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Knowledge and Practices of Climate Change Adaptation Among the Maasai Community of Ngerengere Division, Morogoro Region, Tanzania

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Abstract

The objective of this article is to explore the knowledge and practices of adapting to climate change among the Maasai community in Ngerengere Division, Morogoro Region, in Tanzania. The research used an embedded case study design. The study sample was drawn from the Maasai community, as well as agricultural and livestock extension officers of Ngerengere Division, media experts and veteran journalists on environment and climate change. The findings show that, to the Maasai rural community of Ngerengere, climate change adaptation implies mainly transhumance and agro-pastoralism due to climatic changes; and practices related to climate change adaptation include agro-pastoralism and destocking activities. The paper recommends education, proper communication and administrative linkages as appropriate initiatives to be employed for proper climate change adaptation in the study area. These measures will improve the prevailing social, economic, environmental and political contexts related with the Maasai's indigenous and traditional pastoral knowledge and systems for better climate change adaptation.

Key words: *adaptation, climate change, knowledge, practices, Maasai.*

1. Introduction

Climate change is described as a change of climate attributed, directly or indirectly, to human activity that alters the composition of the global atmosphere, and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 2013). As commonly known, climate change is caused by natural internal processes and external forces such as modulations of solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of atmosphere or land-use. The impacts of climate change persist for an extended period, typically decades or longer (IPCC, 2015).

Due to climate change, many terrestrial, freshwater and marine species have shifted their geographical ranges. Climate change has also led to changes in seasonal activities, migration patterns, abundances and species interactions. In addition, there are also impacts on human systems and crop yields, and ocean acidification that affect marine organisms (ibid.). As the UNFCCC (2007) notes, climate change impacts differ from place to place; and not all the climate change issues manifest equally in all countries.

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Because of such various impacts of climate change, the global response has consisted of adaptation strategies to accommodate such impacts and related phenomena to modify the livelihoods and means of sustenance of communities that are vulnerable to climate change (Practical Action, 2010). Climate change adaptation refers to the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate, avoid harm or exploit beneficial opportunities (IPCC, 2015). Climate change adaptation encompasses knowledge and practices. In this study, knowledge on climate change adaptation refers to the general understanding that climate change adaptation implies the potential to adapt to the challenges posed by climate change, and describing the ability to be actively involved in processes of change (ibid.). Practices of climate change adaptation imply measures taken to reduce vulnerability to climate change hazards, efforts to build adaptive capacity, and actions to increase resilience (Ensor & Berger, 2009). Generally, these are actions taken to help communities and ecosystems deal with changing climate conditions (Skinner, 2011).

Knowledge and related practices are among the vital components of climate change adaptation because they not only encompass the ability to describe clearly and sufficiently the meaning, causes, features and impacts of climate change system (ibid.); but also help societies to respond to changes, shape changes and create changes in that system (Chapin et al., 2006). Several studies have been conducted on climate change adaptation in East Africa in general, and Tanzania in particular (Mushi & Edward, 2015; Tabuti et al, 2016; Liwenga, 2016). Despite all these studies, however, information that provides an evaluation of knowledge and practices of climate change adaptation, especially by local communities such as the Maasai community in Tanzania, is still scarce. This study, therefore, aims at exploring the knowledge and practices of adapting to climate change among the Maasai community in Ngerengere Division, Morogoro Region, in Tanzania. It specifically seeks to explore the knowledge, practices and initiatives among the Maasai of Ngerengere in the adaptation to climate change. The objective is that the findings of this study will provides insights to developing implementable policies, programmes and technologies for climate change adaptation among local communities, such as the Maasai of Ngerengere.

2. Related Literature

2.1 Pastoralism as a Maasai Livelihood System and Climate Change Impacts

Maasai communities in Tanzania practice pastoralism, a form of livestock production or traditionally arranged ranching where mobility—a common feature among pastoral systems—is a key option (Hesse, 2006). Pastoralism constitutes their main livelihood system based on livestock keeping, in conjunction with other minor reasonable economic engagements embedded in firm socio-cultural and environmental objectives (ibid.). Pastoralism encompasses humans, rangelands and herds as the three interlinked pillars (Abdalla & Gaiballah, 2016). It is one of the main livelihood practices in semi-arid areas of East Africa because it is a natural resource-based land use system.

Pastoralism happens to be the most affected by climate change compared to other forms of land use in the East Africa region (Abdalla & Gaiballah, 2016). Climate change has particular impacts on livestock: it affects livestock production in multiple ways, directly by impacting on livestock performance; and indirectly by affecting the environment, society and the economy (FAO, 2016). The most important impacts are experienced in animal productivity, yields of forages and feed crops, as well as in animal health and biodiversity. In arid and semi-arid ecosystems with a single rainy season, there is usually a short growth period followed by a long dry season. In these circumstances, pasture areas become greatly reduced, overgrazed (as there is less pasture available) and degraded; and the amount of water becomes very limited (Awuor, 2011). In addition, scarcer resources, coupled with the current levels of demographic growth, lead to stronger competition between pastoral communities, and between these and other groups, hence resulting into conflicts and even violent clashes (CCCD, 2008).

Moreover, due to climate change, livestock become less resistant to diseases as they often die because of extreme conditions. In consequence, there is reduced nutrient availability for animals; and ultimately this translates into reduced livestock production, which impacts on food security and incomes through the reduction of milk and meat production for smallholders (Awuor, 2011). Subsequently, the marketing of livestock often declines and their price increases immediately after drought because farmers are rebuilding their herds; and hence are more likely to withhold animals from sale (Little, 2009; Parsons et al., 2001).

Importantly, extensive use of indigenous knowledge has enabled pastoralists and their animals to survive in extremely difficult conditions in arid and semi-arid environments; and have been able to cope with harsh conditions (Gaiballah & Abdalla, 2016). For example, as an insurance mechanism for surviving through periods of stress and maintaining herd structure, pastoralists have learnt to keep a sex ratio of 2:3 or 3:4, with females dominating; and at a low off-take rate of 6–10% compared to 30% in modern ranches (Niamir, 1990). In addition to knowledge, cultural institutions and practices are importantly used as climate change adaptation strategies. Such cultural institutions include norms, rules, relations and practices (Goldman & Riosmena, 2013).

3. Methods

3.1 The Study Area

This study was conducted in Ngerengere division, Morogoro District, in Morogoro Region. Geographically, Morogoro District is divided into mountainous areas, low mountainous areas and savannah. The mountainous zone takes a large part of the Uluguru and Unguu mountains. The area consists of several rivers such as Ngerengere, Mgeta, Kafa, Ruvu, Wami, Msongozi and Mbulumi (Mollel, 2010). At an altitude of 100–300m above sea level, the Ngerengere area features sparsely wooded, rolling plains that connect the coastal lowlands with the higher elevations of the central region. Average monthly temperatures are around 25–28°C (URT, 2008).

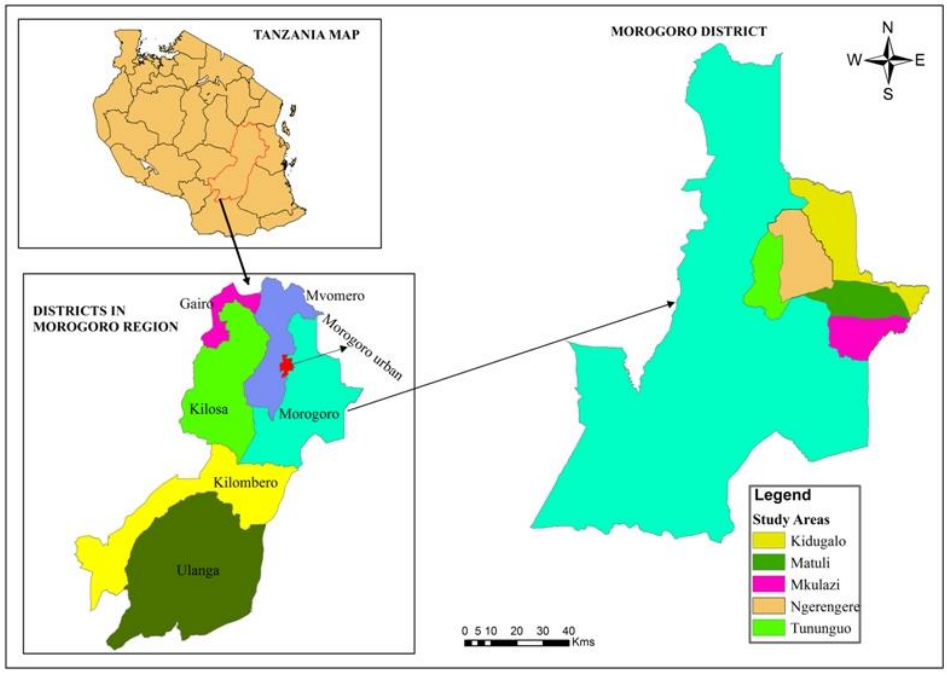

Figure 1: Study Area (Ngerengere Division and Wards)
Source: Geography Department, University of Dar es Salaam (2018)

The study area receives bimodal rainfall. The first short rainfall season (*vuli)* starts in November to early January, followed by a short dry season. The second long rain season (*masika*) starts at the end of February and goes to May, followed by a long dry season. The annual rainfall varies from 800–1,000mm (Yanda & Munishi, 2007; Van Aelst & Holvoet, 2017). The average monthly minimum and maximum temperatures are almost the same throughout the Ruvu-Ngerengere basin. The coldest month is August (about 18°C), and the hottest is February (about 32°C). The annual average temperature is about 26°C (Mero, 2011). Ngerengere division had a population of 39,683 consisting of 20,153 males and 19,530 females (URT, 2013). The division comprises of both rural and semi- (peri-) urban (township and military centres) areas. The division consists mainly of Maasai people (80 percent); while other groups include the Kwere, Mang'ati and Khutu (Mero, 2011). The dominant economic activities in the area include livestock-keeping, crop cultivation and agro-pastoralism. More than 90% of the livestock kept by Maasai pastoralists in Ngerengere are indigenous. In terms of agriculture, the crops cultivated in Ngerengere include maize, bananas, tomatoes and vegetables (Kihila, 2005).

Ngerengere was chosen as the area of study because, first, it is marked by both production systems: agriculture and pastoralism (Mero, 2011). Relatedly, there is a reduction in pastoralists' mobility in Ngerengere, hence making it a suitable area for

this study. Second, this is one of the areas that have proved to have more climate change adaptation activities and options—especially smallholder adaptation options (Van Aelst & Holvoet, 2017)—which provide useful and relevant variables for this study. Third, the literature indicates that there is a very high increase in the rate of agricultural activities and population growth located in the downstream zone of Ngerengere, which exacerbates water pollution threats, as well as lowering the flow and volume of the Ngerengere River (Kihila, 2005).

4. Methodology of the Study

4.1 Population of the Study

Ngerengere division contains five wards and 24 villages, and the researcher aimed at studying all these wards and villages. However, four—out of five—wards, namely Ngerengere, Mkulazi, Kidugalo and Tununguo were selected for the study. All the 20 villages of these four wards were reached (see Table 1). Matuli ward, which has 4 villages, was not selected because, from field visits observation and Ngerengere division local government leaders' official information, it is not resided by Maasai people who were the subjects of this study.

Table 1: Study Wards and Villages

Ward	Ngerengere	Kidugalo	Tununguo	Mkulazi
Villages	Ngerengere Mgude Sinyaulime Kiwege	Kidugalo Visaraka Kisemo Magera Pulambili Seregete A Seregete B Lubumu	Mlilingwa Dete Kisanga Stand Tununguo	Mkulazi Chanyumbu Usungura Kidunda
Total	**4**	**08**	**04**	**04**

Source: Field Data (2018)

4.2 Research Design

This study used an embedded case study design. This research design tends to involve more than one unit or object of analyses, and is usually not limited to qualitative analysis alone as it can integrate both qualitative and quantitative methods. A multiplicity of evidence is investigated at least partly in sub-units, focusing on different salient aspects of the case (Scholz & Tietje, 2002). This design allows for the use of mixed methods—such as observation, survey and case study (an in-depth study of an individual or group of individuals)—to collect data. In fact, it allows for multiple units of analysis (Skogerbo, 2011). It is suitable for studies that explain and analyse relationships between variables (Churchill, 2002). Furthermore, this design uses methods of knowledge integration that help explain the data under consideration, thereby making data and inferential processes more transparent (Scholz & Tietje, 2002). As such, it was relevant to this study's purpose, which assessed knowledge (understanding) on climate change.

4.3 Sampling Methods

The researcher used purposive sampling technique to select respondents among the population of the study at three levels: ward, village and individual level of households. In purposive sampling, a researcher purposely chooses respondents who, in the researcher's judgement, have some appropriate characteristics required and are relevant for the study (Rwegoshora, 2014). Ward and village (local government) leaders helped the researcher to purposively select the respondents. These respondents were chosen based on their duration of stay in the area; which determined their familiarity with activities related to climate change and understanding of the environmental and socio-political phenomena at the study area. This helped the respondents to provide informed and 'strong views' on the subject under review (Deacon et al., 2010). First, the sample size of the study consisted of 60 Maasai respondents (who were both/either farmers or/and pastoralists) who were purposively selected using the criteria noted above. This number was representative of each of the village's population in the division in terms of gender and age. Also, the basis for this number was the fact that these were the respondents that the researcher and the local authorities (local leaders in Ngerengere) found very appropriate in terms of their familiarity (they had stayed longer – up to 20 years in the respective villages) with the activities related to climate change; and in their understanding of the environmental and socio-political phenomena at the study area. The distribution of respondents in the four wards was as follows: Kidugalo (15), Ngerengere (18), Tununguo (15), and Mkulazi (12).

Second, the sample size also comprised 10 agriculture and livestock extension officers who were purposively selected from 10 villages (providing particular representative officers from each selected study wards); five (5) senior or experienced environmental journalists (mainly members of the Association of Journalists for Environment in Tanzania (JET)) and, finally, five (5) communication/media experts from the University of Dar es Salaam: all to provide proficient insights on rural people's understanding on climate change. Therefore, the total number of respondents was 80; and the distribution of this sample size used in the study was as Table 2 shows.

Table 2: Distribution of Sample Size

Respondents	Number of Respondents
Farmers and/or Pastoralists	60
Agriculture and/or Livestock Extension Officers	10
Senior/Experienced CC journalists	05
Media/Communication experts	05
Total	**80**

Source: Field Data (2018)

4.4 Research Approach and Data Sources

The study collected both primary and secondary data. Documentary sources included books, journals, articles, official publications, newspaper clippings, reports and seminar papers, which were used to obtain secondary data. Primary

data, on the other hand, came from interviews and observation. The researcher used interviews and documentary review as data collection methods. Interviews were conducted to the 80 respondents, namely: Maasai farmers/pastoralists, agriculture and/or livestock extension officers, experienced climate change journalists, and media/communication experts. Interviews were used because they allowed face-to-face communication with respondents. The observation method was also used to evaluate the residents' understanding of climate change in the Ngerengere. Documentary review analysis was used to collect data and historical information on the subject of study. This study used observation during field visits to villages to complement the results of the interviews and documentary review.

5. Findings and Discussion

5.1 Knowledge of Climate Change Adaptation

The findings indicate that, of the 60 respondents/key informants (Maasai farmers/ pastoralists of Ngerengere) interviewed, 35 (58.3%) had high understanding on the subject, 17 (28.3%) had average understanding, and eight (8) (13.3%) did not provide any response on the subject as Table 3 illustrates.

Table 3: Understanding of Climate Change Adaptation

Level of Understanding of CCA	Frequency	Percent
No responses	8	13.3
Average	17	28.3
High	35	58.3
Total	**60**	**100.0**

Source: Field Data (2018)

These findings indicate that more than 85% (52) of the 60 Maasai respondents interviewed had knowledge and understanding about climate change adaptation; with 35 out of 60 respondents having high understanding, while 17 had an average understanding on the subject. This result concurs with the position that rural people have indigenous knowledge or traditional wisdom that forms the foundation of climate change adaptation knowledge and ability; and this includes practices and customs that have been passed from generation to generation through word of mouth and cultural rituals (Ensor & Berger, 2009; Gaiballah & Abdalla, 2016; Goldman & Riosmena, 2013). This position is also echoed by Kerubo (2016) who notes that environment and climate change—and climate change adaptation in particular—are subjects commonly communicated and taught to members of the Maasai society in general through their indigenous ecological or environmental knowledge and means, as noted by some respondents:

> *In adapting to these changes, we have to shift by moving from one place to another until we find pastures in* lonjo (Pastoralist and Farmer 4).
>
> *…you can never find a Maasai destroying water sources, by activities such as grazing. We have our own rules to control ourselves and adapt to the changes that are happening* (Pastoralist and Farmer 19).

In addition, the local experts—i.e., the agriculture and livestock extension officers of Ngerengere wards and villages—similarly explained that the Maasai of Ngerengere had climate change adaptation knowledge and ability that were relevant to their needs, as one noted:

> *In most cases, their understanding on climate change adaptation is evident in their shifting practices. They usually do shifting; trying to move from one place to another in search of pasture and water for their cattle. They might shift from Kidugalo village to Visaraka village, and create good friendship with the people they find in such places* (Agriculture Extension Officer 4).

It is apparent from the view above—and in addition to what is asserted by Homewood et al. (2009), as well as what was observed at the study area—that for some of the Maasai in Ngerengere, transhumance is considered a climate change adaptation means. However, for others it is not a means for adaptation. The latter case is probably due to the fact that the ensuing land use changes across Tanzania's Maasailand in the form of expanding conservation and mechanised farming have adversely impacted livestock mobility (Ndesanjo, 2017).

Apart from the importance of information as a component of knowledge in climate change adaptation, the journalists interviewed noted the importance of resources to facilitate the employment of that knowledge. This concurs with the position that a consideration of resources or tools that make up adaptive capacity and knowledge is important. These include tangible assets, such as financial, technological, information and natural resources; and less tangible elements, such as skills and opportunities to make decisions and implement changes to livelihoods or lifestyles (Ensor & Berger, 2009). In this line, the journalists interviewed noted:

> *Information come, and through it people know that now we have to adapt; but there are people with means and those without. There are people who know the ecosystem. But there are those who know it but it does not help them. Thus, the ability and resources to respond and implement climate change adaptation measures also include knowledge and information* (Journalist 2).

> *So, the information is the one that addresses the problem they are concerned with. In Pangani, fresh water was once attacked by salt. So, since they wanted to adapt, they wanted to dig a well; but it was the government who could decide to dig the well. So, you see, in the case of Maasai, they would want to adapt quickly but in other cases the government needs to announce tenders and let NGOs dig the well. Maasai adapted quickly because it was under their jurisdiction, but it was not in the capacity of these farmers to dig a well. So, they had the information but could not adopt it.* (Journalist 1).

Generally, the findings indicate—through their explanations and examples—that most of the Maasai in Ngerengere have certain knowledge and understanding about climate change adaptation. Most know climate change adaptation in terms of shifting forage sites; mixing farming and pastoralism (agro-pastoralism) and/or doing mixed farming; and up-taking livestock protective measures. This reality was evidenced on how they had new land use plans: one plot would be divided into several portions for various uses such as farming, pastoralism and others. Also, this climate change adaptation knowledge appeared to be mainly obtained through

indigenous knowledge or traditional wisdom, which includes practices and customs that have been passed from generation to generation through word of mouth and cultural practices/rituals. This result is in line with the literature (Gaiballah & Abdalla, 2016; Goldman & Riosmena, 2013): that there is a growing understanding among the rural communities in East Africa on climate change adaptation and its imperative.

5.2 Practices of Climate Change Adaptation

In their answers, respondents mentioned various practices related to climate change adaptation that they were aware of. These included livestock mobility or nomadism (shifting from one place to another in search of pasture); practising agro-pastoralism or mixed farming to supplement food needs; doing special preparation for uncertainties ahead (e.g., storing food and forage); planting trees; constructing dams for cattle's drinking water; securing or owning land through purchasing; planning land use such as dividing it into different uses; reducing the number of cattle; and making by-laws to address various climate change challenges. In this regard, the respondents noted:

> *In Ekenyi, a place nearby here, and in other places, they have set their own ways of protecting the environment; and there are clear defined fines if one does follow them. Also, through their own efforts, they have circles to protect water sources…. You see, the Maasai too nowadays are forced to farm. They must do so. They have seen that overdependence on cows may lead to great losses. You may be able to buy a sack of maize after selling a whole herd of cows, but if you were to buy seeds it would be very easy for you. Also, those pulps from maize may be used later for feeding animals. Even in their farming, Maasai farm near the village while keeping animals in the wild so that in no way they can contribute to environmental problems* (Pastoralist and Farmer 19).

> *Adaptation includes the government helping people by providing a strip of land which they need to for feeding cows during the rainy season so that we can return them here in the dry season. But where I border with barracks, even when they have some grass while our cows are starving, you cannot get any help. You might be beaten to death if caught. It is a command* (Pastoralist and Farmer 1).

These findings, which list the practices related to climate change adaptation that the Maasai of Ngerengere had knowledge about, indicate that pastoral Maasai are currently evolving and adopting new strategies to deal with current socio-ecological perturbations. This result is opposed to the emphasis by some scholars (Goldman & Riosmena, 2013; McKune & Silva, 2013) that pastoral Maasai use only—or mostly—traditional strategies for climate change adaptation.

In addition, local experts—i.e., the agriculture and livestock extension officers of Ngerengere—informed that the Maasai of Ngerengere had knowledge of the practices related to climate change adaptation, as one noted:

> *The society living here is the Maasai community. Most of them have begun farming as a means of climate change adaptation. Maasai are environmental protectors. They do not cut trees. Also, they are usually in search for water and pasture for the animals they keep* (Livestock Extension Officer 1).

5.3 Appropriate Initiatives to be Undertaken for Climate Change Adaptation

In this aspect, the study aimed at exploring the views of respondents on what they thought were the appropriate climate change adaptation initiatives to be undertaken in Ngerengere that could sustain their economic activities, i.e., pastoralism and farming. In their answers, the respondents mentioned such initiatives to include educating the Maasai on climate change and climate change adaptation; strengthening the legal basis; doing agro-pastoralism; the presence of administrative linkages (government versus communities); and the presence of lateral or horizontal conversations and communication (instead of the dominant top-down communication mode).

In particular, the 60 Maasai respondents interviewed mentioned the climate change adaptation practices that are appropriate in their area (Ngerengere) as follows: 23 (38.3%) mentioned self-initiatives or measures like the use of secure treatment for their cattle; measures relevant to the nature and kind of climatic problems at a particular season and area, e.g., diseases, drought; nine (15.0%) mentioned agro-pastoralism; seven (11.7%) mentioned reducing the number of cattle as an appropriate climate change adaptation measure; six (10.0%) mentioned the provision of education on climate change and climate change adaptation; two (3.3%) mentioned effective communication; 1 (1.7%) mentioned legal basis; while 12 (20.0%) respondents did not respond to this question.

In particular, the Maasai respondents explained these climate change adaptation practices that are carried out, and which are viewed as appropriate for Ngerengere, as they noted:

> *There are two ways of climate change adaptation which are mostly employed here; one way is periodic grazing or rotational grazing. That means they feed in shifts: from January to May, let's graze in the north; from June let's go west. The second solution we use is to reduce the number of animals. If someone had 1000 they would reduce so they can fit into the available land* (Pastoralist and Farmer 3).

> *The government must enact laws to protect the environment, particularly water sources. The government should give training to the people. Before taking action, educate them and make laws so you could take actions if he does not play his part. Education about environment will help both farmers and pastoralists so that they can put it in mind that they have to stay 60 meters from water sources to sustain them. We could even establish a motto that 'every drop of water should be protected'* (Pastoralist and Farmer 2).

> *As a result of climate change, when there is too much drought you can have no cows to sell. They may fall or die on the way, and that will make you not get even a small amount of money to buy food. So, for me, I thought why not go directly to farming. Due to climate change, it has forced us to adapt in this way: doing both agriculture and pastoralism* (Mbabakapurwa Kisawani, Farmer and Pastoralist, Ngerengere, 2018).

Generally, from these findings and field observations, the kind of climate change adaptation practices that are carried out and viewed as appropriate in Ngerengere are arguably in line with the prevailing social, economic, environmental and

political contexts in the area in particular, and Tanzania in general. As Smit and Wandel (2006) point out, adaptive capacity does not only depend on the availability of elements and assets, but also on the prevailing social and political context through which distribution takes place: networks, institutions, entitlements and political influence. Such contexts operate at different scales: while some adaptive strategies are local (such as networks of family relationships); others are broader and sometimes global social, economic and political forces that may have the most significant influence on local vulnerabilities (Ensor & Berger, 2009). For instance, due to climate change, land use changes across Tanzania's Maasailand in the form of expanding conservation and mechanised farming are the new adaptation practices. These have changed (the Maasai) livestock mobility tendencies. As a result, the Maasai have embraced such climate change adaptation practices and others—as was the case with this study—such as reducing the number of cattle and doing agro-pastoralism (Homewood et al., 2009). This concurs with the position by Abdalla and Gaiballah (2016) that pastoralists now not only herd livestock, but also practice other complimentary activities. These include subsistence farming; hence they are now mixed farmers or agro-pastoralists, i.e., they combine livestock keeping with crop production.

5.4 Recommendations on Stakeholders' Roles on Climate Change Adaptation

In this aspect, the study aimed at exploring views or recommendations of the Ngerengere Maasai respondents on what they thought different stakeholders should do to enhance climate change adaptation in their area. In particular, the literature (e.g., Abdalla & Gaiballah, 2016; Ensor & Berger, 2009) identifies and lists a variety of roles and functions different stakeholders should play on climate change adaptation. These include enabling knowledge-sharing; provision of resources for, and to influence, climate change adaptation; helping access to resources and influence over policy; facilitation of, or taking part in, particular adaptation activities such as vulnerability reduction, building adaptive capacity and strengthening resilience; and generally providing and/or working with local communities on proper and relevant mechanisms for understanding and practising proper climate change activities.

Accordingly, such literature (Abdalla & Gaiballah, 2016; Ensor & Berger, 2009) identify stakeholders related to climate change adaptation, namely: the government (central and local); civil society organisations; media; and local livestock and agriculture experts, i.e., ward or village agriculture and livestock extension officers. Relatedly, this study's respondents mentioned particular roles that such stakeholders were expected to play with regard to climate change adaptation in Ngerengere. The roles include the provision of sustainable education, e.g., training the people of Ngerengere on issues such as charcoal business, grazing activities, and other land use schemes; diversifying and modernising locals' economic activities such as the introduction of hybrids and irrigation schemes; and in particular, the government and its agencies, and the mass media to change the approach of reaching them (Maasai of Ngerengere):

instead of using top-down approach, they should to go to these Maasai's grassroots; and build a system that will ensure there is information availability at all levels. The respondents noted:

> *In facing climate change; first, it is for any stakeholders to give pastoralists education. Then, there can be external intervention. If we take farming, many people use local seeds. But there could be some stakeholders who may bring seeds that can withstand harsh climatic conditions. On the side of pastoralists, we think the number matters. A large group of cows is difficult to manage. It could be easier to even provide forage at home for small herds. But for huge herds it becomes impossible* (Pastoralist and Farmer 2).

> *Stakeholders like the NEMC [National Environment Management Council] should give education. In livestock, there are many infrastructures that are needed so as to facilitate green pastures. But these are not available. They cannot get enough breeds* (Agriculture Extension Officer 9).

In particular, respondents underscored the role of the government, especially on financial, legal and administrative aspects and practices of climate change adaptation, as they noted:

> *The best solution should be that experts of climate change should be coming to the villages to offer seminars. The government should educate the Laigwanani so these could deliver the message to the pastoralists. There is a need for education. It is not easy to accept the idea of reducing the number of cows but when there are strict policies and laws, people may comply. These laws should come from both sides: the Laigwenani on one side, and the government on the other.* (Pastoralist and Farmer 19).

> *We have no one to help us; we have no education. I ask the government to reach us in the villages. If the village government needs something, they can call our leaders. Another thing that we need is for the TV to come here. So basically we need to use both methods, old and modern ones* (Pastoralist and Farmer 24).

All in all, in view of these findings with regard to the role of different stakeholders in climate change adaptation in Ngerengere, it can be established that, one, stakeholders form and can determine the adaptive capacity of a society as they are part and parcel of the prevailing social and political context of society (Smit & Wandel, 2006). Two, the role and functions of stakeholders in climate change adaptation—especially in the framework of 'working together with local communities'—are very significant. In particular, the government should take the leading role in this regard. This is similarly emphasised by the United Nations Framework Convention on Climate Change (UNFCCC). Article 4 of the convention places an obligation for stakeholders—such as international organisations, and especially developed countries—to assist developing countries with adaptation (Ensor & Berger, 2009).

Therefore, from the respondents' views above, it can be established that stakeholders' major roles on climate change adaptation should include working, through setting particular key practices and strategies or activities, in collaboration with local communities, such as the Maasai of Ngerengere. These practices include

building strong understanding of adaptation, especially in rural communities; implementing effective adaptation projects and programmes; influencing negotiators, researchers and other groups in adaptive initiatives in climate change; influencing policies and government actions; as well as assisting in funding adaptation strategies and activities mainly in developing countries in general, and rural areas in particular.

6. Conclusion and Recommendations

The findings of this study have generally established that most Maasai community members in Ngerengere have certain knowledge and understanding about climate change adaptation. In particular, to them climate change adaptation constitutes shifting forage sites, and taking agro-pastoralism and livestock protective measures. The climate change adaptation activities in Ngerengere include subsistence farming or agro-pastoralism; education; reducing the number of cattle; and proper communication and administrative linkages. Importantly, most of these practices are in line with the prevailing social, economic, environmental and political contexts; and their foundation is the Maasai indigenous and traditional pastoral knowledge and systems.

Also, this study has established that various stakeholders, in collaboration with the respective communities, are expected to play a very significant role related to climate change adaptation, especially in rural areas such as Ngerengere. Stakeholders identified include the government (central and local); civil society organisations; media, especially electronic media such as radio and TV; and local livestock and agriculture experts, namely ward or village agriculture and livestock extension officers. The roles that such stakeholders are expected to play with regard to climate change adaptation in Ngerengere include the provision of sustainable education, e.g., training the people of Ngerengere on issues such as charcoal business, grazing activities, and other land use schemes; diversifying and modernising the locals' economic activities by the introduction of hybrids and irrigation schemes; and building a system that ensures information access at all levels. However, such roles are arguably not performed adequately, which calls for appropriate measures to be taken to enable efficient climate change adaptation, and hence society's development.

This study emphasises that knowledge and understanding of climate change and climate adaptation are crucial to societies, especially rural communities. They not only help in the assessment of the past, current and future climate change trends, but also provide ways to develop relevant adaptation strategies and practices. In view of that, it is imperative to deploy mechanisms to facilitate and increase climate change adaptation understanding, and update rural communities on trends of expected events. Such an exercises should reflect the local contexts, needs, and conditions in terms of information dissemination, resources, and uptake; as well as local livelihoods and (indigenous) knowledge systems. Thus, there should be policy formulation and intervention that emphasise on knowledge and proper climate change adaptation practices that will have more positive impact in respective areas.

Since climate change adaptation relate to literacy or knowledge level and related practices, it is vital to ensure that such proper knowledge on the strategies, initiatives and practices is given especially to the rural community. This knowledge can be given to this community—which comprises mostly of farmers and pastoralists—through the mass media such as radio and television; as well as by the provision of seminars and other kinds of training, e.g., the use of local or traditional leaders. In addition, the government should formulate policies and create programmes that give sufficient emphasis and support on climate change adaptation practices, especially to rural areas.

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