

# Climate change and forest governance: towards a sustainable forest management of the half mile forest strip and adjacent communities in Kilimanjaro Region, Tanzania

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## ABSTRACT

The study focused on the influence of climate change on forest governance at the Half Mile Forest Strip (HMFS) and adjacent villages in the Kilimanjaro region, Tanzania. Specifically, the study identified the impacts of climate change on the HMFS and adjacent communities, and examined the people's perceptions on climate change in relation to forest governance. Further, the study examined the role of local institutions on forest governance and climate change resilience and adaptation strategies with associated policy interventions. The study adopted a mixed research designs whereby both qualitative and quantitative data were collected through different methods such as direct field observation, using semi-structured interviews, household surveys and focus group discussion. Data were analyzed using statistical package for social sciences (SPSS) software and excel programs. Findings revealed that climate change has affected the forest ecosystems, agriculture and water resources in the adjacent villages. Using the Pearson's product moment correlation coefficient, it was revealed that there was a negative correlation between the impacts of climate change and the current forest condition. Forest governance was perceived as a control mechanism for forest degradation whereby restrictions on the use of forest resource, afforestation, and reforestation were undertaken as measures to mitigate climate change impacts and build resilience in the forest sector and to adjacent communities.

Keywords: Forest governance, Climate change and Sustainable forest management

## INTRODUCTION

Van Bodegom et al (2008) define forest governance as the modus operation by which officials and institutions acquire and exercise authority in the management of forest resources. Further, Agrawal et al (2008) explained that governance of

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forest programs seeks to improve the participation, transparency, and responsiveness of government practices that impact on forest land allocation and use. Climate change and forest governance are among the subjects of contemporary debates in most forest-dependent communities (Owusu et al (2010). Climate change has become a global concern because of its negative impacts on the environment. Moreover, climate change has impacts on forest ecosystems which include changes in forest health, growth and productivity, distribution and composition of species, forest structure, and other ecological goods and services provided by the forest (UNEP 2007). In this fact, forest-dependent communities have reduced the opportunity to effectively cope with the risks of climate change due to poor capabilities, poverty, weak institutional mechanism, and lack of forest access (FAO 1993). Climate change impacts on forests need to be addressed by society as a whole through suitable and effective forest governance which encompasses legal support on forest tenure and rights, the equal participation and interaction between the public sector, the private sector and civil society (Robledo et al 2005).

Forest management in many African countries has moved from command and control system to more participatory approach. Participatory Forest Management (PFM) includes process and mechanism that enable people who depend on the forest to be part of decision-making in all aspects of forest management, from managing the resource to formulating and implementing institutional framework (Willy 2001). According to Carter and Grownow (2005), PFM approaches such as Joint Forest Management (JFM), Community Based Forest Management (CBFM), and Collaborative Forest Management (CFM) emphasize decentralization of forest management rights and responsibilities to forest adjacent communities.

According to the Ministry of Natural Resources and Tourism (MNRT) (2006), forest resources in Tanzania involve forest ownership which includes public and private ownership, and some forests have been protected by traditional and customary means. Despite the fact that Tanzanian's forests are being protected by traditional and customary means, they are also governed by different organizations like the Tanzanian Community Forest Conservation Network (TCFCN), Tanzania Forest Conservation Group (TFCG), Tanzania Forest Services (TFS), and Mpingo Conservation Development Initiative (MCDI).

Various participatory programs such as Joint Forest Management (JFM), Community Based Forest Management (CBFM), and Reducing Emission from Deforestation and Degradation (REDD+) have been initiated by Local Government Authorities (LGA) in cooperation with village communities. Also, TANAPA (1987) explained that the conservation and management of the Half Mile Forest Strip (HMFS) fall under the authority of local institutions like the Community Forest Participation (CFP) and Kilimanjaro National Park (KINAPA). However, degradation in the HMFS continues and the negative effects of climate change on the adjacent communities have increased.

The HMFS was heavily impacted by human activities such as cultivation and grazing, increasing settlement due to population increase and small illegal logging of indigenous trees (Bjorndalen 1992). According to Robledo et al (2005), climate

change affects all forest landscapes with rising temperatures, changes in water availability and the expected increase in carbon dioxide levels. These changes will have significant impacts on forest-dependent people, the availability, and quality of forest goods, and services and changes in species diversity. Furthermore, Yanda and Shishira (2001) described the climate impacts on the sustainability of the forest ecosystem which is likely to cause stress on forest and biodiversity. The role of forest governance on the management of the forest ecosystem has been explained by Kleinschmit et al (2007); It needs the involvement of the stakeholders like the public sectors, private sectors, and the civil society in planning and decision making on the protection, conservation, and management of the forest.

Many studies such as those by Robledo et al (2005), Yanda and Shishira (2001), and Kleinschmit et al (2007) have attempted to discuss the impacts of climate change on the forest ecosystem and the importance of forest governance in forest management. However, there is scant information on how effective governance of forest resources can contribute to the mitigation of climate change while simultaneously enhancing the ability of local people to adapt to the changes in climate patterns and lead to sustainable forest management.

The main objective of this study was to examine the influence of climate change on forest governance at the HMFS and adjacent communities in Kilimanjaro Region, Tanzania. Specifically, the study identified the impacts of climate change on the HMFS and adjacent communities; examined people's perception on the impacts of climate change and forest governance at the HMFS and adjacent communities; analyzed the role of local institutions on forest governance at the HMFS; and examined climate change adaptation strategies and policies at HMFS and adjacent communities.

## **METHODOLOGY**

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

The study was undertaken in the Kilimanjaro region located in the northeastern part of Tanzania Mainland covering an area of 13,209km<sup>2</sup> (URT 1998). Mount Kilimanjaro is located at 3°04'S and 37°21'E in the northeastern of Tanzania and reaches a peak of 5895 meters above sea level (TANAPA 1992). The Half Mile Forest Strip (HMFS) is located on the lower slopes of Mount Kilimanjaro between altitude 1500 and 1800 m above the sea level. The forest area was declared in 1941 for water and timber values. Furthermore, the HMFS which starts from Kikelelwa River in North Kilimanjaro (Rombo district) along eastern slopes of the noble mountain to SanyaJuu (Hai district), has an area of about 1065 ha, whereas Moshi has 5120 ha and Rombo has a total of 2584 ha (Kashenge 1995). This research on the climate change and forest governance for sustainable forest management was carried out at the HMFS and adjacent villages, namely, Lyasongoro and Mweka in the Moshi Rural district.

### **Research Methodology**

The study was guided by mixed research designs where different methods were used in data collection such as household surveys and interviews, direct field observation, and focus group discussion. Both primary data and secondary data collection were employed in the study whereby a sample of 80 respondents living adjacent the HMFS was involved in the study.

## **RESULTS AND DISCUSSION**

The results obtained are presented in several sections. The first section focuses on the impacts of climate change on the HMFS and adjacent villages and the correlation between the effects of climate change on forest and the current condition of the forest area. The second section presents the people's perception of climate change and forest governance. The third section presents the role of local institutions on forest governance at the HMFS, and the final section deals with climate change adaptation strategies and policies at the HMFS and adjacent villages.

### **Impacts of Climate Change on the HMFS and Adjacent Communities**

The findings revealed that 56.4% of the respondents disagreed that climate change did not affect the forest ecosystem at Mweka village (Table 1). Moreover, 43.9% agreed that climate change affects the forest ecosystem in the HMFS. However, at Lyasongoro village, 56.1% of the respondents strongly agreed that climate change had impacts on forest ecosystem while 43.6% disagreed.

Table 1. Impacts of climate change on the HMFS and adjacent communities

	Villages		Total (%)
	Mweka (%)	Lyasongoro (%)	
People's response			
Yes	43.9	56.1	100
No	56.4	43.6	100

### **Forest Ecosystem Components Affected by Climate Change**

The results showed that 57.5% of the respondents strongly agreed that forest vegetation has been affected by climate change (Table 2). Similarly, 30% also agreed that wild animals have been affected by the climate change. Besides, 10% of the respondents slightly agreed that birds were affected by climate change, and only 2.5% responded that insects were also affected by climate change. Similar findings were observed by William (2003), who pointed out that some plant species are not easily found in the HMFS including *Myricasalicifolia* (Mruka) and a timber tree species such as *Octeausambarensis* because they were heavily extracted some years ago for commercial timber as a climate-resilient strategy.

**Table 2. Forest ecosystem components affected by climate change**

Forest ecosystem components	Frequency	Percent
Wild animals	24	30
Birds	8	10
Insects	2	2.5
Forest Vegetation	46	57.5
Total	80	100

***The Current Condition of the HMFS Area***

Findings revealed that 67.5% of the respondents reported that the current condition of the HMFS at the adjacent Mweka village was slightly degraded while 17.5% responded that the HMFS is highly degraded; 15.0% responded that the forest is moderately degraded (Table 3). In the adjacent Lyasongoro village 50.0% of the respondents agreed that the forest is moderately degraded, 40.0% of respondents said that the forest was slightly degraded, and 13.8% responded that the forest was highly degraded. It was revealed that forest management at Mweka village is better compared to Lyasongoro village where the forest area was moderately degraded.

**Table 3. Current forest condition of the HMFS area**

Forest condition	Mweka Village		Lyasongoro Village	
	Frequency	Percent	Frequency	Percent
Highly degraded	14	17.5	8	10
Moderate degraded	12	15	40	50
Less degraded	54	67.5	32	40
Total	80	100	80	100

***Relationship between the Effects of Climate Change on Forest and the Current Condition of the Forest Area***

The Pearson's product moment correlation coefficient as a category of correlation coefficient represents how strongly pairs of variables are related (Gentle 2013).

**Table 4. Relationship between climate change and the current forest condition area (n=80)**

		The current status of the forest area	The effects of climate change on the forest
The current status of the forest area	Pearson Correlation	1	-0.056
	Sig. (2-tailed)		0.623
	N	80	80
The effects of climate change on the forest	Pearson Correlation	-0.056	1
	Sig. (2-tailed)	0.623	
	N	80	80

Findings in Table 4 above depict that there is a weak relationship of -0.06 between climate change and current forest condition which indicates that the changes in climate patterns affect the forest status.

#### ***People's Perceptions of the Impacts of Climate Change***

The results obtained explained significantly the different perceptions of the respondents on the causes of climate change at the HMFS and adjacent villages. The findings revealed that climate change is considered by 56.2% of the respondents as the major reason for the decrease in the number of trees in the area (Table 5). Also, 55% of the respondents slightly agreed about the land use change as the contributing factor to climate change while 7.5% of the respondents agreed that population growth can contribute to climate change. Only 5% of the respondents agreed that environmental degradation is also a reason for changing the temperature pattern.

**Table 5. Reasons for the changing in rainfall and temperature patterns**

People's Response	Reasons for climate change					
	Decrease of trees	Overgrazing	Environmental Degradation	Population Growth	Land use Changes	Tree Increases
Yes	56.2	0	5	7.5	55	3.8
No	43.8	100	95	92.5	45	96.2
Total %	100	100	100	100	100	100

### Indicators of Climate Change

The increase in temperature and drying of river bed are considered by 58.8% of the respondents to be the major indicators of changes in climatic patterns in areas adjacent to the HMFS (Figure 2). Moreover, 52.5% of the respondents agreed that decreased rainfall is also an indicator of climate change. Other indicators reported were water shortage and increased occurrence of forest fires. The results are similar to the findings of Minja (2014) on his study about vulnerability of tourism in Kilimanjaro National Park and the livelihoods of adjacent communities to the impacts of climate change and variability where shortage of water, drying of riverbeds, and increase in forest fire occurrences were reported as major indicators of climate change.

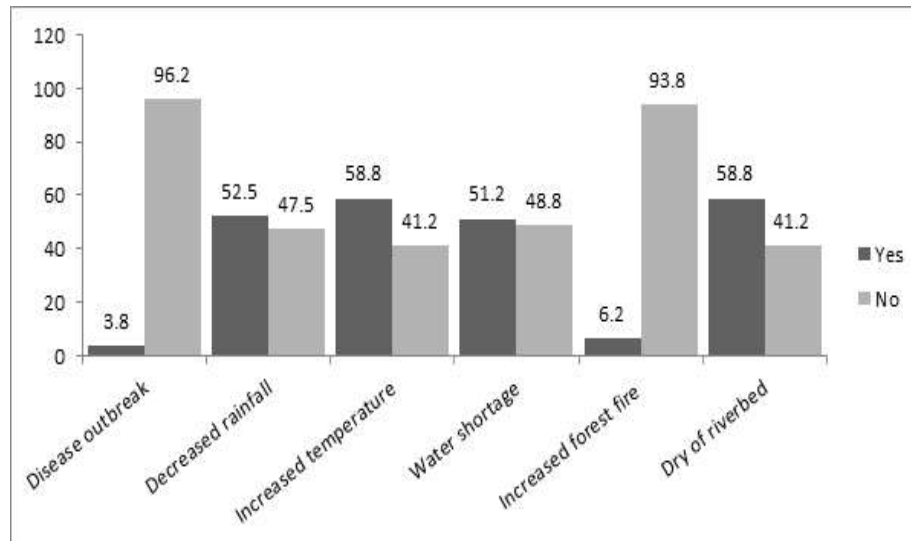


Figure 2. Indicators of climate change in the HMFS and adjacent areas

### People's Perceptions of Forest Governance

The people's perceptions of forest governance were observed on the measures practiced to reduce the climate change impacts at the HMFS and the adjacent villages. It revealed that 67.5% of the respondents in Mweka village strongly agreed that the restriction on the use of forest resources was the only measure practiced to reduce climate change impacts while in the Lyasongoro village, 62.5% of respondents also agreed about it (Table 6). Moreover, 22.5% of the respondents at the Mweka village slightly agreed that afforestation and reforestation were also the measures practiced to reduce climate change adjacent to the HMFS while 10% of the respondents at Lyasongoro village also agreed about those measures. The study further revealed that 7.5% and 15% of the respondents in Mweka and Lyasongoro village, respectively, weakly agreed that reducing the overuse of forest

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resource was among the measures for reducing climate change. Finally, only 2.5% and 12.5% of the respondents in Mweka and Lyasongoro also weakly agreed that the provision of environmental knowledge was a measure practiced to reduce climate change impacts adjacent the HMFS.

**Table 6. Measures that have been taken to reduce the impacts of climate change in the forest area**

Measures	Mweka		Lyasongoro	
	Frequency	Percent	Frequency	Percent
Reduce the overuse of forest resource	6	7.5	12	15
Afforestation and reforestation	18	22.5	8	10
Provision of environment knowledge	2	2.5	10	12
Restricting the use of forest resources	54	67.5	50	62.5
Total	80	100		100

#### ***The Programs Introduced for the Management of the HMFS***

The study found that that there was no program initiated for the management of the HMFS according to 98.8% of the participants (Table 7). Only 1.2% responded that PFM and JFM programs have been introduced for the forest management. During an interview with the household leader at Mweka village, it was revealed that most of the local communities were not involved in forest management.

**Table 7. Programs introduced for the management of the HMFS**

Programs	Frequency	Percent
PFM and JFM	1	1.2
PFM and REDD	0	0
None	79	98.8
Total	80	100

#### ***Role of Local Institutions on Forest Governance***

The local institutions are the most important in governing the forest area when the local communities adjacent to the forest area are also being involved. The study revealed that 63.8% of the respondents disagreed that the existing local institutions do not involve the local community in the management of the HMFS



while 35% of the respondents agreed the local community are involved (Table 8). In addition, upon focus group discussion it was revealed that the local communities and village environmental clubs were not permitted to plant trees in the HMFS.

**Table 8. Local institution involving local people in the management of HMFS**

People's response	Frequency	Percent
Yes	28	35
No	51	63.8
Do not know	1	1.2
Total	80	100

### ***Climate Change Adaptation Strategies and Policies***

The findings revealed that 86.2% of the respondents strongly agreed while 13.8% of the respondents slightly disagreed that afforestation and reforestation are the most important adaptation strategies for climate change adjacent the HMFS (Table 9). Also, 22.5% of the respondents slightly agreed that loan provision was among the adaptation strategies for climate change while 77.5% strongly disagreed that providing loans was a climate change adaptation strategy. Furthermore, the study revealed that 96.2% of the respondents strongly disagreed that land rehabilitation was among the climate change adaptation strategies.

The findings concur with the results by Ngoile et al (2001) which found that local NGOs and the private sector have played a significant role in the promotion of the tree planting aimed at reducing the pressure on the forest reserve. However, a direct field observation done during this study confirmed the presence of trees in every farm area and near the water source to reduce soil erosion in areas adjacent to the HMFS.

**Table 9. Climate change adaptation strategies adjacent the HMFS**

People's Response	Afforestation Reforestation	Agroforestry	Education provision	Capacity Building	Loan provision	Land Rehabilitation
Yes	86.2	0	0	0	22.5	3.8
No	13.8	100	100	100	77.5	96.2
Total	100	100	100	100	100	100

### ***Factors Limiting the Climate Change Adaptation Strategies***

The findings obtained revealed that 30.0% of the participants responded that lack of awareness was the most limiting factor to adaptation strategies for climate change followed by 21.2% who responded that the irresponsibility was also a limiting factor (Table 10). Only 18.8% responded that lack of finances and lack of environmental education were among the limiting factors while a mere 11.2% responded that a small farm size also limited the adaptation strategies process.

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Moreover, the findings obtained from focus group discussion from “Roots” and “Shoots” environmental clubs said that most of the local people in the village were not willing to engage in environmental clubs which made the implementation of climate change adaptation strategies unsuccessful.

**Table 10. Factors limiting the climate change adaptation strategies**

Limiting factors	Frequency	Percent
Irresponsibility	17	21.2
Lack of awareness	24	30.0
Lack of finances	15	18.8
Lack of environmental education	15	18.8
Small farm size	9	11.2
Total	80	100

## ***Policy Option to Promote Sustainable Forest Management of the HMFS***

The results showed that there is no any existing policy option that has been used to promote sustainable forest management at the HMFS according to 62.5% of the respondents (Table 11). However, 33.8% of the participants responded that policy response on forest ecosystem conservation and management was among the policy options to promote sustainable forest management.

Similar findings from Agrawala et al (2003) tried to suggest some policy options which would respond toward climate change impacts in KINAPA. These responses include policy response for glacier and snow, wildlife and birds, land management, water, and forest. Policies can be achieved through effective cooperation between adjacent community and the Kilimanjaro National Park community conservation program.

**Table 11. Policy option to promote sustainable forest management at the HMFS**

Policy responses	Frequency	Percent
Forest ecosystems conservation and management	27	33.8
Forest land management	3	3.7
None	50	62.5
Total	80	100

## **CONCLUSIONS**

The study found that climate change affects forest resources, activities, and local people's livelihoods at the HMFS and the adjacent villages especially the Lyasongoro village. Deforestation was seen as the major cause of climate change which has impacts on the human activities and forest ecosystems in the area.

Wild animals and forest vegetation have also declined due to increase in temperature. The study also found that the effects of climate change on forest and current forest condition are negatively correlated.

The majority of the respondents perceive climate change as changes in temperature and rainfall patterns over a period of time. Furthermore, they consider changes in temperature and rainfall patterns, shortage of water, and drying of river beds as major indicators of climate changes at the villages adjacent the HMFS.

Local communities perceive forest governance as the control mechanism of degradation as they reported that the government has restricted the use of forest resources in order to control the forest degradation. However, it was revealed that there were no sustainable programs in the management of the HMFS. KINAPA is the only institution involved in the protection of the HMFS although the present environmental clubs in the village are not permitted to manage the forest area by planting trees due to encroachment. The existing local institutions do not involve the local community in managing the forest strip.

Afforestation and reforestation are the only adaptation strategies practiced to mitigate the impacts of climate change in the village. However, most of the local people are not willing to plant trees in their farm area due to lack of education on climate change.

Regarding the existing policy option in the management of the HMFS, majority of the respondents indicated that there is no policy option initiated to enhance the management of forest area.

## **RECOMMENDATIONS**

Environmental Non-Government Organizations in all villages should be encouraged to participate in tree planting to conserve the half-mile forest strip for the benefit of the communities and the forest ecosystem. Also, the adjacent communities should be encouraged to be actively involved in those environmental clubs at their villages so as to promote the effective climate change adaptation activities. Education, awareness, and training are required for building climate change resilience on forest resources. Furthermore, education on forest governance should be provided to the communities and other private sectors in order to mitigate the impacts caused by climate change. Also, policy option should be formulated to enhance the protection and management of the Half Mile Forest Strip by introducing Joint Forest Management and other participatory programs. The policy option should intervene cooperation between the communities adjacent Half Mile Forest Strip and Tanzania Forest Services.

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