Climate Change and Variability: Local Farmers Perception in Rombo District, Kilimanjaro Region, Tanzania

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Abstract

Agriculture, the highly vulnerable sector to climate change is the main sources of livelihood in Africa, and in Tanzania it is the backbone of the economy. Agriculture has been impacted by climate change and therefore increasing food insecurity and poverty level. As response farmers have adopted different adaptation measures depending on geographical location and social economic status. This study therefore, aimed at identifying and documenting climate stresses and perception on climate change in Rombo District. The study was carried out in Mahango and Nguduni villages and employed both qualitative and quantitative techniques. Questionnaire represented quantitative approach while focus group discussion, key informant interviews and direct observation represented a qualitative approach. About 5% (80) of 1576 total household were randomly selected while 5 key informant and 10 focus group members were purposevely selected. Descriptive statistics and thematic analysis techniques were used to analyze the data. Findings show that, prevalence of prolong dry spell, drought and below average rainfall has led to food shortage, and poor household income; therefore increasing poverty level among the household. People experienced different climate stress such as dry spell, extreme temperature, drought, water shortage and below average and above average rainfall. About 42.5% respondents perceived temperature to have increased and decreased in rainfall for the past 30 years. The study recommends local adaptation strategies to be streamlined to relevant policies in order to enhance local farmers' adaptive capacity and become helpful in facing both present and future climate change effects.

Keywords: Agriculture, climate change, vulnerability, perception, poverty

1.0 Introduction

Agricultural is one of the important sector of the national economy in developing countries, Sub Saharan Africa (SSA) and Tanzania in particular. It provides sources of employment for more than 60% of the population and 30% of gross domestic product (GDP) in the world (Kandlinkar and Risbey, 2000). Agriculture and climate change are closely interelated.

Climate change and variability is one of the environmental global problems affecting many sectors icluding agriculture, and is considered to be one of the most serious threats to sustainable development with adverse impact on environment, human health, food security, economic activities, natural resources and physical infrastructure (IPCC, 2007; Huq, *et al*., 2006).

In SSA, climate change and variability has an adverse impact on agriculture. Crop modelling indicates that by 2050, the average production of rice, wheat, and maize yields will decline by up to 14 percent, 22 percent, and 5 percent respectively, as a result of climate change. The impact of climate change will be influenced by less adaptive capacity which will make these countries more vulnerable to climate change (IPCC, 2007; Huq, et al., 2006).

In Tanzania, climate change and variability has posed a significant threat to natural resources base and agriculture in particular. According to URT (2007), annual temperature was projected to increase by 1.0 ^{0}C – 1.8 ^{0}C throughout the country and the precipitation by 10% by 2010.This trend causes agriculture sector to become the second vulnerable sector to the impact of climate change and variability.

Agricultural production in Tanzania supports the livelihood of two thirds of Tanzanias and employs 80% of rural workforce. However, it accounts for 23% of GDP (URT, 2009). Basically, Tanzania is seriously affected by climate change and variability since it depends primarily on rain-fed agriculture, with only 2% of arable land having irrigation facilities (Shemsanga *et al*., 2010). Increasing impacts of climate change and variability on agriculture have been associated with various adaptation and coping mechanisms (Gwambene, 2007). Adaptation is the most efficient and friendly way for farmers to reduce the negative impacts of climate change (Füssel *et al*., 2006).

According to UNFCCC (2003) farmers have been modifying their farm practices to adapt to changing climate and have evolved approaches that increase resilience to variable and changing climatic conditions. New agricultural practices have been introduced to improve the capacity to adapt to climate change. Policies have emerged at different levels (local, national and subregional) that encourage the adoption of such practices. New tools and

innovative financing mechanisms have also been introduced to reduce the impacts of climatic risks on farmers. Compared with the extent of information existing on the challenges associated with climate change in Tanzania, less information is available on Local Farmers Perception on Climate Change and Variability.Therefore this paper aimed at investigating the phenomenon in a developing country's context. Specifically, the study explored local farmers perception on climate change and variability, and examine local farmers awareness to climate change and access to climate change information, by taking a case of Rombo District.

2.0 Methodology

2.1 Study area

The study was conducted in two villages of Nguduni and Mahango in Rombo District. Rombo District is one of the seven districts of Kilimanjaro region.Other are Mwanga, Same, Moshi Rural, Hai, Siha and Moshi Urban.Rombo District lies between latitude 30° 17' south of equator and longitude 370° 40' East The area was chosen purposely because it has been experiencing serious food shortage and poverty level among the households (URT, 2007).

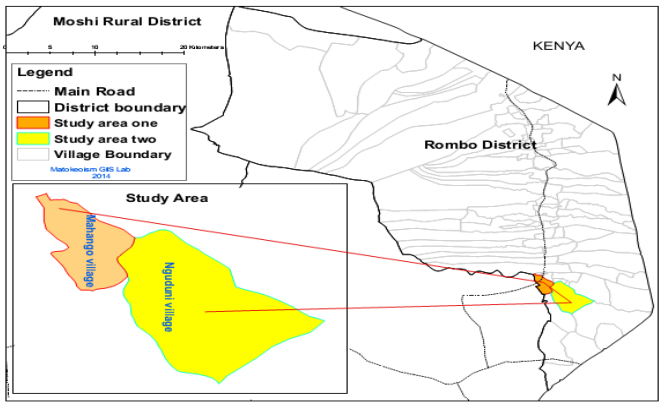


Figure 1: Map showing the location of the study area

2.2 Study design and data analysis

The study involved a cross-sectional survey to 80 out of 1556 households (HH) (i.e. 5%) from villages under study (Table 1) for primary data. Households were selected using simple random sampling. In addition key informant interviews (10 key informants) and

Focus Groups Discussions (FGDs) were also were also to provide qualitative information for the study. Key informants were selected based on their knowledge on climate change aspect and, thereby proving specific information needed in this study. Secondary data were obtained from documentary review from various soruces.

Table 3: Total number of households and households selected per village

Villages	Number of HH	Number of HH selected
Nguduni	886	45
Mahango	690	35
Total	1556	80

Qualitative data were analysed using themantic analysis while quantatative data were analysed using descriptive statistics; particulary frequencies . Statistical Package for Social Science Research (SPSS) was used to analyse the data.

3.0 Results and Discussion

3.1 Characteristics of Respondents based on age, sex, marital status and Education Level

According to Bayard *et al.* (2007) age is positively related to some climate change adaptation measures. The study findings obtained from the field revealed that the majority of the interviewed respondents were between 36-53 years followed by 26.3% who were between 54-71 years. Only a small proportion 8.8 % were71 and above.Generally the findings clearly shows that the selected respondents were older enough and that they were considered as having adequate experience in explaining climate change.

Education of household head has a significantly impact on the perception of climate change (Bayard *et al*., 2007). This is influenced by the fact that education brings about exposure to areas beyond one's immediate locality. The study findings revealed that, the majority of the respondents 72% interviewed had primary education, 5% secondary education, 6.3% college, 5% adult education, while 11.3% had never gone to school. Generally, the implication of the study finding is that a farmer who perceives that climate change is happening in the study area had at least primary education level. Therefore, a farmer who has a certain level of education has a capacity to perceive the existence of climate change and vulnerability in the study area since the education level increases the ability of an individual to decode, receive and understand information. This is in conformity with Noor (1981) who documented the relevance of the literary rate of a farmer to farm production and efficiency. According to him education facilitates farmers understanding and the use of improved technologies.

Farming is noted as a major source of income to most rural households since it provides more than 70% of employment to the rural dwellers (Fleshman, 2007). When the occupation of the household was examined, the study found that, 90% of respondent were farmers, 6.3% were civil servants and 3.8% other groups (businessmen and Carpenters) (Table 2). Since majority of respondents were farmers, it implies that substantial proportion of households in the study population is vulnerable to climate change.

3.2 Awareness to climate change

Access to climate information has significant impact on the adaptation as it can better help farmer to make comparative decisions among alternative adaptation practices and hence choose the best one that can cope with the changes (Baethgen *et al*., 2003; Jones, 2001). Regardless of the importance of climate related information to farmers, only 32.5% of respondents that were interviewed had access to climate information.

Farmers in the study area have been using local knowledge and experience in predicting the rainfall pattern. However farmers acknowledged that, predicting the rainfall pattern is not as easy as previously; therefore they feel that they are forced to try their luck when it comes to important farming decisions, and only the luckier farmers get good harvest. The study realised that, despite the fact that TMA has been producing and climate information in daily and seasonal basis, yet some farmers were not aware and those who were aware failed to effectively use the information in making farming decisions because of not been able to interpret the information as it is in technical language.

The language used by TMA is too technical for user to understand. For example, looking at the climate outlook for Tanzania (October – December, 2014 rainfall season), issued by TMA the problem of technical language can easily be seen at the following extract part of the outlook, which reads:-

"...The rains are expected to be normal to above normal over the Northern Coast (Dar es Salaam, Northern Morogoro, Coastal regions, including Unguja and Pemba isles), North-eastern Highlands (Kilimanjaro, Arusha and Manyara regions) and Lake Victoria Basin." (Kagera, Geita, Mara, Mwanza, Simiyu, and Shinyanga.

The utilized bold words above cannot be easily understood by a user who is not a meteorologist.

Farmer's awareness to climate change can be through personal observation or experience, media, extension services consultancy and also village meetings (Ajuaye, 2010). Based on the study findings, 95% of the respondents at the households were aware of climate change. They acknowledge that they have been experiencing changes on temperature,

rainfall and change in wind direction. Only 5% were not aware of the climate change and variability.

Respondent based on their level of awareness described climate change in different understanding. Table 4 below indicates that 50% of respondent described climate change as the increase in rainfall and change in patterns and seasons, meanwhile 38% described climate change as the change in temperature and 10% of respondents acknowledged that they were not sure whether climate has changed or not .

Table 3: Description of climate change based on Farmers awareness

Responses	Frequency	Percent
I don't know	8	10
Increase in rainfall and change in patterns and seasons	31	50
Change in temperature	40	38.8
Change in ecosystem and biodiversity	1	1.3
Total	**80**	**100**

3.3 Farmers' perception on climate change and variability

Temperature and rainfall are the two climatic variables that influence farming in the study area. In farming the amount of rainfall and temperature is regarded as an important indicator of long term changes in climatic system. In order to understand farmers' perception towards climate change in Rombo District, farmers were asked to indicate what they had noted regarding long term changes in temperature and precipitation. The results of this analysis are presented below in Table 4.

Table 4: Farmers' perception on temperature and rainfall change

Response	Frequency	Percent
Temperature and Rainfall increased	16	20
Temperature and Rainfall decreased	15	18.8
Rainfall increased but Temperature decreased	11	13.8
Temperature increased but Rainfall decreased	34	42.5
No changes	4	5
Total	**80**	**100**

The households data revealed 42.5% perceived that temperature has increased with the decreased of rainfall for the past 30 years, and only 5% of respondents claimed that there is no change (Table 5) .The District Agricultural officer and FGDs participants in both

villages had the following views pertaining to the state of temperature and rainfall which look similar to the findings obtained from the households.

"*.....compared to the past rainfall in this area has dropped so much and the drought condition is increasing day to day. The District in terms of rainfall is divided in three ecological zones; low land, midland and highlands. Previously because of climatic conditions, maize was only planted in low lands and little in midlands but today because of the decline in rainfall and prolonged dry spell, maize is now mostly planted in midlands and little in the highlands where the situation is a bit encouraging and this is because of existence of agroforestry."* (District extension, Nguduni village).

Apart from changes noted in both temperature and rainfall, the study realized that onset of rainfall has shifted. Rainfall starts abnormally early or late. Farmers perceived that first rains onset "Vuli" starts so earlier now than before (at the beginning of September) and ceases so early before December and sometime in December there is no rainfall at all. Also respondents argued that there is delay in onset of "Masika" first rains than before (now starts at the end of March) and cease so earlier than before (now ends on May or early June). Findings from the focus group discussion correspond with households findings. Participants of FGDs all together agreed that rainfall pattern in the area has dramatically changed for the period of 30 years. The discussants claimed that predicting the onsets and the secessions of rainfall is now a serious challenge to farmers. It is harder now days and sometimes impossible to accurately predict as in past. One of the discussants argued that because of uncertainties in rainfall onset, farmers to day use first rains to plant.

"*when short rains known as "Vuli" start at the end of September and ends on December, we always get good harvest and also when long rains known as "Masika" rain start at the end of February and end on July we also get good harvest ."* (Elder 1, Nguduni).

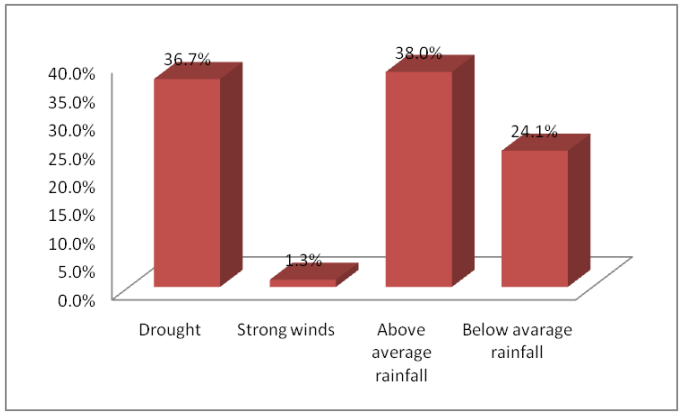
On the same argument one of the key informant highlited that currently, farmers are unable to predict rainfall patterns as they used to in the past because there are many changes that make it difficult for them to do so.

"In the past, rainfall was regular, predictable and of the normal amount. We had some fluctuations in terms of amount but not very much. This was appropriate for farmers and they rarely experienced water shortage for their agricultural activities." (Agricultural officer, Rombo, District Council).

3.4 Climate extremes experienced by people in the study area

Respondents in the households pinpointed several environmental events that upon time they have come across and they associated them with climate change. (Figure 3)

Figure 3: Climatic events



Drought has been a serious problem in area. Respondents argued that drought have been happening after every 10 years. The most recalled drought event happened in 1974 and 1984. The farmers admitted that 1974 and 1984 cannot be forgotten in the history of their life because of severe hunger they experienced. Table.5 below reveals an inventory of historical events related to climate change events experienced by people in the study area.

Table 5 : Inventory of historical climatic event

Type of event	Year of occurrence	Out come	Action
Drought	1970's, 80's 90's, 2000's and 2004	Hunger, death of livestock, crop failure	Reduced number of meals per day, casual jobs, sell livestock
Below average rainfall	2006 to 2010 and 2012	Food shortage, decline crop yield, reduced pasture, Famine,	Relayed on savings'. Reduce meals,
Above average rainfall	1973,1996 and 2014	Decline crop yield,	

3.5 Vulnerable livelihood assets

The study noticed vulnerability assets in the study area including crops and livestock. There has been decline in crop and livestock productivity because of presences of dry spell causing planted crops dried before matured and loss of livestock because of disappearance of grasses and pastures. The most affected crops and livestock in the study area are maize, beans, banana goats and cows

Findings reveal that the study area as other areas of the country has been seriously impacted by climate change and variability and its impacts are vivid. Increasing food shortage, change of rainfall pattern, increasing drought and decline of income were mentioned as the main outcomes of climate change. Farmers in the study area are fully aware of climate change and they perceive it as the change in the variation of temperature and rainfall patterns which result to increase in drought condition, emerging of new diseases like malaria and fluctuations of both rainfall and temperature. However, the study noticed that land (home garden locally known as "Kihamba" and low land farm or ("shamba") which is the important assert for farmers in the study area has continuously decreased. The size of “kihamba” has continuously decreased with every generation (Fernandes *et al*., 1984). This led to the cultivation of more marginal land (Soini, 2005).

4.0 Conclusion and Recommendations

This study has examined local farmer’s perception on climate change and variability in Kilimanjaro Region with specific reference to Rombo District. It was found out that majority of the farmers were well aware of the changing climatic conditions. Majority of the farmers noted that there was an increase in temperature, extended periods of temperature, a decrease in precipitation, changes in the timing of rains and an increase in the frequency of droughts. As a result, the rural households experienced some environmental problems which are associated with climate change such as droughts and strong winds that were ravaging in the district. Thus the study recommends that, government policies should address climate change and agriculture while focusing the attributes of farming communities putting much emphasis on climate Smart Agriculture (CSA). Climate change awareness is still very much needed among rural farmers, and in doing so, information pertaining climate change and variability should be disaggregated and disseminated at the community level, regional and national level.

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