



Ecosystem-based Adaptation to Climate Change – Policy Making and Institutional Framework in Kenya’s Mt. Elgon Forest Ecosystem

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Authors’ contributions

This work was carried out in collaboration among all authors. Author JMO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors PO and FD managed the analyses of the study. Author FD managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Ecosystem-based Adaptation (EbA) is a strategy that relies on forest landscape’s biodiversity management and restoration to enhance the sustainable production and supply of ecosystem goods and services as alternative livelihoods to cushion the society against the negative impacts of climate change. As climate change becomes a reality, adaptation measures which are cost effective and economically beneficial are urgently required. Mount Elgon ecosystem in the western region of Kenya has EbA characteristics which could offer longer term solutions to adaptation to climate change impacts while providing a range of other benefits in terms of ecosystem goods and services. This paper established the existing capacities for Ecosystem based adaptation inclusion in the sub-national adaptation plans and policies in order to improve resilience to climate change impacts in the Mt. Elgon ecosystem. To achieve this, a descriptive survey was carried involving 405 household and 51 government and civil society respondent drawn from Saboti, Kiminini, Endebess and Kwanza sub-counties, Transnzoia County in Kenya. Results showed that there

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were good institutional representations in Mt. Elgon ecosystem with line ministries largely being responsible (63.4%) for the management of the individual natural resources that occur in the Mt. Elgon ecosystem while a few others were either co-managed (9.7%) or managed by the County Government of Transzoia (9.7%). Majority (77%) of household respondents observed uncoordinated approach in ecosystem management. This should be addressed in order to increase ecosystem health which eventually leads to enhanced EbA services. Majority (73.2%) of government and civil society respondents cite inter-sectoral policy inconsistencies and conflicts as contributors to degradation of ecosystem health in the study area. This too has impacted negatively on EbA. A major conclusion in the study was that consolidation and harmonization of ecosystem policies in the Mt. Elgon's ecosystem will lead to a healthy landscape that provides sustainable EbA services.

Keywords: Ecosystem; adaptation; climate change; forest ecosystem; landscape's biodiversity.

1. INTRODUCTION

1.1 Ecosystem Based Adaptation to Climate Change

Ecosystem-based Adaptation (EbA) is the use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change [1]. While EbA is a new adaptation strategy, it borrows from other current ecosystem management practices such as integrated water resource management, community-based natural resource management and forest landscape restoration, bringing in the climate change adaptation angle [2,3].

Climate change is no longer a speculative issue and the reality of its impacts is affecting millions of people across the world, impacting negatively on their efforts to escape poverty. Against this harsh reality, it will be imperative to speed up the integration of climate risk decisions into regional, national and local policies to ensure that development proceeds along pathways that are resilient to climate change [4]. The questions as to the type of strategies, approaches and actions required still generate divergent views on the international policy arena. Closer attention to a broader spectrum of adaptation options is urgently required [5].

1.2 Eba Justification

Vulnerability to climate change impacts is expected to be higher in countries south of the Sahara not only due to their low institutional and financial capacity to cope, but also because a much higher share of their economies are dependent on climate-sensitive sectors such as agriculture or forestry and natural resource

extraction. With this reality of climate change, measures to enhance the ability of these countries to respond to, manage and cope with increasing variability are thus of highest priority [6]. Existing coping strategies to deal with climate variability, as well as new and enhanced adaptation approaches are required.

Most developed economies are able to "pay for" protection against the impacts of climate change through technology and engineering. Developing economies such as Kenya and more especially in its densely populated agricultural landscapes, the effects of the impacts continue to cause severe losses of livelihoods. This category of countries urgently needs a proven, accessible and affordable option. The complexity and cost associated with infrastructural and technological solutions in addressing climate change vulnerability is far beyond the abilities of most African economies.

EbA, which is a nature-based approach, has the potential to increase adaptive capacity and social and ecological resilience to climate change in both developed and developing countries [2]. It provides a cost effective and/or economically beneficial, as well as longer term solutions, with a range of co-benefits in terms of the goods and services provided by ecosystems.

1.3 Kenya's Mt. Elgon Ecosystem

The Mount Elgon ecosystem in the western region of Kenya is one of the world's forest biome that supports various habitat types and a collection of rare faunal and floral species on its slopes which reach over 4,000 m above sea level. This ecosystem consists of a mix of heavily populated agricultural landscape supporting over two million people who interact directly with an adjacent forest. These crucial interactions for

livelihood support that span a range of economic sectors have the potential of offering EbA services [7]. The forest provides most of the goods and services to the riparian communities forming the basis of their subsistence, which form the basis of their subsistence. The agriculturally rich Mt. Elgon forest adjacent communities view the forest as a massive reservoir of goods and services.

Climate change impacts are being experienced in the Mt Elgon ecosystem and are anticipated to increase with climate change. This ecosystem's biodiversity has EbA characteristics which can be tapped to improve resilience of people to the effects of climate change. This cost effective, economically beneficial approach that offers long-term solutions continues to be underutilized in this heavily populated yet vulnerable agro-ecosystem that supports over 2 million people.

Despite its usefulness, little has been published on EbA can be included in the national plans and policies related to climate change adaptation. This is especially true for regional decentralized governance units of Kenya where there is a high dependence on natural resource but no specific policy or planning tool that prioritizes Ecosystem based adaptation approaches. A review of the policy documents, strategic plans and the County Development plans for Transnzoia County revealed that the recognition of this important ecosystem and its climate proofing potential role

was glaringly missing, in its climate change adaptation strategy documents. In view of the foregoing, this paper sought to establish the existing capacities for Ecosystem based adaptation in improving resilience to climate change impacts in the Mt. Elgon ecosystem.

1.4 Study Area

Mt. Elgon ecosystem counts as one of Kenya's "five water towers" that support a rich diversity of flora of at least 400 species (KWS, 2010). It traverses altitudinal niches of the open moorlands within the crater, the extensive montane forests on its slopes and into the rich agricultural farmland at the plains (Fig. 1).

Arising from slopes of this mountain is the Nzoia River which traverses Kenya's Western Province, influencing a range of productive activities including irrigated agriculture and industry to an estimated watershed population of over 1.5 million [8-10]. There are other major rivers which sustain the livelihoods of the residents in the study area that originate from Mount Elgon. They include Kaibei, Kapteka, Kimoson, Mubere, Kiptigot, Chebirirbey, Kamuchong', Chepchoinor, Kipyoywan, Kisawoy Kipkukul, Cheptantan, Rongai, Kamakoiwa, Sosio, Laba, Kipkuresai Kimelil, Kibuk, Kimobo, Kibingey, Kitaban, Kibusi, Kapkateny, and Terem. Others include Kuywa, Kaptenai, Emia, Morkiis Emanang, Sitt and Rakook (Sobett, 2017).

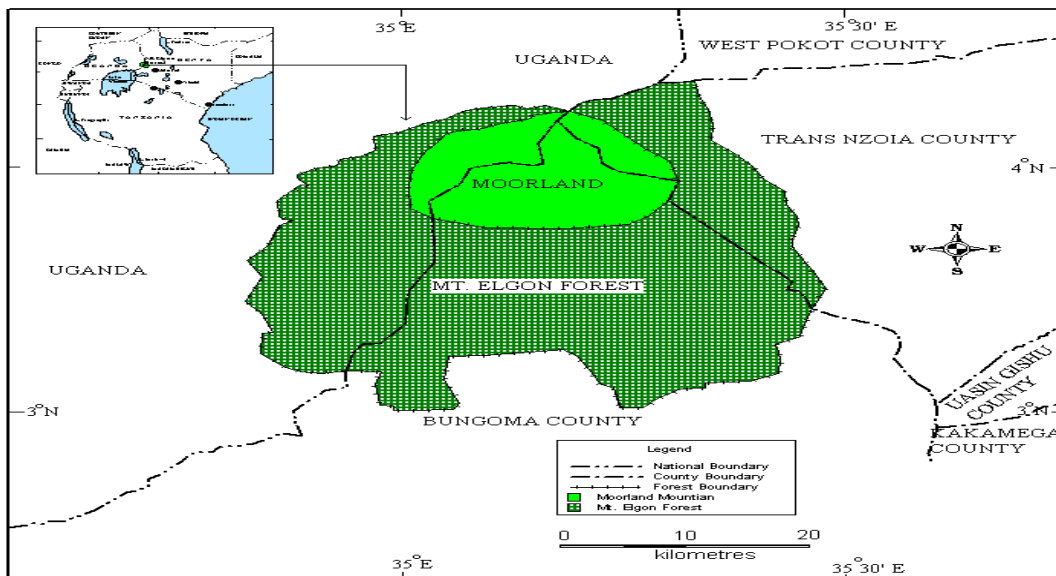


Fig. 1. Map of Mt. Elgon forest in both sides of Uganda and Kenya
(Source: Moi University Geography Department GIS Lab, 2013)

2. METHODOLOGY

Data was collected by using a descriptive survey in which a questionnaire was administered to 405 households who are residents of Saboti, Kiminini, Endebess and Kwanza sub-counties (Table 1).

By use of purposive sampling, 51 responds drawn from government and civil society organizations based on their relevance to Mt. Elgon ecosystem and climate change adaptation matters (Table 2). Information obtained was correlated with existing secondary information.

3. RESULTS AND DISCUSSION

The ages of most respondents (44.2%) was above 39 years and were dominated by male respondents (66.2%) whom the study revealed they were the household heads (Table 3). The majority of the respondents had an education of up to secondary level (37.0%).

3.1 Institutional Fragmentation of Natural Resource Management and Its Effect on Ecosystem Based Adaptation to Climate Change

Findings from this study showed that line ministries Fig. 2 are largely responsible (63.4%) for the management of the individual natural resources that occur in the Mt. Elgon ecosystem while a few other natural resources are either co-managed (9.7%) or managed by the County Government of Transzoia (9.7%).

The good institutional representation in the study area Table 4 should ideally lead to improved management, development and sustainable exploitation of ecosystem resources.

The fact that each represented institution is exercising and executing some specific mandate as guided by its own policy and piece legislation

Table 1. Size of the study area by sub-county

Sub-county	Area in Km ²	Wards
Kwanza	466.9	Kwanza; Bidii
Endebess	680	Endebess; Chepchoina
Saboti	323.6	Kinyoro; Matisi; Tuwani; Saboti; Machewa
Kiminini	395.3	Kiminini, Sikhendu; Nabwiswa

(Source: Transzoia CIDP 2013 -2017)

Table 2. List of government and civil society groups interviewed

Governance level	Department/Organization	Designation of respondent
County Government of Transzoia	Ministry of Agriculture and Livestock Development, Ministry of Environment, Water and Natural resources	County Directors of Agriculture, Livestock, Fisheries, Environment, Water
National Government Ministries, Departments and Agencies (MDAs), Education institutions	Kenya Forest Service, WRA, , KWS, Education and Educational institutions, Environment,	Ecosystem conservator, WRA sub-Regional manager, KWS Regional Scientist, sub county Education Officers, Meteorological services, Station manager, Kimothon forest, Sampled Heads of Secondary and primary Schools
Private sector	Manor House Agricultural College, Panocal International, Mt. Elgon Flowers	Liaison officers
NGOs	VI Agroforestry, KCWCG, KEETA, Dajopen Waste Management	Liaison officers
CBOs	MANEWACTO, SABAOT, WRUAS, CFAs	Chairpersons of the CBOs

Source: Author, 2019

Table 3. Socio-demographic characteristics of respondents

N=405					
Variable	Description	Frequency	Percent	Valid percent	Cumulative percent
Age of respondent	Below 18	6	1.5	1.5	1.5
	18- 25	41	10.1	10.1	11.6
	26- 32	61	15.1	15.1	26.7
	33- 38	118	29.1	29.1	55.8
	39 and above	179	44.2	44.2	100.0
Gender of respondent	Male	268	66.2	66.2	66.2
	Female	137	33.8	33.8	100.0
Education level	Primary	61	15.1	15.1	15.1
	Secondary	150	37.0	37.0	52.1
	College	92	22.7	22.7	74.8
	University	92	22.7	22.7	97.5
	A - Level	1	2	2	97.8
	None	9	2.2	2.2	100.0
Marital status	Single	78	19.3	19.3	19.3
	Married	305	75.3	75.3	94.6
	Separated	9	2.2	2.2	96.8
	Widowed	13	3.2	3.2	100.0
Total		405	100.0	100.0	

Source: Author, 2019

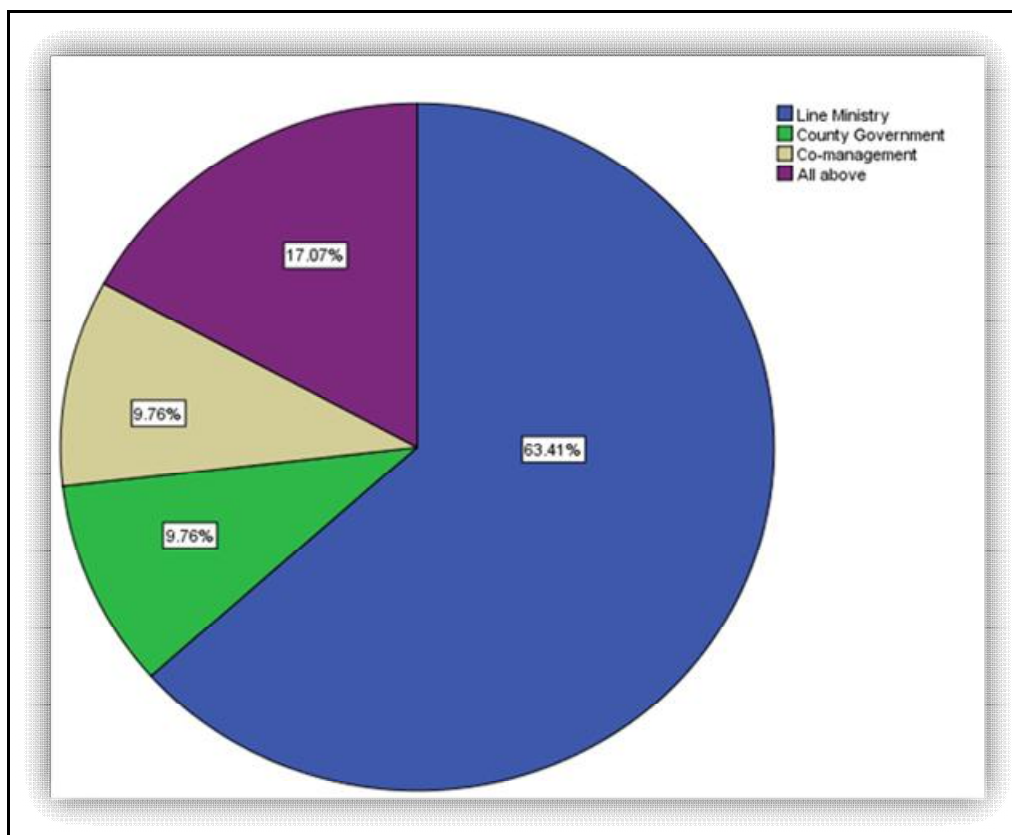


Fig. 2. Natural resources management in Mt. Elgon

Table 4. Institutions managing natural resources in Mt. Elgon ecosystem

Institution	Role in Mt. Elgon ecosystem
KFS	Management of Forest resources
KWS	Management of wildlife resources
WTA	Management of Kenya's Water towers
WRA	Management of Kenya's water catchment areas
NEMA	Coordination and supervision over all matters related to environmental conservation
KTB	Promoting tourism to Kenya's tourism attraction sites
NLC	Administration of land in Kenya

(Source: Author, 2018)

domiciled in its sector is contributing to the deterioration of ecosystem resources in terms of quantity and quality. Biodiversity which has been a key ingredient of a natural ecosystem has the ability to increase resilience to the impacts of climate change in the study area, continues to shrink due to this institutional fragmentation [11]. Biodiversity is essential to ecosystem survival; once destroyed, they are often costly and sometimes impossible to restore. Unlike the jurisdictional boundaries exhibited by individual institutions, ecosystem resources transcend political, administrative and ecological boundaries of existing ecological structure. In the interest of the future prosperity and in the interest of utilizing this ecosystem to cushion the adjacent community against the effects of climate change, there is need for a system of resource management that aims at the long-term and prudent use of natural resources.

Another marked observation of the sectoral approach to natural resource management in the Mt. Elgon ecosystem has been the frequent duplication of efforts and conflicting objectives. Moreover, it also entails the serious waste of resources and the oversight of important environmental issues. There are good examples of conflicting objectives among government agencies such as witnessed between Kenya Water Towers Agency (WTA), Water Resources Authority (WRA) and Kenya Forest Service (KFS) as relates to restoration of water

catchment areas in the study area. All these agencies would be at one point involved in the planting of trees purportedly to restore the integrity of the water catchment. This kind of duplication of efforts adds more stress to the already underfunded government apparatus by making these environmental agencies to compete for the scarce resources. This eventually has been leading to the shortage of funds making it difficult for some programmes or ideas to get off the ground. The ecosystem approach which promoted management of the environment according to ecological principles has often led to the restoration and maintenance of the ecosystem structure and eventually cushions the residents against the deleterious effects of climate change.

3.2 Role of Effective Coordination and Collaborative Management in Ecosystem Based Adaptation to Climate Change

Though the many natural resources in the study area are within the same ecosystem, it emerged that there were uncoordinated approach (77%) in the way they are managed Table 5. This has to some extent contributed to the degradation of the individual resources thus weakening further the ability of this ecosystem to offer alternative livelihood sources for the residents during times of climatic uncertainty.

Table 5. Respondent views on coordination the management of ecosystem resources

There is poor coordination in the management of natural resources	Frequency	Percent	Valid percent	Cumulative percent
Strongly Agree	160	39.5	39.5	39.5
Agree	152	37.5	37.5	77.0
Don't know	35	8.6	8.6	85.7
Disagree	46	11.4	11.4	97.0
Strongly disagree	12	3.0	3.0	100.0
Total	405	100.0	100.0	

Source: (Author, 2018)

Table 6. Presence of inter-agency policy inconsistencies

Presence of inter-sectoral conflicts	Frequency	Percent	Valid percent	Cumulative percent
Yes	30	73.2	73.2	73.2
No	11	26.8	26.8	100.0
Total	41	100.0	100.0	

(Source: Author, 2018)

Due to the resource interdependencies and interconnectedness, collaborative management has come out as the best strategy to manage the ecosystem resources in the study area. This will enhance the health of this ecosystem and thus contribute to societal resilience to climate change impacts. An ecosystem approach that provided for inter-sectoral coordination and a unified policy focus from which specific policies and solutions can be derived with a satisfactory degree of internal consistency is of uttermost importance.

In order to win the community support it's also prudent that the sectoral agencies incorporate the resource user communities in the management and development of individual natural resources [12]. Further, community representation should be seen in the management structure of the various natural resources that are in the project implementation area. For this approach to succeed, there were supposed to be regular intra-agency and inter-agency consultations. This will offer a collaborative environment which would be based on trust and resources may be delivered proactively.

3.3 Policy Harmonization for EbA in Mt. Elgon Ecosystem

Majority (73.2%) of government and civil society respondents were of the view that there exist inter-sectoral policy inconsistencies Table 6 and incoherencies that has led to the degradation of the ecosystem's natural resources in the study area. They observe that various sectoral policies at play in the study area need to be harmonized so that they work for the enhancement of the quality and quantity of the resources and eventually to enhanced livelihoods.

The findings pointing to the existence of policy inconsistencies in managing natural resources found in the same ecosystem supports views by Plummer and Fitzgibbon [13], who observe that managing renewable natural resources were difficult because of the complexity of their interlinked social and ecological components. He

added that policy consistency and coherence was a major factor that determines the ecosystem health and sustainable supply of livelihood goods and services. In this context, co-management, where management responsibility shared between government and resource-users, may improve the suitability and perceived legitimacy of management rules when there is policy coherence. However, despite the potential for such arrangements to improve the resilience of natural resource systems, how co-management works in the face of the glaring policy inconsistencies remains poorly understood [13].

The research findings regarding the impact of policy incoherencies on natural resource management are consistent with Mhlanga et al. [12] who also observes that the existence of various policies and institutional frameworks managing interdependent resources in a homogenous geographical space can lead to weak coordination in basic approaches to addressing the challenges that a nation faces with regard to resource conservation and this has been exacerbated by institutional rivalries due to overlapping mandates among the ministries and departments. The findings support views by Ongugo [11] who observed that policy incoherence; ineffective coordination and fragmented management of strategic activities between different actors in Mt. Elgon ecosystem are the main cause of ecosystem deterioration. This posed a threat of interfering with institutional frameworks and possibilities of weak enforcement of polices and legislation at all levels of governance, national and county level. A major recommendation given in his study was the adoption of an integrated ecosystem management system which would require an active and sustained involvement of all resource users and stakeholders on how the available resources are allocated, managed and how conflicts are mitigated in order to encourage long-term supply of ecosystem goods and services for improved livelihoods.

Mhlanga [12] agreed with this approach but noted that the diversity of statutory instruments if

properly coordinated can make the management of an ecosystem's resources very effective. Such coordination can create synergies between and among various government departments which is necessary for sustainable production and utilization of ecosystem goods and services hence cushioning against the effects of climate change. This implied that if the various institutional policies guiding the natural resource use and exploitation in Mt. Elgon are well coordinated and harmonized could lead to restoration and maintenance of the natural structure of the ecosystem and thus enabling it to sustainably provide ecosystem goods and services to the resource users. This would be more useful especially in cushioning the residents against the negative effects of climate change.

The study findings pointed to the ineffectiveness of sectoral approach to the management of natural resources that are interdependent and are in the same ecosystem supports views by Morrison et al. [14] who notes that governments regularly restructure departments in the natural resource management and environmental arena, sometimes for the purpose of improved policy integration, but most frequently to meet ministerial and bureaucratic aspirations. He further observed that fragmentation of policies and their implementation seriously diminished the overall effectiveness of natural resource management programs.

4. CONCLUSIONS AND RECOMMENDATIONS

The economy of the study area was basically supported by rain-fed agriculture, a phenomenon that are heavily influenced by the mountainous ecosystem characteristics. The current sectoral ecosystem planning and management practices in the study area is confined to jurisdictional mandates which are not fully informed by the existing and accepted scientific knowledge on the interconnectivities of ecological systems. Further, institutional rivalries may arise due to overlapping mandates among the ministries and departments especially with regard to handling of conservation funds by the state and donors. All these factors work against ecosystem health which is vital for EbA success.

Maintaining and restoring "nature's infrastructure" in the study area should be a priority for reducing vulnerability to climate change impacts. The County Government of Transzoia has been

asked to take advantage and to take a proactive role in mainstreaming EbA approaches in its planning for adaptation to climate change. The design of adaptation measures should not be limited by political, administrative and ecological boundaries.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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