The Impacts of Climate Change on Food Security in Tanzania: A case Study of Kilosa District

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Abstract

In Tanzania climate change is manifested through the increase in atmospheric temperature and uneven distribution of rainfall to most of the areas in the country. Farmers have reported the declining crop yields due to unpredictable climatic conditions. The main objective of the study was to investigate on the impact of climate change on food security. The specific objectives were to examine the agricultural practices that are carried out in Kilosa District and the activities that have been affected due to effects of climate change.. The study was carried out in Lunezi and Lumbiji villages whereby 120 respondents were selected for the study using simple random and purposively sampling. The finding of the study revealed that climate change has resulted in unpredictable rain, drought and floods, which have affected crop production. The study recommends on the use of improved seed varieties and irrigation farming, sensitization on environmental conservation and establishment of tree planting programs. The study concludes that the change in climate through human induced activities has affected accessibility and utilization of food resulting to food insecurity.

Key words: Climate Change, food Insecurity, vulnerability

Introduction

Agriculture remains low in Africa as compared to other region of the World largely due to climate change (Howden*et al*,.2007). For example, a sub- Saharan African farmer produces less than half of what an Indian farmer produces and less than a fourth Chinese farmer produces (IFAD, 2011). That is because 90% of the African farmers depend on rain fed agriculture for food production. Farmers in Africa plan their production based on anticipating for both good and bad yields due to uneven distribution of rainfall exacerbated by climate change and this poor condition is already is experienced across the region with high

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threat to the system of farming (Shemsanga, 2010). Climate change have a significant impact on the livelihoods especially on food security and food production. As several studies have well documented and predicted that climate change is likely to have a significant effect on food security in many African countries (IPCC, 2007). The estimated number and proportion of hungry people in Africa is about 777 million, which is unacceptably high in the world. The production pattern and land productivity decline is attributed to weather changes that are a result of climate changes causing floods, draughts and crop diseases (Engeru, 2009). The projected reductions in yield in most of the African countries could be as much as 50% by 2020, and net crop revenues are expected to fall by 90% by 2100 (Regassa, 2011), However, developing countries in Africa is believed to be the most vulnerable to climate change and variability due to some key features such as dependency on natural resources for their livelihoods (Gukurume, 2013), poverty prevalence, poor government and social infrastructures, diseases like HIV and Cholera and low technology to adapt to climate change (Ngigi, 2009). Farmers in Tanzania play a vital role to both livelihoods development and the economy in general (Howden *et al* 2007; Gaudum and Alam, 2006). As a result, sensitivity changes of climate affects farmer's production process for their food security and livelihoods.

Moreover, in 2009, a report by the United Nation Development Program warned that Africa will have more impact of climate change on food production due to its lack of access to fore warnings caused by difference in access to education on environmental realities that affects the response strategies which could have led to devastating droughts. In Kilosa District the impacts of climate change have left the farmers with no food as all the crops in the fields dried off. In Tanzania the mean annual rainfall varies from 500 millimeters to 2,500 millimeters and above per annum, and the average duration of the dry seasons is 5 to 6 months. The rainfall follows two regimes namely unimodal and bimodal patterns, long rains occurs between March and May and short rains is between October and December (Chang'a and Nduganda, 2008). However, climate change has resulted the variation in the dry spell and rainy seasons. droughts, desertification floods and diseases are some of the effects of climate change that threatens the lives and livelihoods of many farmers in Africa particularly in Tanzania by hindering the social progress.

Kilosa District in recent years has been experienced changes in some weather condition. Quick assessment indicated and documented some changes in climatic condition (URT, 2009), this change includes dry spells, short time heavy rains and the average temperatures have increased (URT, 2011). These

spontaneously give a reflection of changes in climate and weather. Some assessment of the study area reported and documented that there is a climate change in an area such as the prevalence of droughts, shortage of water, low maize production and floods and these were the effects of climate change in the area. For Example in a household baseline survey conducted in Kilosa District by the Ilonga Agricultural Research Institute between 2nd November to 13th December 2010 to get an in depth understanding on the impact of climate change and how it has affected the farming it was found that the impacts were mainly in maize production and less in beans and paddy. It was also observed that some farmers have shifted from producing maize and produced new crops with shorter cycle such as sorghum and millet. However, it is not yet clear if climate change has affected food security and if so what and how has affected food availability, accessibility and utilization in the District. This explains the need for undertaking a study that examined the impact of climate change on food security in Kilosa District and suggest possible adaptation and mitigation measures.

Literature Review

Climate change is not a new concept to both scientific and academic communities around the globe. This is because for the past decades scientists to a large extent concluded that the warming of the global system is unequivocal and it is largely human induced (IPCC, 2007). Climate change affects our lives in different ways and (IPCC, 2001), it impacts on people's livelihoods will be greatest to the most parts of the world particularly in Africa, mainly because many poor farmers depends on agriculture and with few alternative to sustain their livelihoods (IPCC, 2000). Climate change has caused a prolonged and intensified drought and unprecedented floods in most of the parts of East Africa (Lisk, 2013).

According to Mbiru (2010), climate change has caused prolonged spells of droughts and floods in Uganda. These findings are in similar with what Yanda and Moshy (2007) observed when they noted that in Tanzania climate change has caused a prolonged drought and floods to most of the parts of the country which affected crops and livestock production. According to UNDAP (2011), there is a decline of the average caloric intake per person per day from 2,050 mgs in 2005 to 1,985 mgs in 2007 which is attributed to natural and manmade hazards including drought, agricultural pests and floods that cause food insecurity. Thus shows that the food security is persistently declining, and there is need of having practical coping and mitigating strategies to reverse the situation. Therefore this provides evidence that the food security has been

hampered. However the evidence provides a general over view of the effects of climate change but do not show how climate change affects food production. The study was particularly interested in finding climatic constraints to food security in Kilosa District.

The patterns of weather have changed over time. This is indicated by rainfall which has totally changed; the wind intensity has increased and the vegetation cover has also changed (Egeru, 2009), concurring with the argument, that the decline in production patens and land productivity is attributed to the weather extreme changes which are the results of climate changes causing floods, diseases, droughts, pest and poor land management (Egeru & Majaliwa, 2009). The majority of farmers practice their farming depending on rain fed agriculture, which is sensitive to fluctuations in weather conditions (Benin el at, 2007). The Ilonga Agricultural Institute Reports, (2011) documented that there was a climate change in Kilosa District such as the prevalence of drought, shortage of water, low maize production and floods which were associated with the effects of climate change and how it has affected farming practices. However the report does not show exactly how climate change has affected food production and crop yields leading to food insecurity.

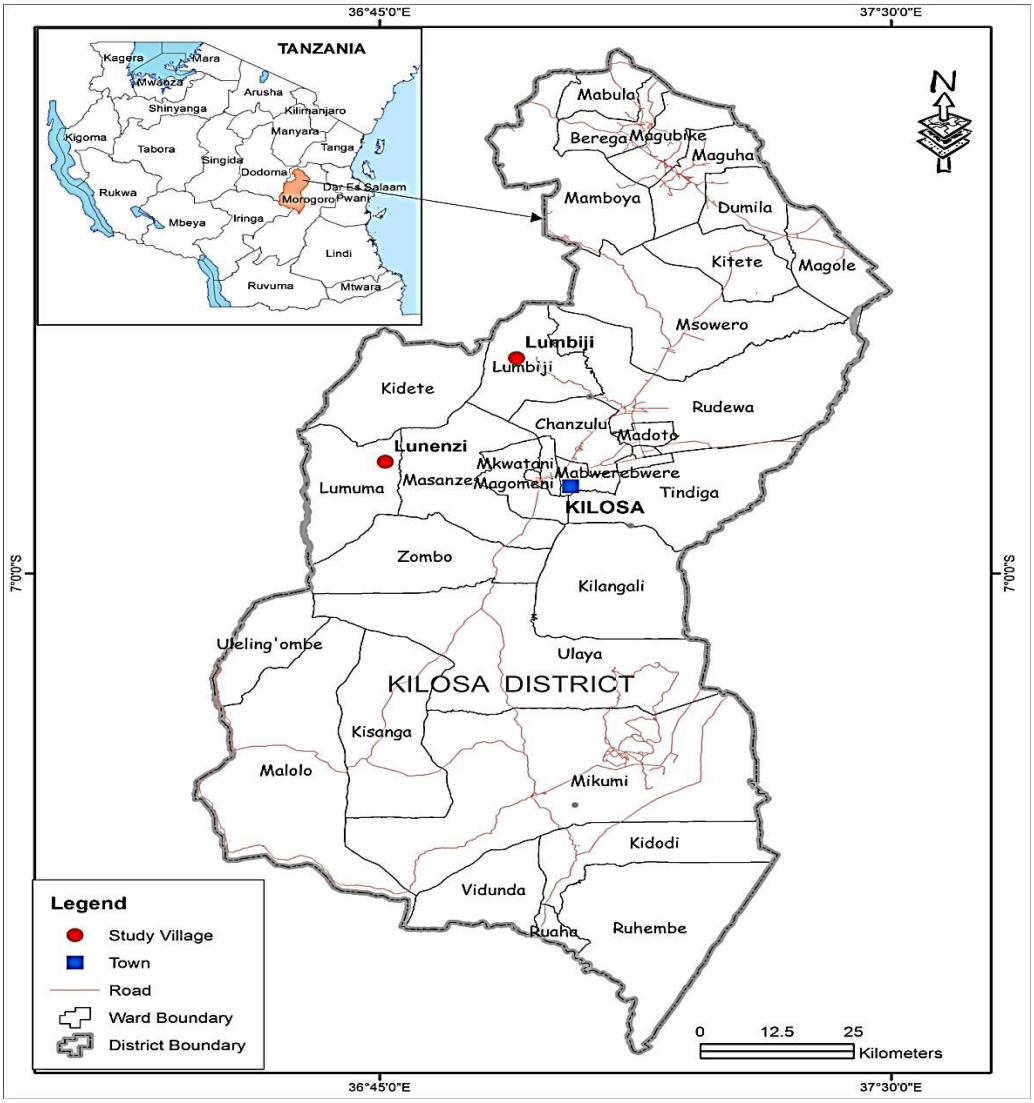
Activities Responsible for Climate change

Rising fossil fuel burning and land use changes caused by human activities since the beginning of Industrial Revolution have emitted, and are continuing to emit, and hence increasing quantities of greenhouse gases into the Earth's atmosphere (Matthies, 2005). These greenhouse gases include carbon dioxide [CO2], methane [CH4] and nitrogen dioxide [N2O], and a rise in these gases, has caused a rise in the amount of heat from the sun withheld in the Earth's atmosphere, heat that would normally be radiated back into space. The increase in heat has led to the greenhouse effect, resulting in Climate Change (Bhutan, 2006). Climate change has wide ranging effects on the environment, socioeconomic and related sectors and changes in rainfall patterns are likely to lead to severe water shortages or flooding. For example, melting of glaciers can cause flooding and soil erosion (Meehl *et al,* 2007). This has also affected food production and food security (Lisk, 2013). According to Robinson and Herbert (2001), the incorporation of indigenous knowledge into climate change policies that can result to the development of appropriate strategies for adaptation and mitigation which are cost effective, participatory and sustainable. This means that there is a need of making the people understand the outcome of their activities to climate so that they can participate in remedying the consequences of climate change. In addition human activities are among the activities

responsible for climate change (World Metrological Organization, 2010), which have led to changes in the amount of sunlight radiated and reflected back into the space from the ground. However, how these activities affect the climate and food production has not been well studied. Therefore the study investigated on the activities responsible for climate change and how these activities affect food production, which may lead to food insecurity.

Methodology

The study was conducted in Lumbiji and Lunezi villages in Kilosa District (. A cross sectional survey design was employed to examine how climate change has affected food security in the District. The researcher employed triangulation approach whereby both qualitative and quantitative methods of data collection and analysis were used. The triangulation approach enabled the researcher to collect large amount of information relevant to the study. 126 respondents were selected for the study: simple random sampling was used to select 120 farmers from the two villages and purposive sampling was used to select 6 key informant respondents from the District agricultural department, Ward Extension Officer, Ward Executive Officers and Village Executive Officers from the two villages. Focus group discussion was also employed and total of five focus group discussion were conducted in the study villages. Groups were selected based on gender, age and thus were categorized into three groups of youth, adult and elders in order to effectively elicit information that responds to key research questions. Questionnaires survey and in depth interviews were used to collect data. The quantitative data were analyzed using a IBM Statistical Package for Social Science Research (SPSS), and Ms Excel whereas qualitative data were analyzed using a thematic analysis, which involved developing broad themes and a coding system based on samples of collected data. Descriptive statistics and cross tabulation of different variables were also used to explain various variables of the study.



Map 1: Location of Study Viillages in kilosa District
Source: Field Study 2018

Results and Discussion

Climate change and food security

The study examined the impact of climate change on food security. Overall 95% of all farmers indicated that climate change has adversely affected food security in the study villages for agriculture is the main activity and a major source of food. About 85% of the farmers stated that crop yields are poor which is attributed by the change in the climate while 15% indicated that some farmers in their villages have abandoned the cultivation activities and have opted on other alternative ways of living like small business and bee keeping. These findings

are similar with that of Kangalawe and Lyimo (2013) who observed that small holder farmers are well aware of the effects of climate change. The study further found that the activities that people are involved included tree cutting and hunting by bush burning also affected the climate of the district. In turn this has affected the availability, accessibility and utilization of food especially when the crop yields are low. This result concurs with Shemsanga (2010) who observed that the major disaster that African countries including Tanzania suffers are droughts, famine, floods, diseases and human induced disasters. Thus food security and food supply fluctuation interventions should be taken into consideration for effective strategies and mechanisms against such fluctuations. Thus the study revealed that climate is a determinant of food security and should be included for any poverty reduction strategies. Climate change effects have adversely affected the availability and accessibility of food in the study villages leading to food insecurity.

However the study also established the determinants of food security in the study area so as to indicate what should be addressed in ensuring food security (see Table 1)

Table 1: Determinants of food security

	Responses per Village (%)		**Total Responses (%)**
Determinants	**Lunezi (n=60)**	**Lumbiji (n=60)**	
Crop yield	60	65	62.5
Post harvest handling	35	25	30.0
Storage facilities	5	10	7.5
Total	**100**	**100**	**100**

Source: *Field Survey Data* 2018

The study results indicated that 62.5% of the farmers stated that crop yield as one of the determinant of food security, 30% mentioned post harvest handling and only 7.5% indicated storage facilities as the determinant of food security. Thus this implies that in the study area the quantity of food produced is what determines the food insecurity. The reason for this could be because of the historical background that the farmers in these areas used to produce more crops and had more food than what they had during the field visit. During the focus group discussion one of the discussant had this to say on the crop yield

"*In 1990's we were producing more crops than what we are producing now because the rain is not enough as it used to be, and most of the villages are now moderately food secure due inadequate rain fall and sometimes the rain comes with floods"*

This implied that the farmers in the study area are aware of the challenges that come along with climate change such as floods, droughts and unpredictable rain. This is in line with what Yanda and Moshy (2007) who indicated that the effects of climate change has been observed in Tanzania and was associated with drought and prolonged spells which significantly affected food production resulting to food insecurity. The study suggests the need of addressing the challenges of food production in avoiding food insecurity.

Climate change and agriculture activities

The study also assessed the agricultural activities practiced in the study area in finding the way how these activities affect food production. The results revealed that over 90% of the villagers practice agriculture as a source of livelihoods as indicated in Fig 1. However, this fact was more stressed by the response of the District Agricultural Officer of Kilosa who pointed out that the main source of food in these two villages is agriculture. The implication for this is that there is a need for more strategies in ensuring that there is favourable climate since agricultural practices largely depend on climate. Thus the finding of the study will enable in establishing possible strategies to the constraints that come with these activities. As indicated in the figure

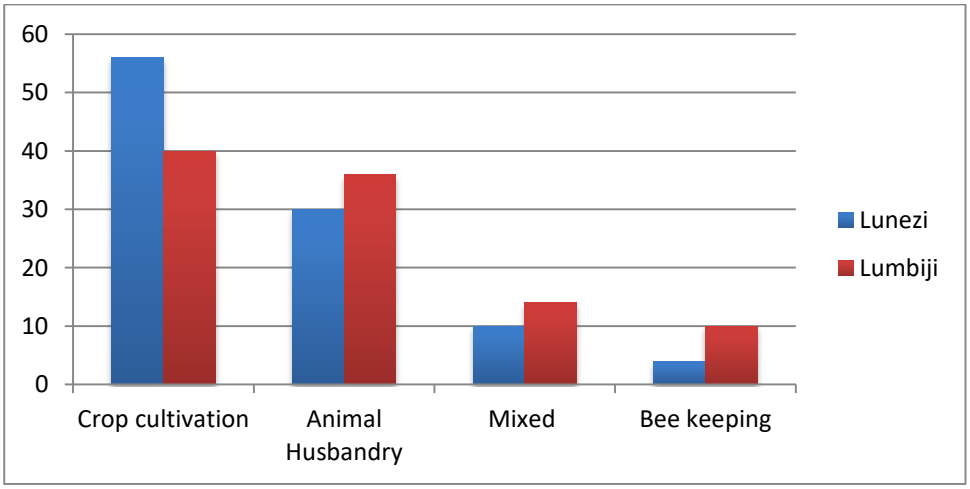


Fig 1: Agriculture activities carried by farmers in the study area
Source: Field Survey Data 2018

56% and 40% respectively from the two study villages indicated that crop cultivation as their main agricultural activity, whereas 36% and 30% respectively indicated animal husbandry while 14% and 10% respectively indicated mixed farming. During the focus group discussion one of the discussant had this to say regarding the agricultural activities in the study area:

"*Because now the climate is not certain then people in our village have diversified their activities, some cultivate crops, keep few chicken and also have some goats and sheep so as to be secure in case of any change of the climate"*

However, about 80% of the respondents in the study area pointed out that the main activity practiced is crop cultivation which is also the main source of food. These findings concur with Mang'enya & Makupa (2017) who observed that the farming system in Kondoa District is predominantly annual cropping and cattle rearing. This implies that cattle rearing reduce the vegetation covers which in turn have negative impacts on environment that is associated with droughts, and biodiversity due to habitat fragmentation and conversion. That means climate affects the activities that are carried out in the area and hence have a negative impacts on crop production which is the main source of food. An interview with the Ward Executive officer stated that over 90% of the population in these villagers depends on the selling of agricultural produce. This implies that agriculture in the study area forms the main source of livelihood. Therefore, in order to increase productivity proper adaptation strategies should be taken into account to introduce drought resistant crops and establish drip irrigation practices in the study area.

Moreover, in establishing the impacts of these activities on climate change the study needed to establish which crops were most affected in the study area (see Fig.2). The study revealed that Maize is more affected by these changes followed by paddy. This was revealed by 95% of the respondents. As indicated in Fig. 2 about 50% and 46% in Lunezi and Lumbiji villages respectively of the farmers indicated that maize is more affected by climate change. Meanwhile

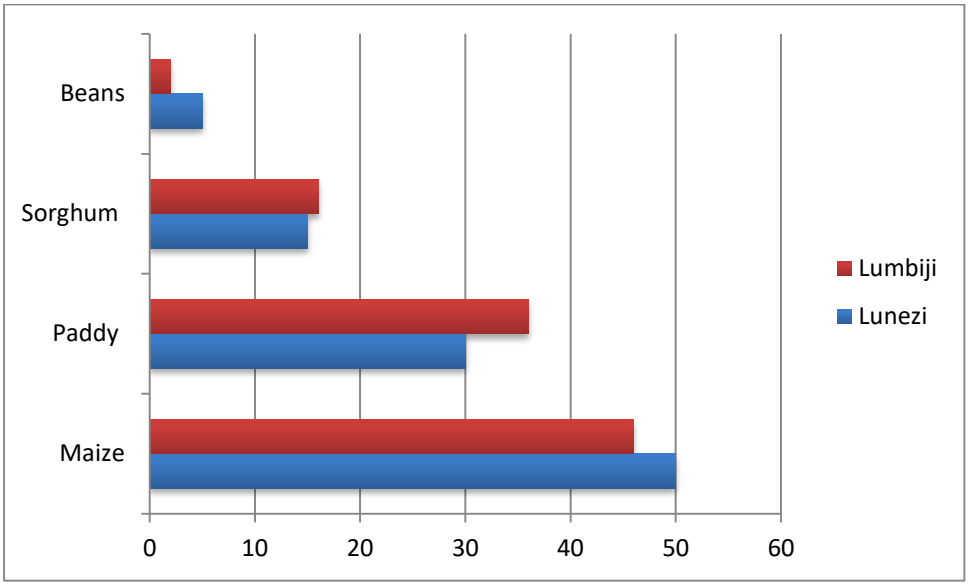


Figure 2: Type of crops affected by climate change in the study area
Source: Field Data Survey 2018

36% indicated paddy 16% respectively indicated sorghum and 5% and 2% respectively indicated beans. However, this was more emphasized by an interview with the District Agriculture Officer from Kilosa District who indicated that maize was mentioned because the farmers use the local type of seeds which takes a very long time to grow so for any change in the amount of rainfall they harvest less but in the case of paddy more water is needed and mostly the farmers depend on seasonal rivers in trapping water for irrigation so when these sources dry it becomes difficult for them to grow paddy and harvest. This implies that the type of seed used by the farmers in the study area are not improved seeds they are the ones that are locally used which cannot withstand any change in climate. These findings are similar with Kangalawe and Lyimo (2013) who observed that low use of improved seeds and agricultural inputs are among the factors that causes the decline of cereal yields as major crops in semi arid areas of Tanzania that are linked to the effects of climate change. These results into frequently crop failure to major staple food crops produced in the study areas. This implies that there is a need for more emphasis on climate change coping strategies in crop production which includes the use of improved seeds which are drought tolerant varieties and the use of fields with permanent irrigation in increasing crop production in the study area.

Activities that causes climate change

In order to establish the solution used to address climate change affects the study examined the human induced activities that are responsible for climate change in the study area. As shown in Table 2 about 60% of the respondents pointed out deforestation as the activity responsible for climate change, 25% indicated overgrazing and 15% mentioned bush burning.

Table 2: Activities responsible for climate change

	Responses by Villages		**Total (%)**
Activities responsible for climate change	**Lunezi (n=60)**	**Lumbiji (n=60)**	
Deforestation	55	65	60
Overgrazing	25	25	25
Bush burning	20	10	15
Total	**100**	**100**	**100**

Source: Field Survey Data 2018

The majority of the respondents pointed deforestation as responsible for climate change. During the focus group discussion one of the discussant had this to say,

"*The main sources of energy for cooking in our village are firewood and charcoal, So people cut down trees, in earning income from selling charcoal and fire wood"*

An interview with the Ward Executive officer revealed that the community members are cutting down trees without replacing them by planting more trees in the study area which is also a challenge to the climate. This concurs with Mang'enya and Makupa (2017) who observed that in Kondoa District there was a reduction of forest size due to forest clearing and cutting of trees in extraction of forest resources for example firewood and charcoal that increases the quantities of greenhouse gases into the Earth's atmosphere resulting to climate change. This implies that despite of villager's knowledge of tree cutting bush burning and overgrazing as causes of drought, they still do these activities for their livelihoods improvements, due to lack of other alternative sources of energy. This is typical of what is happening in the study villages where the villagers knows the effects of their activities, especially with deforestation, but they still cut trees as a result climate change.

However, when they were further asked on how these activities affects the climate, 55% of respondents indicated little rainfall, 35% indicated drought and 10% indicated floods as shown in Fig 3. As a whole the majority of the farmers indicated little rainfall has effects on the activities responsible for climate change. Above 95% of farmers further mentioned that this has resulted to poor crop yields.

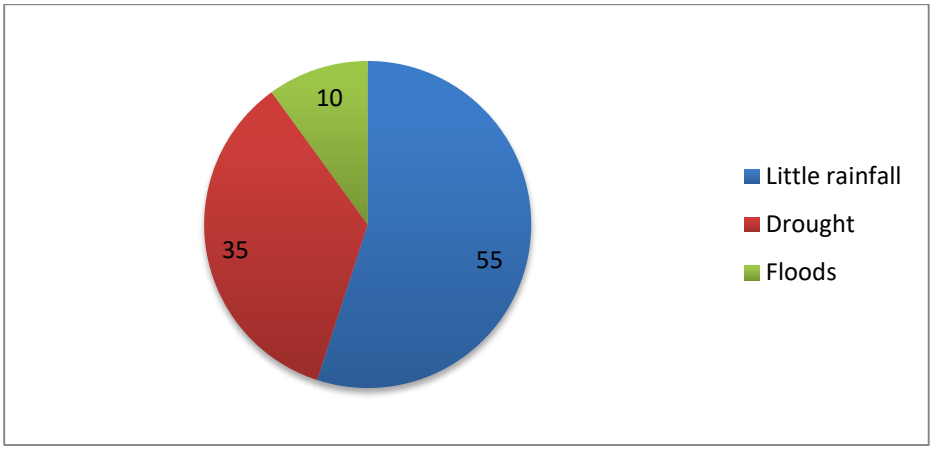


Figure 3: Effects of activities responsible for Climate change
Source Field Survey Data 2018

An interview with the District Agricultural Officer of Kilosa District revealed that there has been uneven distribution of rainfall in Kilosa District and the farmers have abandoned to grow some of the crop like maize for they do not harvest anything. During the focus group discussion one of the discussant had this to say

"*In 2016, I cultivated and planted one acre of maize and over the sadden the rain disappeared and I lost all what I planted and ended up having food insecurity in my house."*

This remark is in line with Lisk (2013), who pointed out that the prolonged and intensified droughts in East Africa and unprecedented floods in West Africa had direct affects on food production due to climate change in the region. Moreover, in order to establish the solution to the effects of climate change the respondents were requested to give the solution of averting the situation in the study area. These solutions are shown in Table 3.

Table 3: Solutions to Climate change

	Responses by Villages (%)		Total (%)(n=120)
Solutions to climate change	**Lunezi (n=60)**	**Lumbiji (n=60)**	
Tree planting	48	57	52.5
Awareness creation	40	23	31.5
By laws enforcement	12	20	16.0
Total	**100**	**100**	**100**

Source: Field Survey Data 2018

The results revealed that 52.5% of the respondents indicated Tree planting as a solution to climate change that will ensure food security whereas 31.5% of farmers indicated awareness creation on climate change and 16% indicated bylaws enforcement as one of the solution to climate change.. An interview with the Village Executive officer emphasized on tree planting program like Participatory Forest Management (PFM) in the area that will help in climate improving the climate especially in rainfall distribution. This finding concurs with DANIDA (2002) who noted that Participatory Forest Management Program by tree planting and managing the forest resources is not only a strategy of improving rural livelihoods by getting income but it also helps in protecting the environment. DANIDA (2002) is also in consonance with Elis (2002), who argued that the concept of livelihoods is widely used in relation to poverty and rural development, and is considered as a means of living. It comprises the component of capability assets (stores, resources, claims and access) and the activities required for a living. This means tree planting program will regulate and grantee sustainability of the climate which is important in ensuring food security in the study villages. The study revealed that people depends direct on forest resources for their livelihood. They cut tree for fire woods and charcoal for domestic use and for commercial use. This reduces the size of the forest in the study areas which is a big burden to the environment leading to climate change effects on food security.

Conclusion

The finding from the study reveals that climate change has affected food security in the study village in terms of quantity, accessibility and the utilization of food. This requires appropriate strategies, like sensitizing the communities on the effects of involving in the activities that are not environmental friendly

which includes tree cutting and also in strengthening existing institution, which are responsible for environmental conservation and policy making.

There is also a need for farmers to opt for the use of improved seeds varieties, which are drought tolerant varieties in order to increase crop yields and the use of fields with permanent irrigation in increasing crop production under the changing climatic conditions. This can help in overcoming the problem of food shortage and in increasing household food security.

The communities should be equipped with proper knowledge on climate change through various methods such as radio, television and seminars provision. This can also be imparted to students at various levels by incorporating climate change in their syllabus. There is a need for the governments and other stakeholders to address the issues of food security and climate change in encouraging the community member to farm sustainably, and encourage them to diversify their practices into other economic activities, like bee keeping, tree nursery establishment and fishing and operate business enterprises other than entirely depending on farming.

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