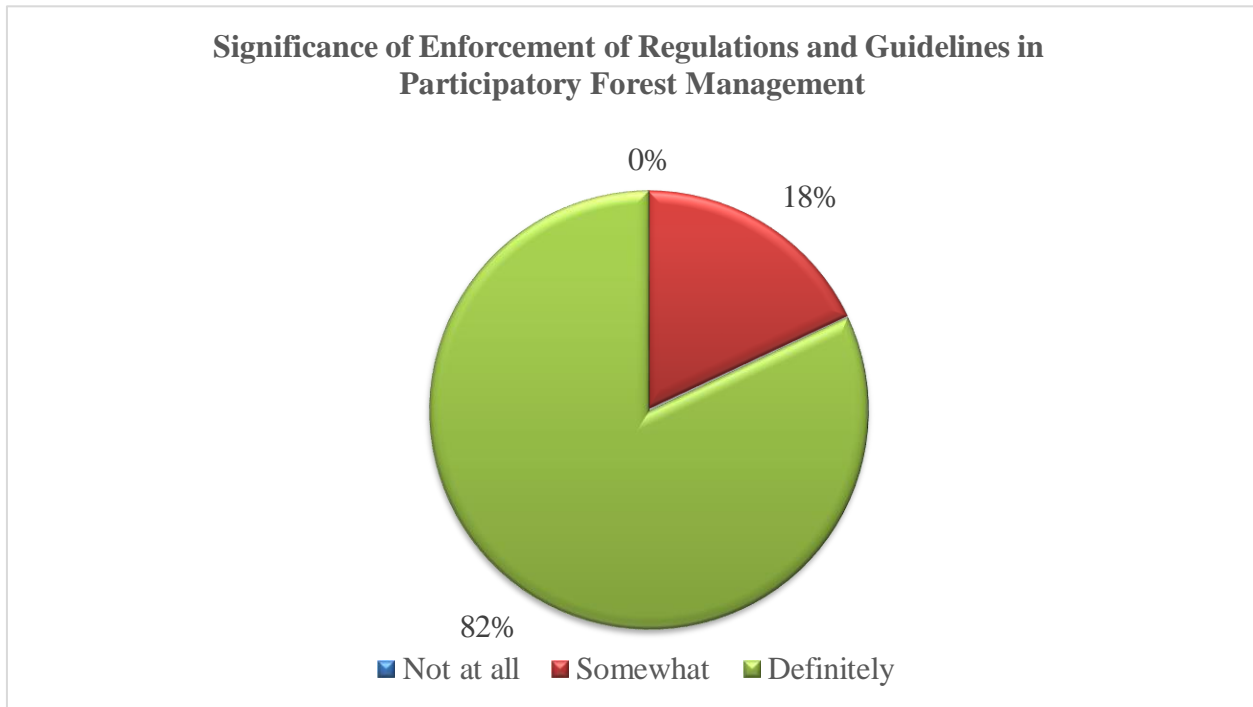
climate-induced stressors, contributing to the overall health of the ecosystem and supporting ecological processes and functions, including carbon sequestration to mitigate climate change impacts.

Improved forest structure resulting from proper forest management practices, including controlled logging and afforestation, contributed to the overall health and sustainability of the forest ecosystem. A well-structured forest provide habitat for diverse species, support natural regeneration, and enhance ecosystem functioning, thus enhancing carbon sequestration and mitigating the effects of climate change. Moreover, PFM practices approaches involving riparian zone protection, reforestation near water sources, and erosion control measures contribute to improved water quality. Protecting water sources and maintaining healthy riparian zones prevent sedimentation, nutrient runoff, and pollution from entering water bodies, benefiting both the forest ecosystem and downstream communities reliant on clean water sources.

Karura Forest Ecosystem river water Preliminary analyses have shown that the rivers are highly polluted with coliform bacteria, presumably from poor sewage treatment in the surrounding neighbourhoods; titers from sample points as the streams enter the forest were $>2,500$ cfu. There is some evidence that the streams enjoy some reduction of the bacterial load as they pass through the forest, but the journey is not long enough to result in a significant reduction” (KFPFMP,2021-2026). It is therefore note taking that healthy water systems can be attained through ecosystem resilience being championed by PFM practices and overally support the adaptability of the forest to changing climate conditions.

Improved access to forest resources is another significant socio-economic benefit, directly contributing to local livelihoods by providing materials for construction, fuel, and traditional medicine. The regulated utilization of these resources under PFM practices prevents over-exploitation, fostering sustainable forest management practices. A classic example is supervised firewood collection allowed once a week in non-indigenous plantation areas. By ensuring that the accessibility of forest resources is sustainable, local communities contribute to the conservation of carbon sinks and biodiversity. This sustainable and regulated approach reduces the pressure on the forest ecosystem, enhancing its resilience to climate-induced stressors and promoting climate change mitigation efforts (KFS Report, 2022).Figure 4.23 illustrates on significance of enforcement of regulations and guidelines in PFM.

Figure 4.23: Significance of Enforcement of Regulations and Guidelines in Participatory Forest Management



Source: *Researcher, 2024.*

The enforcement of regulations and guidelines is paramount in PFM practices as it ensures the implementation of sustainable forest management practices. According to the study results (Figure 4.23), the majority of respondents, accounting for 82%, firmly believe that enforcement has significantly contributed to positive environmental outcomes, with an additional 18% somewhat agreeing with this notion. This strong consensus highlights the critical role of legal frameworks, regulations, and monitoring mechanisms in guiding and regulating activities within the forest ecosystem, ultimately ensuring its sustainability. The Forest Conservation and Management Act (FCMA), 2016, and the FKFCFA constitution provide the necessary legislative framework to govern PFM activities, with specific rules and regulations outlined to guide implementation, as detailed in the KFPFMP, 2021-2026.

Enforcement of regulations within the PFM framework (Figure 4.23) is essential for promoting compliance among community members and stakeholders, thereby preventing detrimental activities such as illegal logging and overexploitation of non-wood forest products. By upholding

these regulations, biodiversity is protected, carbon sinks are conserved, and the overall health and resilience of the forest ecosystem are maintained. This stringent enforcement not only safeguards the forest's ecological integrity but also has direct implications for climate change mitigation efforts. Sustainable forest management practices, underpinned by robust enforcement mechanisms, play a pivotal role in addressing climate change challenges by mitigating carbon emissions, preserving biodiversity, and fostering ecosystem resilience. Therefore, effective enforcement of regulations in PFM is instrumental in achieving both environmental conservation and climate change mitigation goals.

The transformative impacts of PFM practices on local livelihoods (Figure 4.21) in Karura are evident through various indicators, as highlighted by the study respondents. The implementation of KPFMPs has led to positive changes in employment opportunities and poverty alleviation within forest-adjacent communities. Job creation within the forest, including roles such as forest scouts, tour guides, and recreation officers, has significantly improved the livelihood conditions of residents. Moreover, the provision of funds for activities like tree seedling raising and maintenance of rehabilitated degraded areas has further contributed to income generation and poverty alleviation. The acquisition of sustainable forest management skills among individuals has empowered them to participate in conservation efforts, enhancing both livelihoods and forest health. Beyond employment within the forest sector, the diversification of livelihood opportunities, such as honey production, aligns with principles of sustainability and resilience, thereby contributing to community well-being and environmental conservation. These transformative impacts underscore the multiple benefits of PFM practices in improving local livelihoods and promoting sustainable development.

Monitoring and evaluation (KFPFMP, 2021-2026) are crucial components of PFM practices in Karura, providing a systematic approach to assess the impacts of various activities and ensure the effectiveness of conservation efforts. The existence of monitoring processes, employing various methods such as human observation, camera traps, and specific tools and instruments, reflects a commitment to assessing the effectiveness of PFM practices. Additionally, biodiversity conservation monitoring by organizations such as Nature Kenya and the use of motion-activated cameras in strategic locations aid in tracking the impact of PFM practices on biodiversity conservation. Regular assessments help identify and address activities that may degrade forest

ecosystems, thereby protecting them from harm and contributing to climate change mitigation. However, there is a recognition of the need for more resources to establish a proper and informative M&E framework, emphasizing the importance of investing in human and technological resources to enhance monitoring and evaluation processes. This highlights the ongoing efforts to improve the effectiveness of PFM practices through robust monitoring and evaluation mechanisms, crucial for achieving sustainable outcomes in both local livelihoods and global environmental contexts. On this view, an informant said:

Through M&E activities, the impacts of reforestation and afforestation practices on carbon sequestration and biodiversity conservation are evaluated, contributing directly to climate change mitigation efforts.

(KI 7, 10 January 2024, FKFCFA Member, Karura Forest Office)The voice in the statement depicts that M&E activities play a crucial role in assessing the impacts of reforestation and afforestation practices on carbon sequestration and biodiversity conservation, directly contributing to climate change mitigation efforts. Through systematic M&E processes, the effectiveness of these practices in restoring degraded areas and promoting the growth of new forests can be assessed. By measuring changes in carbon stocks and biodiversity levels over time, M&E activities provide valuable insights into the success of reforestation and afforestation projects in sequestering carbon dioxide from the atmosphere and preserving the ecological balance.

4.6 Analysis of Inferential Statistics

The study is based on participatory forest management practices and climate change in Karura forest ecosystem in Nairobi County, Kenya. The study involved a survey that was conducted in Karura forest ecosystem. The individuals who responded to three main objectives were 135. The specific objectives were;

- i. To assess Participatory Forest management practices and climate change mitigation in Karura Forest ecosystem.
- ii. To analyze Participatory Forest management regulatory framework and climate change mitigation in Karura Forest ecosystem.

- iii. To evaluate impact of Participatory Forest management implementation and climate change mitigation in Karura Forest ecosystem.

4.7 Multiple Regression Analysis

Based on the study objectives, multiple linear regression was performed to determine the effect of PFM practices, regulatory framework to successful participatory management and evaluation of impacts on participatory forest management implementation in the Karura Forest ecosystem.

Model Summary

Table 1 below shows the model summary following the multiple regression between the outcome variable (climate change Mitigation in the Karura forest ecosystem) and the predictor variables (participatory forest management practices, participatory forest management regulatory framework and evaluation of the impacts of participatory forest management implementation). From the table, $R = 0.758$, which implies that a strongly positive correlation of 0.76 exists between the outcome and the predictor variables. Additionally, adjusted $R^2 = 0.568$, which implies that up to 56.8% climate change mitigation in the Karura forest ecosystem is explained by PFM practices, PFM regulatory framework and implementation of participatory forest management.

Table 4.2: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.682 ^a	.465	.461	.78879	
2	.758 ^b	.575	.568	.70599	2.327

Source: *Researcher, 2024.*

- a) Predictors: (constant), Evaluation of impacts of PFM implementation.
- b) Predictors: (constant), Analysis of PFM regulatory framework, practices of PFM implementation.
- c) Dependent variable: Climate change Mitigation.

4.8 Analysis of Variance

The analysis of variance following the multiple regression analysis is presented in Table 4.3 below. The ANOVA table has two parts based on the predictor variables. The first part examines the significance of the model with only an evaluation of the impacts Participatory management implementation as the predictor variable, while the second part contains both Participatory management regulatory framework and Participatory management practices as the predictor variables. With the two predictor variables, the model is statistically significant. This implies that the PFM practices, and participatory management regulatory framework, impact of Participatory management implementation are statistically significant predictors of climate change mitigation in the Karura Forest ecosystem at a 95% significant level, $F(2, 132) = 89.20, p < .001$.

Table 4.3: ANOVA

		ANOVA^a				
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	71.957	1	71.957	115.652	.000 ^b
	Residual	82.751	133	.622		
	Total	154.708	134			
2	Regression	88.918	2	44.459	89.200	.000 ^c
	Residual	65.791	132	.498		
	Total	154.708	134			

Source: *Researcher, 2024*

- a) Dependent variable: Climate change Mitigation in Karura Forest Ecosystem.
- b) Predictors: (constant), Evaluation of impacts of PFM implementation.
- c) Predictor: (constant), Analysis of PFM regulatory framework, practices of PFM

4.9 Regression Coefficients

The coefficient values following the regression are shown in Table 4.4 below. From the table, the model can be obtained as follows; Climate Change Mitigation = - 0.56 + 0.524 Impacts of PFM

implementation + 0.434 PFM practices, PFM regulatory framework. The model implies that without the effect of participatory forest management implementation and participatory forest management practices and participatory forest management regulatory framework, the climate change mitigation in the Karura forest ecosystem would be -0.56.

With the predictor variables, a unit change in impacts Participatory forest management implementation results in a positive of 0.524, while a unit change in participatory forest management practices and participatory forest management regulatory framework, it brings about a positive change of 0.434 on the climate Change Mitigation in the Karura forest ecosystem. Based on the corresponding individual p-values, both participatory forest management practices and participatory forest management regulatory framework, and evaluation of impacts participatory forest management implementation are statistically significant in the model at a 95% significant level, $p < .001$.

Table 4.4: Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Collinearity Statistics	
		B	Std. Error	Beta			Tolerance	VIF
1	(Constant)	.578	.253		2.290	.024		
	Evaluation of the environmental and socio-economic impacts	.797	.074	.682	10.754	.000	1.000	1.000
2	(Constant)	-.056	.251		-.224	.823		
	Evaluation of the environmental and socio-economic impacts	.524	.081	.448	6.455	.000	.668	1.498
	Main drivers or hinderances to successful participatory management	.434	.074	.405	5.833	.000	.668	1.498

Source: *Researcher, 2024.*

- a) Dependent variable: Climate change Mitigation in Karura Forest Ecosystem.
- b) (Constant), Evaluation of impacts of PFM implementation.
- c) (Constant), Analysis of PFM regulatory framework, Participatory Forest Management practices.

Regression Assumption tests

Multicollinearity Test

The multicollinearity test checks for the variance inflation factor (VIF) in the model. The regression coefficients table contains the collinearity statistics, which measure the amount of collinearity in the resulting regression model. According to Table, the VIF values for both the predictor variables are approximately 1.50. The multicollinearity effect is present in the model if the VIF values are equal to or greater than 1.000. For the above model, the VIF values for the predictor variables are relatively lower, which implies no multicollinearity in the model.

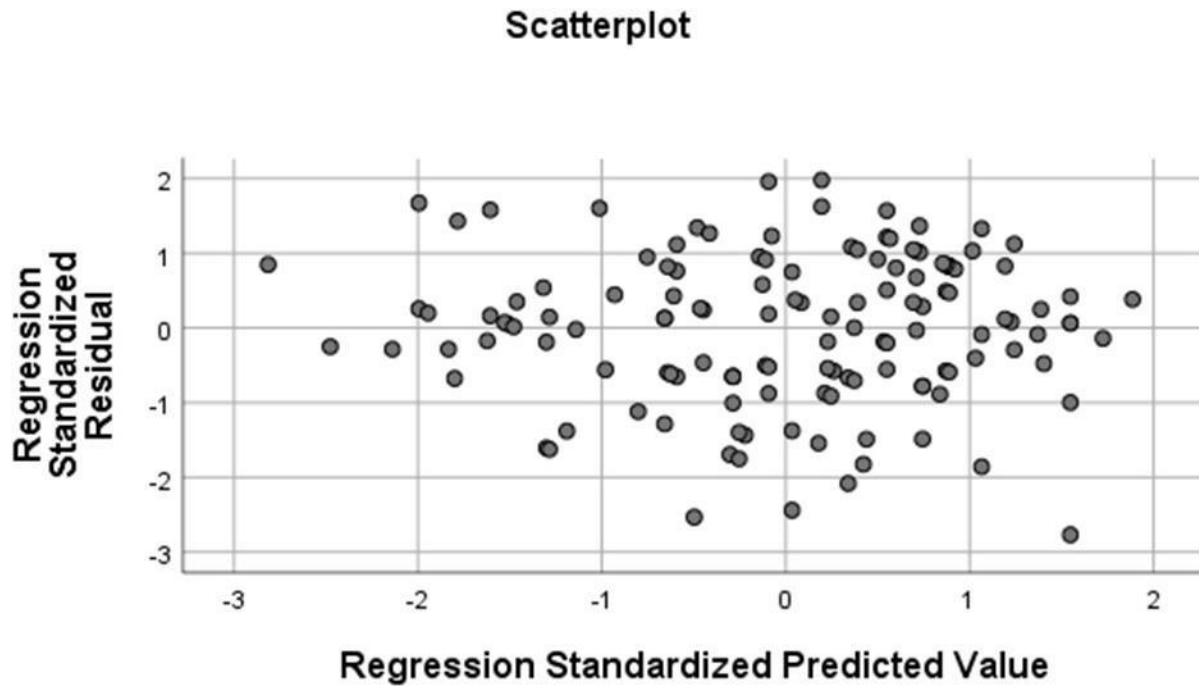
Autocorrelation Test

Durbin-Watson test is used to check whether the resulting multiple regression model has a positive, negative, or no autocorrelation. From the model summary table, the Durbin-Watson value is 2.33. When the Durbin-Watson value is less than 2, there is a positive autocorrelation, when equal to 2, there is no autocorrelation, and when the value is greater than 2, there is a negative autocorrelation in the model. Since Durbin-Watson is approximately 2, the model has no autocorrelation.

Heteroscedasticity Test

Heteroscedasticity checks for consistency of the error terms within the regression model. The regression model needs to have consistency of error terms for reliability. The scatter plot below illustrates the assumption of a common variance. According to the plot, the scatter points tend to fan outwards from the left side towards the right side, which implies that the error terms are less consistent within the model.

Figure 4.24: Heteroscedasticity Plot



Source: *Researcher, 2024.*

Discussion

As already stated, the study was conducted in response to three main objectives including; to assess PFM practices and climate change mitigation in Karura Forest ecosystem, to analyse PFM regulatory framework and climate change mitigation in Karura Forest ecosystem and evaluation of impact of PFM implementation and climate change mitigation in Karura Forest ecosystem

Multiple linear regression was performed on the study objectives. Through the regression analysis, the effect of PFM practices and climate change mitigation in Karura Forest ecosystem, analysis of PFM regulatory framework and climate change mitigation in Karura Forest ecosystem and evaluation of impact of PFM implementation and climate change mitigation in Karura Forest ecosystem was determined.

The results show that assessment of PFM practices and climate change mitigation in Karura Forest ecosystem, analysis of PFM regulatory framework and climate change mitigation in Karura Forest ecosystem and evaluation of impact of PFM implementation and climate change mitigation in

Karura Forest ecosystem are statistically significant determinants of the climate change mitigation in Karura forest ecosystem at a 95% level of significance.

The analysis has also checked on the major assumptions of the multiple regression model including multicollinearity, autocorrelation, and heteroscedasticity to determine the reliability of the model. The various tests performed indicate that the model has met the various assumptions.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

The Chapter presents the summary of findings of the entire research study, where the study draws out generalizable conclusions and provides suitable policy recommendations.

5.1 Summary of the Findings

5.1.1 Participatory Forest Management Practices and Climate Change Mitigation in Karura Forest Ecosystem

In summary, this study examined the PFM practices and its implications in climate change mitigation in Karura Forest Ecosystem, Kenya. It revealed that PFM practices were aimed to restore degraded areas, conserve the forest ecosystem, and improve livelihoods. These objectives directly contribute to climate change mitigation by enhancing ecosystem resilience, promoting carbon sequestration, safeguarding biodiversity, and empowering local communities to engage in sustainable forest use and conservation efforts.

5.1.2 Participatory Forest Management Regulatory Framework and Climate Change Mitigation in Karura Forest Ecosystem

The study delved into the PFM regulatory framework and climate change mitigation within the Karura Forest Ecosystem in Kenya, exploring several factors influencing its effectiveness. These factors encompassed the roles of stakeholders, collaborative efforts between the government and partner organizations, practices for training and capacity building, and potential challenges that could impede progress. Through a comprehensive analysis of these elements, the study aimed to provide insights into the dynamics of PFM regulatory frameworks and its implications on climate change mitigation in the Karura Forest Ecosystem.

5.1.3 Impacts of Participatory Forest Management implementation and Climate change mitigation in Karura Forest Ecosystem

The study evaluated the influence of PFM practices implementation and climate change Mitigation in Karura Forest Ecosystem in Kenya, finding positive outcomes for both the environment and local communities. Environmentally, PFM practices implementation led to increased forest cover, biodiversity, and carbon sequestration, along with improved forest health and water quality, while also reducing illegal logging and other destructive activities. Socio-economically, PFM practices implementation resulted in increased income generation and poverty alleviation, improved access to forest resources in a sustainable manner, and enhanced community empowerment.

5.2 Conclusion

In conclusion, the study underscores the influence of PFM practices in mitigating climate change in the Karura Forest Ecosystem, Kenya. The success of PFM practices is attributed to the active involvement of local communities (Figure 4.5), which fosters a sense of ownership and responsibility (Figure 4.20), leading to sustainable practices. Additionally, PFM practices aligns with global climate change mitigation goals (Figure 4.8), ensuring that local efforts contribute meaningfully to broader strategies. Further, the integration of traditional ecological knowledge with scientific approaches enhances the holistic and effective management of forest resources, emphasizing the importance of a multidimensional approach to address climate change challenges in forest ecosystems.

The study highlights the positive perception of stakeholder roles (Figure 4.9) and the importance of integrating traditional knowledge and community involvement in driving PFM practices in the Karura Forest Ecosystem. However, communication gaps (Figure 4.7) and conflicting interests (Figure 4.16) remain areas that require further attention to enhance effectiveness. Collaboration between government and partner organizations (Figure 4.10) emerges as essential for successful PFM implementation, providing necessary resources and fostering a comprehensive conservation approach. Accessible training and capacity-building programs (Figure 4.11) play a crucial role in empowering local communities to actively engage in PFM practices. Nonetheless, addressing the lack of awareness (Figure 4.12) among some community members poses a significant obstacle that necessitates targeted awareness campaigns and culturally sensitive education practices.

Furthermore, challenges such as funding constraints, policy limitations, technological deficiencies, and community resistance hinder the successful implementation of PFM practices, underscoring the need to address these barriers for long-term sustainability.

PFM practices has proven to be successful in achieving its objectives within the Karura Forest Ecosystem. Through PFM practices, significant strides have been made in environmental conservation, including the restoration of forest cover, biodiversity enhancement, and the mitigation of destructive activities such as illegal logging. Additionally, PFM practices has had a positive impact on the well-being of local communities by fostering sustainable livelihoods, improving access to forest resources, and empowering community members. Overall, PFM practices has demonstrated its effectiveness in promoting both environmental sustainability and socio-economic development thus enhancing climate change mitigation within the Karura Forest Ecosystem.

5.2.1 Contribution to Knowledge

The study contributes to the understanding of PFM practices by demonstrating its effectiveness in climate change mitigation through a case study in Kenya's Karura Forest Ecosystem. It highlights the importance of community involvement, traditional knowledge, and collaboration for success, while also identifying challenges like communication gaps and limited awareness that need to be addressed for long-term sustainability.

5.2.2 Implications to Theory

The study supports the theories explored earlier. Common Pool Resource theory is reinforced by the positive outcomes achieved through community governance and collective action in PFM. Environmental Governance Policy theory finds support as stakeholder collaboration and strong regulatory frameworks were crucial for PFM's success. However, the study emphasizes the need to address limitations in both theories, such as incorporating diverse stakeholder dynamics and adapting to evolving policies, for a more comprehensive understanding of PFM's role in climate change mitigation.

5.2.3 Implications to Practice

The study offers valuable insights for implementing successful PFM practices. It emphasizes active community participation, which fosters a sense of ownership and sustainable practices. Integrating traditional ecological knowledge with scientific approaches is crucial for effective forest management. The study also highlights the need to address communication gaps, raise community awareness, and secure funding and collaboration to overcome challenges and ensure the long-term viability of PFM practices for climate change mitigation and overall forest ecosystem health.

5.2.4 Policy Implications

The study suggests policy improvements to strengthen PFM's role in climate change mitigation. Policies should encourage active community involvement and integrate traditional knowledge alongside scientific approaches. Addressing communication gaps and fostering collaboration between government, partners, and communities are crucial. Additionally, policies should focus on overcoming limitations like funding constraints and technological deficiencies to ensure the long-term sustainability and effectiveness of PFM practices in achieving environmental and socio-economic goals.

5.3 Recommendations

The study recommends the following;

- i. Kenya Forest service and partners ongoing support for PFM practices in Karura to be enhanced. There is need to address challenges such as negative perceptions among marginalized groups and ensuring effective communication channels to promote inclusivity. Additionally, there's a call to seize opportunities by Kenya Forest service and partners to promote awareness and continually improving the integration of traditional and scientific knowledge within PFM practices. Furthermore, maintaining alignment with climate change goals frameworks is essential to ensure the long-term sustainability and effectiveness of PFM practices in Karura, highlighting the importance of continuous efforts to enhance community engagement and conservation practices in the face of evolving environmental challenges.
- ii. Kenya Forest service and partners to enhance communication and collaboration among stakeholders to address potential conflicts and improve the effectiveness of PFM in the Karura Forest Ecosystem. Advocating for increased funding and policy reforms is crucial to create an enabling environment for PFM implementation in Karura. Implementing

targeted awareness campaigns and culturally sensitive education programs can address knowledge gaps within the community and foster support for PFM practices. Developing strategies to overcome challenges such as limited technology and community resistance is essential for promoting inclusive and sustainable PFM practices. Continuous monitoring and evaluation of PFM practices is recommended to Kenya Forest service and partners and make necessary adjustments and ensure their effectiveness in contributing to climate change mitigation efforts.

- iii. Kenya Forest service and Partners ongoing support for PFM practices in the Karura Forest should be stepped up in the several key areas for improvement highlighted. Firstly, strengthening the enforcement of regulations is essential to uphold sustainable PFM practices and safeguard the forest ecosystem from harmful activities. Additionally, investing in robust monitoring and evaluation mechanisms will provide valuable insights into the influence of PFM practices and facilitate continuous refinement to mitigate climate change. Expanding alternative income generation activities beyond traditional forest-dependent livelihoods will help alleviate pressure on forest resources while creating new economic opportunities for local communities. Finally, ensuring the equitable distribution of benefits from PFM practices is critical for fostering community support and ensuring the long-term sustainability of conservation efforts in the Karura Forest ecosystem.

5.4 Suggestions for Further Studies

This research study recommends for further research on:

- i. Addressing equity and inclusivity in Participatory Forest Management.
- ii. Stakeholder collaboration and conflict resolution in Participatory Forest Management.
- iii. Optimizing Participatory Forest Management for long-term sustainability and climate change mitigation.

REFERENCES

- Abebe, D. B. (2022). *Does Participatory Forest Management Increase Forest Resource Use to Cope with Shocks? Empirical Evidence from Ethiopia*. Environment for Development Initiative.
- Agrawal, A. (2001). Participation and exclusion in community forest management. *The World Bank Research Observer*, 16(1), 163-188.
- Ameha, A., Meilby, H., & Feyisa, G. L. (2016). Impacts of participatory forest management on species composition and forest structure in Ethiopia. *International Journal of Biodiversity Science, Ecosystem Services & Management*, 12(1–2), 139–153.
- Angelstam, P., Elbakidze, M., Angelstam, D., & Kuuluvainen, J. (2019). Participatory Forest Landscape Management in the European Context: A Review. *Forests*, 10(12), 1180.
- Banerjee, A., & Chaudhury, S. (2010). Statistics without tears: Populations and samples. *Industrial psychiatry journal*, 19(1), 60.
- Behr, D. C., Cunningham, E. M., Kajembe, G., Mbeyale, G., Nsita, S., & Rosenbaum, K. L. (2012). Benefit sharing in practice.
- Bellard, C., Bertelsmeier, C., Leadley, P., Thuiller, W., & Courchamp, F. (2012). Impacts of climate change on the future of biodiversity. *Ecology Letters*, 15(4), 365–377.
- Berhanu, M., Negash, L., & Bongart, M. (2021). Impact of Participatory Forest Management on Soil Properties and Vegetation Cover in Degraded Communal Forests of Tigray, Ethiopia. *Land Degradation & Development*, 32(14), 5458-5470.
- Blomley, T., & Iddi, S. (2009). Participatory forest management in Tanzania: 1993-2009: Lessons learned and experiences to date. URT: Ministry of Natural Resources and Tourism, Forestry and Beekeeping Division. Participatory forest management in Tanzania: 1993-2009: lessons learned and experiences to date.
- Brandon, K. (2014). Ecosystem services from tropical forests: review of current science. Center for Global Development Working Paper, (380).

- Carmenta, R., Carmenta, K., Davies, S., Gillespie, E., McIntyre-Powell, J., Metcalf, S., Wright, M. N. (2019). Rethinking protected areas management in Melanesia: Integrating indigenous land management practices within a conservation framework. *Biological Conservation*, 232, 149-159.
- Cheng, A. S., Lélé, S., Tahmores, M., Augustine-Slightham, A. L., & Zackrisson, A. (2018). Evaluating the Effectiveness of Collaborative Forest Management in Northern California. *Society & Natural Resources*, 31(12), 1426-1443.
- Cook, D. A., & Beckman, T. J. (2006). Current concepts in validity and reliability for psychometric instruments: theory and application. *The American journal of medicine*, 119(2), 166-e7.
- Cooper, D. R., & Schindler, P. S. (2003). Research methods. *Boston, MA: Irwin*.
- Creswell, J. W., & Poth, C. N. (2017). *Qualitative inquiry and research design: Choosing among five approaches*. Sage publications.
- DeNicola, E., Aburizaiza, O. S., Siddique, A., Siddique, A., Khwaja, H., & Carpenter, D. O. (2015). Climate Change and Water Scarcity: The Case of Saudi Arabia. *Annals of Global Health*, 81(3), 342.
- Dyer, J., Stringer, L. C., Dougill, A. J., Leventon, J., Nshimbi, M., Chama, F., Kafwifwi, A., Muledi, J. I., Kaumbu, J. M. K., Falcão, M. P., Muhorro, S., Munyemba, F., Syampungani, S., Kasimba, C., & Kalaba, F. K. (2014). Assessing participatory practices in community-based natural resource management: Experiences in community engagement from southern Africa. *Journal of Environmental Management*, 137, 137-145.
- Ewane, E. B. (2024). Understanding Community Participation in Tree Planting and Management in Deforested Areas in Cameroon's Western Highlands. *Environmental Management*, 73(1), 274-291.
- Gathaara, G. N. (1999). *Aerial Survey of the Destruction of Mt. Kenya, Imenti and Ngare Ndare Forest Reserves: February -June 1999*. Nairobi, Kenya Wildlife Service: 33.
- Ge, J., Zhang, Z. (Justin), & Lin, B. (2023). Towards carbon neutrality: How much do forest carbon sinks cost in China? *Environmental Impact Assessment Review*, 98, 106949.

- GoK. (2016). *Forest Conservation and Management Act*, 2016.
- GoK. (2016). *Kenya Climate Change Act*, 2016.
- Griscom, B. W., Buchanan, J., Ellis, P. W., Pongratz, J., Lauenroth, W. K., Carmona, C. A., . . . Nabuurs, G. J. (2017). Natural climate solutions. *Proceedings of the National Academy of Sciences*, 114(44), 11645-11650.
- Hernandez-Aguilar, A., Ramírez-Reyes, C., Flores-Guido, M., & Hernández-Díaz, J. C. (2020). Payments for Ecosystem Services and Community Forest Management: A Case Study in the Mayan Peninsula, Mexico. *Sustainability*, 12(13), 5233.
- Hou-Jones, A. (2012). Perceptions and realities of climate change in West Africa: Focus on gender in agricultural communities. *Gender & Development*, 20(2), 221-236.
- Jonathan, V. & Leonie, R. (2022). *Research Handbook on Climate Change Mitigation Law*. United Kingdom: Edward Elgar Publishing.
- Kangas, A., Heikkilä, J., Malmivaara-Lämsä, M., & Löfström, I. (2014). Case Puijo—Evaluation of a participatory urban forest planning process. *Forest Policy and Economics*, 45, 13–23.
- Kimutai, D. K., & Watanabe, T. (2016). Forest-cover change and participatory forest management of the Lembus Forest, Kenya. *Land Use Policy*, 58, 215-222.
- Kitula, R. (2022). Sustainability of land management approaches and practices applied in Eastern African forests. AFF Working Paper. African Forest Forum, Nairobi.
- Kogo, B. K., Kumar, L., & Koech, R. (2021). Climate change and variability in Kenya: A review of impacts on agriculture and food security. *Environment, Development and Sustainability*, 23(1), 23–43.
- Kumar, V., Wankhede, K. G., & Gena, H. C. (2015). Role of cooperatives in improving Livelihood of farmers on sustainable basis. *American journal of educational research* , 3(10), 1258-1266.
- Larson, A. M., & Ribot, J. C. (2014). Reconstituting resilience: Subjectivity and adaptation in ligneous landscapes of southern Senegal. *Journal of Peasant Studies*, 41(4), 753-772.
- Lindsey, Rebecca. (2021). *Climate Change: Global Sea Level*.

- Macdonald, D. W. (2023). *Biodiversity Conservation: A Very Short Introduction*. United Kingdom: Oxford University Press.
- Malhotra, Y. (2004). Why knowledge management systems fail: enablers and constraints of knowledge management in human enterprises. *Handbook on knowledge management 1: Knowledge matters*, 577-599.
- Mashwani, Z.-R. (2020). *Environment, Climate Change and Biodiversity*. In S. Fahad, M. Hasanuzzaman, M. Alam, H. Ullah, M. Saeed, I. Ali Khan, & M. Adnan (Eds.), *Environment, Climate, Plant and Vegetation Growth* (pp. 473–501). Springer International Publishing.
- Mbeche, R., Ateka, J., Herrmann, R., & Grote, U. (2021). Understanding forest users' participation in participatory forest management (PFM): Insights from Mt. Elgon Forest ecosystem, Kenya. *Forest Policy and Economics*, 129, 102507.
- Mbuvi, M. T., Maua, J. O., Ongugo, P. O., Koech, C. K., Othim, R. A., & Musyoki, J. K. (2009). Perceptions on participatory forest management impacts on poverty for selected forest adjacent communities in Kenya. ARPIP-KEFRI Project Report, (1).
- Ministry of Environment and Forestry. (2020). *Kenya's updated Nationally Determined Contributions*.
- Muigua, K. (2014). *Food security and environmental sustainability in Kenya*. Nairobi, Kenya: Government Printers.
- Mukheibir, P. (2010). Water Access, Water Scarcity, and Climate Change. *Environmental Management*, 45(5), 1027–1039.
- Mwangi, E., Weigelt, J., Muriuki, J., & Mbatia, E. (2020). Determinants of sustainable forest management practices in community forests in Kenya. *Sustainability*, 12(13), 5323.
- Naeku, M. J. (2020). Climate change governance: An analysis of the climate change legal regime in Kenya. *Environmental Law Review*, 22(3), 170–183.
- Newton, P., Schaap, B., Fournier, M., Cornwall, M., Rosenbach, D. W., DeBoer, J. & Agrawal, A. (2015). Community forest management and REDD+. *Forest Policy and Economics*, 56, 27-37.

- Ngorima, A., Brown, A., Masunungure, C., & Biggs, D. (2020). Local community benefits from Elephants: Can willingness to support anti-poaching efforts be strengthened? *Conservation Science and Practice*, 2(12), e303.
- Nitschke, C. R., Nichols, S., Allen, K., Dobbs, C., Livesley, S. J., Baker, P. J., & Lynch, Y. (2017). The influence of climate and drought on urban tree growth in southeast Australia and the implications for future growth under climate change. *Landscape and Urban Planning*, 167, 275-287.
- Nnoko-Mewanu, J., Téllez-Chávez, L., & Rall, K. (2021). Protect rights and advance gender equality to mitigate climate change. *Nature Climate Change*, 11(5), 368–370.
- Ogilo, M. C. O. (2015). An assessment of socio-economic linkages between protected areas and Eco-tourism performance in Karura forest, Kenya (Doctoral dissertation, University of Eldoret).
- Ogweno, E. O. (2021). Improving Sustainable Development of Eco-Tourism in Kenya. *East African Journal of Business and Economics*, 3(1), 98–103.
- Ojha, H. R., Persha, L., Rham, S. A., & Agrawal, A. (2020). Evolution of Community Forestry in Nepal: A Review of Policy, Practice and Challenges. *Land Use Policy*, 99, 105087.
- Orodho, A. J., & Kombo, D. K. (2002). Research Methods: Kenyatta University. *Institute of Open Learning, Nairobi Kenya*.
- Ostrom, E. (2008). The challenge of common-pool resources. *Environment: Science and Policy for Sustainable Development*, 50(4), 8-21.
- Ostrom, E. (2010). Beyond markets and states: Polycentric governance of complex economic systems. *American Economic Review*, 100(3), 641-672.
- Ototo, G., & Vlosky, R. P. (2018). Overview of the forest sector in Kenya. *Forest Products Journal*, 68(1), 6-14.
- Partelow, S., Schlüter, A., Armitage, D., Bavinck, M., Carlisle, K., Gruby, R. L. & Van Assche, K. (2020). *Environmental governance theories: a review and application to coastal systems*.
- Persha, L., Agrawal, A., & Ferdinand, E. (2018). Forest governance reforms and REDD+ implementation in Nepal: A nested partnerships approach. *World Development*, 108, 7-24.

- Plough, A. L. (2021). *Community Resilience: Equitable Practices for an Uncertain Future*. United States: Oxford University Press.
- Raihan, A., & Said, M. N. M. (2022). Cost–Benefit Analysis of Climate Change Mitigation Measures in the Forestry Sector of Peninsular Malaysia. *Earth Systems and Environment*, 6(2), 405–419.
- Reboredo, F. (2013). Socio-economic, environmental, and governance impacts of illegal logging. *Environment Systems and Decisions*, 33, 295-304.
- Ribot, J. C., & Larson, A. M. (2012). *Democratic decentralization through a natural resource lens: Cases from Africa, Asia and Latin America*. Routledge.
- Runkler, T. A. (2020). *Data analytics*. Wiesbaden: Springer Fachmedien Wiesbaden.
- Serdeczny, O., Adams, S., Baarsch, F., Coumou, D., Robinson, A., Hare, W., Schaeffer, M., Perrette, M., & Reinhardt, J. (2017). Climate change impacts in Sub-Saharan Africa: From physical changes to their social repercussions. *Regional Environmental Change*, 17(6), 1585–1600.
- Siraj, M., Zhang, K., Xiao, W., Bilal, A., Gemechu, S., Geda, K., Yonas, T., & Xiaodan, L. (2018). Does Participatory Forest Management Save the Remnant Forest in Ethiopia? Proceedings of the National Academy of Sciences, India Section B: *Biological Sciences*, 88(1), 1–14.
- Tesfaye, Y., Bekele, M., Kebede, H., Tefera, F., & Kassa, H. (2015). Enhancing the Role of Forestry in Building Climate Resilient Green Economy in Ethiopia. Center for International Forestry Research, 75.
- Thomson, M. C., & Stanberry, L. R. (2022). Climate Change and Vector borne Diseases. *New England Journal of Medicine*, 387(21), 1969–1978.
- Thygesen, S. H., Løber, T., Skensved, E. M., & Hansen, C. P. (2016). Implementation of Participatory Forest Management in Kenya: A case study of Karima Forest. *International Forestry Review*, 18(3), 357–368.

Tikina, V. A & Innes, L. J. (2016). *Sustainable Forest Management: From Concept to Practice*. United Kingdom: Taylor & Francis.

Zhao, N., Wang, K., & Yuan, Y. (2023). Toward the carbon neutrality: Forest carbon sinks and its spatial spill over effect in China. *Ecological Economics*, 209, 107837.

APPENDICES

Appendix I: Questionnaire

Research topic: Participatory Forest Management Practices and Climate Change Mitigation in Kenya. A case of Karura Forest Ecosystem, Nairobi County.

Introduction

I am John Rono, a staff from the Kenya Forest Service and studying at the National Defence University. I am conducting research in partial fulfilment of the requirement of Master of Arts degree in National Security and Strategy. My research topic is; *‘Participatory Forest Management practices and Climate Change Mitigation in Kenya. A case of Karura Forest Ecosystem, Nairobi County’*. Thank you for participating in this study. Please answer the following questions to the best of your knowledge and experiences. Please note that your participation in this is voluntary.

Section 1: General Information

Demographic Information

1. Name (Optional) and Code:

.....

2. Affiliation

Forest Officer

CFA member

Community Leader-Non-CFA Member

NGO/Partners representative)

Youth Group Member

Expert conservation Representative

Administration (National/County)

Other (please specify)

3. Age:

18-25

26-35,

36-45,

46-55,

56+

4. Gender:

Male,

Female,

Other (please specify)

5. Years of involvement in conservation efforts:

Less than 1 year, 1-5 years, 6-10 years, More than 10 years]

Section 2: Objective 1

6. This section seeks to assess Participatory forest management practices and climate change mitigation in Karura forest ecosystem, Nairobi County, Kenya. Please indicate the extent to which you agree with the statements. Tick(√) where appropriate using a scale of 1 = Never, 2 = Low Extent, 3 = Moderate Extent, 4 = High Extent and 5 = Very High Extent.

Statement	1	2	3	4	5
To what extent:					
Does the restoration of degraded areas and conservation to mitigate Climate change and Livelihood improvement the primary reason for introducing participatory forest management in Karura Forest Ecosystem?					
Does community involvement make participatory forest management effective in climate change mitigation in Karura forest ecosystem?					
Does awareness being created among local communities regarding the connection between participatory forest management practices and climate change mitigation in Karura?					
Does the communication channels used to convey participatory forest management practices information and climate change mitigation to local communities in Karura is effective?					

7. To what extent do you agree that PFM practices in Karura Forest have contributed to:

a) Restoring degraded areas (1 = Not at all, 5 = Very much) _____

b) Mitigating the impacts of climate change (1 = Not at all, 5 = Very much) _____

c) Improving livelihoods in local communities (1 = Not at all, 5 = Very much) _____

8. Have you observed any changes in the health of the forest (e.g., tree cover, wildlife) since the implementation of PFM practices?

Yes No

Section 3: Objective 2

11. This section seeks to analyse participatory forest management regulatory framework and climate change mitigation in Karura forest ecosystem, Nairobi County, Kenya. Please indicate the extent to which you agree with the statements. Tick(√) where appropriate. Using a scale of 1 = Poor [], 2=Fair [], 3=Good [], 4=Very good [], 5 = Excellent []

Statement	1	2	3	4	5
To what extent:					
Does the current role and responsibility allocation among different stakeholders involved in participatory forest management practices and climate change mitigation effective in Karura forest ecosystem?					
Does cooperation between government and partner organizations influence success of PFM practices in conservation activities in Karura Forest Ecosystem?					
Does the local communities involved in participatory forest management access training and capacity-building programs for PFM practices in Karura Forest Ecosystem?					

12. How effective is the collaboration between local communities and government agencies in managing Karura Forest?

Very effective somewhat effective Not effective

13. How well do you think different stakeholders involved in PFM (e.g., government, NGOs, communities) communicate and work together?

Very well somewhat well Not well

Section 3: Objective 3

20. This section seeks to evaluate the impacts of participatory forest management practices and climate change mitigation in Karura forest ecosystem, Nairobi County, Kenya.

Please indicate the extent to which you agree with the statements. Tick(✓) where appropriate.

Using a scale of 1 = Poor [], 2=Fair [], 3=Good [], 4=Very good [],5 = Excellent []

Statement	1	2	3	4	5
To what extent:					
Does implementation of participatory forest management practices have overall positive impact on the environment in Karura Forest ecosystem?					
Does participatory forest management practices resulted to social equity level in Karura Forest Ecosystem?					
Does PFM practices engagement with the local communities resulted in a sense of ownership and responsibility thus decreasing illegal logging and other destructive activities in Karura Forest Ecosystem?					
Does the introduction of alternative income-generating activities in PFM practices resulted to reduced dependency on forest resources among local communities in Karura Forest ecosystem?					
Does the PFM practices overall positive impact of proper forest management practices e.g restoring degraded areas by reforestation, afforestation, erosion control and planting of cover crops benefitted the forest ecosystem and downstream communities that rely on clean water sources from the Karura Forest Ecosystem?					

21. How has PFM impacted your sense of ownership and responsibility towards Karura Forest?

Increased significantly Increased slightly No change Decreased slightly Decreased significantly

22. Do you believe PFM has contributed to a decrease in illegal logging and other destructive activities in the forest?

Yes No Uncertain

24. How have the livelihoods of local communities changed since the implementation of participatory forest management in Karura especially after being equipped with sustainable forest management skills, business development and marketing beyond forest sector? Briefly explain

.....
.....

25. Does monitoring and evaluation of activities being conducted to assess the impacts of participatory forest management in Karura? Briefly explain

.....
.....

Thank you for taking the time to participate in this study. Your input is greatly appreciated.

Appendix II: Interview Guide

Background and PFM Implementation (Objective 1 & 2)

1. Can you describe your role and involvement with PFM practices in Karura Forest?
2. How were local communities involved in the initial development and implementation of the PFM framework in Karura?
3. In your opinion, what were the primary goals of introducing PFM in Karura Forest?
4. How would you assess the effectiveness of the current PFM framework in achieving its goals, particularly regarding climate change mitigation and community involvement?
5. What are the biggest challenges faced in implementing PFM practices in Karura Forest?
6. How can communication and collaboration between stakeholders involved in PFM (government, NGOs, communities) be improved?

Regulatory Framework and Capacity Building (Objective 2)

7. To what extent do you believe the existing legal and policy framework supports successful PFM implementation in Karura Forest?
8. Are there any specific regulatory gaps or limitations hindering the effectiveness of PFM?
9. How effective have training and capacity-building programs been in equipping local communities with the necessary skills and knowledge to participate meaningfully in PFM?
10. What additional support or resources would be beneficial for local communities to fully engage in PFM activities?

Impact of PFM (Objective 3)

11. In your observations, how has PFM impacted the overall health and ecological conditions of Karura Forest?
12. Have you noticed any changes in the level of community engagement and sense of ownership towards the forest since the introduction of PFM?
13. How has PFM affected the livelihoods and well-being of local communities surrounding Karura Forest?

14. In your opinion, what are the most significant long-term benefits of PFM for both the forest ecosystem and local communities?

Appendix III: NDU-K Research Authorization

Telephone: 051- 851141
Fax: 051-851046
Email: ndu-kenya@mod.go.ke
When Replying Please Quote:
Ref: NDU - K/AA & R/02



National Defence University-Kenya
P O Box 3812 – 20100
Nakuru, Kenya

23 November 2023

TO WHOM IT MAY CONCERN

RE: RESEARCH AUTHORISATION

Mr. John Kipkemoi Rono of National Defence College, a College of National Defence University-Kenya, successfully defended his Master of Arts research proposal and has been allowed to proceed to the field to collect data for his thesis.

The research's topic is, "**The Impact of Participatory Forest Management on Climate Change Mitigation in Kenya: Case Of Karura Forest Ecosystem-Nairobi County**". The Candidate will be conducting the field work with effect from December 2023.


The purpose of this letter, therefore, is to request you to accord him any necessary assistance to successfully conduct the research.

Your continued assistance is highly appreciated.


Yours faithfully,

Prof Anne W T Muigai
Deputy Vice-Chancellor
National Defence University-Kenya

Appendix IV: NACOSTI Permit



REPUBLIC OF KENYA

Ref No: **606605**


NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY & INNOVATION

Date of Issue: **15/December/2023**

RESEARCH LICENSE




This is to Certify that Mr.. John kipkemoi Rono of National Defence University, has been licensed to conduct research as per the provision of the Science, Technology and Innovation Act, 2013 (Rev.2014) in Kiambu on the topic: THE IMPACT OF PARTICIPATORY FOREST MANGEMENT IN CLIMATE CHANGE MITIGATION IN KENYA: CASE OF KARURA FOREST ECOSYSTEM-NAIROBI COUNTY for the period ending : 15/December/2024.

License No: **NACOSTI/P/23/31907**

606605
Applicant Identification Number

W. Kitembo
Director General
NATIONAL COMMISSION FOR
SCIENCE, TECHNOLOGY &
INNOVATION

Verification QR Code



NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

See overleaf for conditions

THE SCIENCE, TECHNOLOGY AND INNOVATION ACT, 2013 (Rev. 2014)
Legal Notice No. 108: The Science, Technology and Innovation (Research Licensing) Regulations, 2014

The National Commission for Science, Technology and Innovation, hereafter referred to as the Commission, was established under the Science, Technology and Innovation Act 2013 (Revised 2014) herein after referred to as the Act. The objective of the Commission shall be to regulate and assure quality in the science, technology and innovation sector and advise the Government in matters related thereto.

CONDITIONS OF THE RESEARCH LICENSE

1. The License is granted subject to provisions of the Constitution of Kenya, the Science, Technology and Innovation Act, and other relevant laws, policies and regulations. Accordingly, the licensee shall adhere to such procedures, standards, code of ethics and guidelines as may be prescribed by regulations made under the Act, or prescribed by provisions of International treaties of which Kenya is a signatory to
2. The research and its related activities as well as outcomes shall be beneficial to the country and shall not in any way;
 - i. Endanger national security
 - ii. Adversely affect the lives of Kenyans
 - iii. Be in contravention of Kenya's international obligations including Biological Weapons Convention (BWC), Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), Chemical, Biological, Radiological and Nuclear (CBRN).
 - iv. Result in exploitation of intellectual property rights of communities in Kenya
 - v. Adversely affect the environment
 - vi. Adversely affect the rights of communities
 - vii. Endanger public safety and national cohesion
 - viii. Plagiarize someone else's work
3. The License is valid for the proposed research, location and specified period.
4. The license any rights thereunder are non-transferable
5. The Commission reserves the right to cancel the research at any time during the research period if in the opinion of the Commission the research is not implemented in conformity with the provisions of the Act or any other written law.
6. The Licensee shall inform the relevant County Director of Education, County Commissioner and County Governor before commencement of the research.
7. Excavation, filming, movement, and collection of specimens are subject to further necessary clearance from relevant Government Agencies.
8. The License does not give authority to transfer research materials.
9. The Commission may monitor and evaluate the licensed research project for the purpose of assessing and evaluating compliance with the conditions of the License.
10. The Licensee shall submit one hard copy, and upload a soft copy of their final report (thesis) onto a platform designated by the Commission within one year of completion of the research.
11. The Commission reserves the right to modify the conditions of the License including cancellation without prior notice.
12. Research, findings and information regarding research systems shall be stored or disseminated, utilized or applied in such a manner as may be prescribed by the Commission from time to time.
13. The Licensee shall disclose to the Commission, the relevant Institutional Scientific and Ethical Review Committee, and the relevant national agencies any inventions and discoveries that are of National strategic importance.
14. The Commission shall have powers to acquire from any person the right in, or to, any scientific innovation, invention or patent of strategic importance to the country.
15. Relevant Institutional Scientific and Ethical Review Committee shall monitor and evaluate the research periodically, and make a report of its findings to the Commission for necessary action.

National Commission for Science, Technology and
Innovation(NACOSTI),
Off Waiyaki Way, Upper Kabete,
P. O. Box 30623 - 00100 Nairobi, KENYA
Telephone: 020 4007000, 0713788787, 0735404245
E-mail: dg@nacosti.go.ke
Website: www.nacosti.go.ke

Appendix V: KFS Authorizations



Kenya Forest Service Hqs
Karura, Off Kiambu Rd
P.O. Box 30513 - 00100
Nairobi, Kenya

RESEA/1/KFS/VOL.VIII/85

4th January 2024

Ref: No.....

Date:.....

John Kipkemoi Rono
National Defence College
NAIROBI.
jrono4268@gmail.com

RE: PERMISSION TO CARRY OUT RESEARCH IN KARURA FOREST.

Reference is made to your letter of 18th December 2023 requesting authority to undertake research in Karura forest "*The Impact of Participatory Forest Management in Climate Change in Kenya: Case of Karura Forest Ecosystem – Nairobi County*". Your request is hereby approved.

The following conditions shall apply;

- I. No sample shall be collected in such a way that will threaten or be detrimental to the supply of that material in the wild.
- II. No information detrimental or of a confidential manner shall be shared publicly without written permission from Kenya Forest Service.
- III. Intellectual property rights arising from the study of the materials will be jointly shared by the Kenya Forest Service and yourself.
- IV. You shall acknowledge the Kenya Forest Service in all and any publications, patents or presentations involving the use of the information or materials.
- V. You shall indemnify and keep the Kenya Forest Service and the State harmless from any claim, action and damage or cost deriving from or in connection with the use of the information or materials.
- VI. No commercialization shall take place without clearance from Kenya Forest Service.
- VII. Materials (including derivatives arising from) obtained under this permit may only be transferred to a third party with prior written authorization from Kenya Forest Service.
- VIII. You shall provide a copy of your report or thesis or publications to the Chief Conservator of Forests upon completion.

Trees for better lives

Tel: (254)020-3754904/5/6, (254)020-2014663, (254)020-2020285, Fax: (254)020-2385374

Email: info@kenyaforestservice.org. Web: www.kenyaforestservice.org

IX. Notwithstanding this validity period, the conditions above (ii -vii) shall hold throughout the existence of the materials and their derivatives.

This permit is valid from **4th January 2024** to **3rd January 2025**.

By a copy of this permit, the County Forest Conservator and Forest Manager are hereby instructed to facilitate access.



A.L. Lemarkoko EBS, 'ndc' (K)
CHIEF CONSERVATOR OF FORESTS

Copy to:

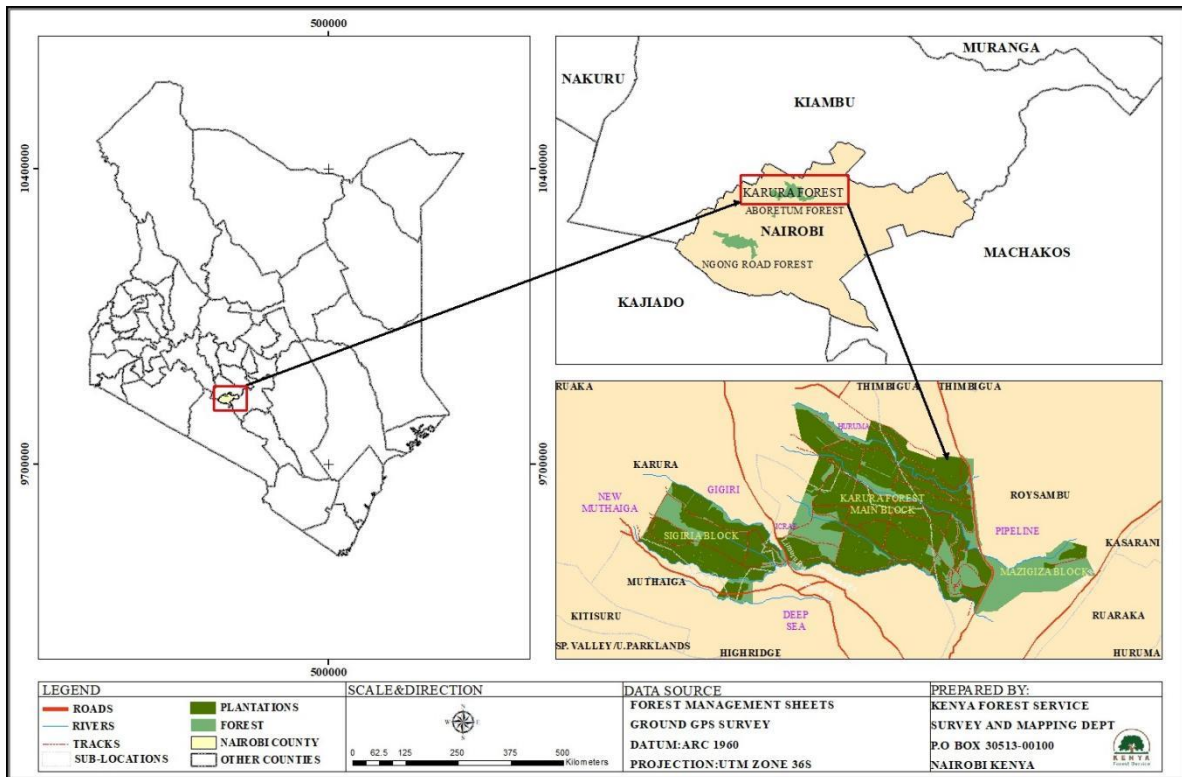
RFC – Nairobi

CFC – Nairobi

Forest Manager – Karura

Jm/Sa

Appendix VI: Map of the Study Area



Appendix VII: Krejcie and Morgan (1970) Table Scale

<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>	<i>N</i>	<i>S</i>
10	10	220	140	1200	291
15	14	230	144	1300	297
20	19	240	148	1400	302
25	24	250	152	1500	306
30	28	260	155	1600	310
35	32	270	159	1700	313
40	36	280	162	1800	317
45	40	290	165	1900	320
50	44	300	169	2000	322
55	48	320	175	2200	327
60	52	340	181	2400	331
65	56	360	186	2600	335
70	59	380	191	2800	338
75	63	400	196	3000	341
80	66	420	201	3500	346
85	70	440	205	4000	351
90	73	460	210	4500	354
95	76	480	214	5000	357
100	80	500	217	6000	361
110	86	550	226	7000	364
120	92	600	234	8000	367
130	97	650	242	9000	368
140	103	700	248	10000	370
150	108	750	254	15000	375
160	113	800	260	20000	377
170	118	850	265	30000	379
180	123	900	269	40000	380
190	127	950	274	50000	381
200	132	1000	278	75000	382
210	136	1100	285	100000	384

Note.—*N* is population size. *S* is sample size.

Source: Krejcie & Morgan, 1970