

The Impact of Climate Change on Food Production in Lugoba Ward, Western Bagamoyo

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Abstract: *This article focuses on the impacts of climate change on food production in Lugoba ward in Western Bagamoyo. The main objective of this article is to explore with other factors, the impact of climate change on food production in Lunga village. This study applied case study design as only one village is selected for this study. The sample of sixty six respondents was selected at random where questionnaires, interviews, focus group discussion, listening to peoples' narratives and observation techniques were used for data collection. Information collected was analysed using MS Excel and contents analysis. The findings show that the development of Lunga village has not changed much since 1980s. In 1980s and before, life of the people was mainly relying on agriculture and livestock keeping. Even today farming is the main economic activity for people residing in Lunga village. People are still producing mainly for subsistence, very little is taken to the market for sale. Crops which are grown in the village include maize, millet, sweet potatoes, banana, cassava and beans. Other economic activities practiced in the village include livestock keeping, charcoal making, petty business and employment in civil societies. People are engaging in more than one economic activity because of climate change and drought. Climate change has impacted food production where harvest has gone down. The finding proved that in 2013, farmers harvested little while others harvested nothing because rainfall did not last long. It rained shortly and then stopped. The crops which were planted stunted and then died. This paper recommends for villagers to grow drought resistant crops and highly follow the predictions of weather as given by Tanzania Meteorological Agency (TMA). It is also recommended that feedback of research findings should be sent to the villagers. Finally, the research recommends for other study in other villages focusing on food production and climate change.*

Keywords: Climate change, food production, food insecurity, agriculture, Lunga village

INTRODUCTION

The Government of the Republic of Tanzania was in favour of farmers and livestock keepers (Kikula, 1996). Farmers in the country were given good prices for their produce and the government was giving subsidies to agricultural inputs (Kikula, 1996). Climate was reliable, rainfall was

adequate and soil in most part of the country was fertile and favourable (Yanda, 2013).

In the 1970s, the country initiated the villagization programme which aimed at collecting people in *ujamaa* villages where people were provided with basic social needs and services (Kikula, 1996). Before villagization programme, people were scattered in different part of the country which was a big problem in providing them with social services such as education, health services, water and roads. With villagization programme it became simple to deliver those services to people. Lunga village in Lugoba ward was one of the villages formed during the villagization programme as *ujamaa* village in the 1970s (Kikula, 1996).

Bagamoyo District is situated between 6° and 6° 45"S longitude and 38° and 39°E latitude. The district has an area of 9,842 square kilometers, of which 855 km² is covered by forests and woodlands (Coastal profile, 2006). The district is made of 6 divisions, Mwambao, Yombo, Msoga, Msata, Miono and Kwaruhombo. There are sixteen wards in the district, one of them is Lugoba ward. The Bagamoyo district borders include the Indian Ocean on the eastern side, Tanga region on the north, Kibaha district and Dar es Salaam region on the south while Morogoro region borders on the western side.

Bagamoyo district has tropical type of climate with temperatures which range from 30°C as a maximum to a 13°C as minimum, and humidity as high as 98% (Jayaran, 1969 in Toroka, 2002). The rainfall average ranges from 800mm to 1200mm. The district experienced two rain seasons, the long and short rains; the long rain seasons (*masika*) is heavy and spread throughout the district between October to January while the short rain season (*vuli*) is unevenly distributed and not very reliable, it starts from February to September every year. The proximity of the Bagamoyo district to the equator influenced the district to have two rainy seasons, allowing two harvests to be achieved in most years. Thus, the rainfall in the district as a whole is moderate; and this influences the types of crops that can be grown in this district. The focus on Lunga village is motivated by increasing concerns about the potentially adverse effects of climate change on food production then effecting food security.

Since the late 1990s, there has been an increased recognition among researchers that Africans diversify their livelihood strategies, including on-farm (crop, livestock) and off-farm activities or market and non-market activities; to mitigate risks inherent in unpredictable agro-climatic and

politico-economic circumstances (Ellis, 1998, 2000; Bryceson, 2002). The policy shift to poverty reduction and sustainable development must be formulated in recognizing how and why African farmers pursue diversified livelihoods. Diversification of means of rural livelihood is brought about by different factors including climate change and decline in soil fertility.

These factors (climate change and decline in soil fertility) contributed to food insecurity as the yield obtained did not suffice the families and kept on declining (Haapanen, 2011). This paper ought to explore the causes of food insecurity and the way people are trying to control food insecurity. How climate change and other factors contributing to food shortage in Lunga village will also be ascertained. The paper based on the peoples' perceptions and views on food insecurity and climate change. It further looked at causes and adaptive measures or mechanisms to address food insecurity problem.

METHODOLOGY

Study area

Lunga is the word derived from two small villages named Lugoba and Tonga. Thus, Lunga is the union of two small villages. Lungavillage is in Lugoba ward registered on 29/06/1976 as the *Ujamaa* village. It is a village established following the villagization programme (*Operation Vijiji*) of 1975 in the country. The village borders Saleni village on the north, Mindu-Kene on the east, Mboga village on the south and Mindu-Tulieni and Diozile villages on the west. The village has 18 sub-villages which are Mbukwa, Maendeleo, Nhunzu, Friends-Kona, Kwa-Chonde, Madukani, Lamboni, Kwa-Chuma, Kudibawe, Kwa-Mwambala, Tonga A, Tonga B, Mavi-ya-Ng'ombe, Mkunguni, Mkwajuni, Kilabuni, Sekondari and Mmbemboni. The village has 1,272 households with a population of 6,222 people, 3,244 and 2,978 being women and men, respectively. Different tribes are residing in Lunga village; they include Kwere, Maasai, Chagga, Pare, Zigua, Haya, Doe and many others but in few numbers. In the village there are Moslem, Christians and Pagans.

Study design

This study adapted a case study design because only one village is selected for this study. This study was designed to collect both qualitative and quantitative information from the study samples. This study targeted famers, livestock keepers, normal residents, extension officers and village officials.

Data collection

Secondary data was collected through reviewing of literature with focus on climate change and food security. The primary data was collected on how people perceive climate change and food security. Questionnaires were distributed and administered to 66 households randomly selected using the village registry. Lunga village had 211 households (village data). From these households 66 household were picked. The first sample was picked at random where others were systematically selected. This study is based on the interviews made in April and May 2014 in Lunga village. To understand the nature of food production and causes of food insecurity in Lunga village 66 people were interviewed; they include the village chairman, village executive officer and environmental village committee. In the time of research village leaders were met in some days distributing food-aid to villagers. Questionnaires, observations, key informants interviews and focus group discussion were held.

Data analysis

Microsoft Excel was used in analyzing quantitative data while content analysis was used for qualitative data.

RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents

Age and gender

Thirty four (51.5%) out of sixty six respondents were males and 32 (48.5%) were females. The ages of respondents ranged from 25 to 88 years old (Table 1). Since all respondents were aged above 18 years, all of them understood the impact of climate change on food security. About 30.3% of respondents were between 30 and 39 years, 22.7% were between 40 and 49 years. 19.7% had 50 and 59 years while 10.6% of respondents constituted ages between 18 and 29 years.

Furthermore, 7.6% consisted of people aged between 60 and 69 years and 9.1% of respondents consisted of people aged 70 and above years. The people interviewed were mature and have stayed in the village for long time, thus they know the area very well and have experience on climate change and food security.

Table 1: Age of the respondents

Age	Respondents	Frequencies
18 - 29	7	10.6
30 - 39	20	30.3
40 - 49	15	22.7
50 - 59	13	19.7
60 - 69	5	7.6
70+	6	9.1
TOTAL	66	100

Education level of the respondents

Twenty five (37.9%) of the respondents had primary school education while 20 (30.3%) of the respondents had not gone to school (Table 2). From the interview, it was further discovered that 9.1% of the respondents were certificate holders and 6.1% were diploma holders. Three percent of the respondents, all men, had degrees in education.

Table 2: Education level of the respondents

Level of education	Males		Females		Total	
	Respondents	%	Respondents	%	Respondents	%
None formal education	8	23.5	12	37.6	20	30.3
Primary school education	12	35.3	13	40.6	25	37.9
Secondary education	4	11.8	5	15.2	9	13.6
Certificate holder	5	14.7	1	3.1	6	9.1
Diploma holder	3	8.8	1	3.1	4	6.1
Degree holder	2	5.9	-	-	2	3.0
TOTAL	34	100	32	100	66	100

Source: Field Survey, May 2014

MEANS OF SURVIVAL

In Lunga village, people's means of survival depends mainly on agriculture, petty-business, selling charcoal and firewood, employment and livestock keeping (Table 3). Most households interviewed relied on a range of off-farm activities for income generation. Due to the location of the village, which is crossed by Chalinze-Segera highway, the villagers also depend on selling of cashew-nuts and groundnuts to passengers for their survival. Drivers crossing Lunga village do allow cashew-nut and groundnuts traders to board their buses from Chalinze to Lunga village and vice versa, selling their products to passengers. Traders are also selling other products like water, biscuits, juices and soda to passengers. Villagers do farming, collect firewood, burn charcoal and keep livestock. In a questionnaire, respondents tick all activities they are doing. Respondents were doing more than one activity.

Table 3: Primary sources of rural livelihoods (n = 66)

Primary sources of livelihoods	Responses out of 66	Percentage
Agriculture	24	36
Selling firewood and charcoal	13	21
Employment	8	13
Livestock keeping	7	10
Trade/business	7	10
Others	7	10

Source: Fieldwork, May 2014

Thirty six percent of the respondents were engaged in agriculture as their main source of their livelihood (Table 3) while 21% of respondents depended on forest products as a source of their livelihood. People engaged in cutting trees for making charcoal and sell it to urban residents. One of the men interviewed retorted that, *"agriculture is not paying as it is affected by drought and lack of water for irrigation. We are forced to make charcoal as it gives us money to feed our family and pay for school fees of our children"*. Other primary sources of rural livelihoods with percentages in brackets include livestock keeping (10%), employment in civil societies and private sector (13%), trade and business (10%) and others (10%).

The other category comprises of remittances, tailoring, handcrafts, bicycle repairs, carpentry and quarrying. Note that, villagers depend on more than one activity for their livelihood. A society or families undertake more than one activity as a way of making sure that if one strategy fails the other activity can subsidize it, as the result they cannot starve. For example, it is very difficult to find rural people keeping animals without farming.

For a long time the primary sources of rural livelihoods in the Lunga village have been agriculture and livestock keeping. Many livestock keepers said that keeping livestock was mainly a livelihood strategy rather than just obtaining milk and meat. Some animals are sold to get money to buy food and settling other family issues like paying for school fees and treatment. Cotton was for sometime a source of income for many villagers, but due to market failure the crop is no longer cultivated as a cash crop. This situation has compelled people in Lunga village to diversify their means of survival. They have changed their sources of livelihood from agriculture to sell firewood and charcoal, trade and business, employment in civil societies and engage in self-employment. The means of living in Lunga village is changing day after day due to weather changes. In 1970s and 1980s most people were depending on farming and livestock keeping, the area was getting enough and reliable rainfall, which is contrary today (Appendix 1). Appendix 1 portrays that rainfall varies from one year to another. In general, Lunga village receive less rainfall compared to the Bagamoyo district. The variation in rainfall dictates the crops to grow. Because of rainfall variation people grow drought resistant crops like cassava and sweet potatoes.

Cotton was the main cash crop grown in Lunga village but people abandoned it because it had no stable market. Formerly, the price was set by the government but due to economic liberalization the price set mechanism was also liberalized, left to the buyer to set the price. Thus, the buyer set very low price which does not cover cost of cultivation, above all the price was not stable. Another cash crop in the ward is sesame. The problem with sesame is the same as the problem which faced cotton. Price set for sesame was not convincing, was very low that it could not cover the cost of production. Millet is among the crop which is doing well in the village and in the Lugoba ward at large. The soil and climate in the ward support it. The problem with millet is birds, thus farmers spend a lot of time in the farm chasing away birds until harvesting. Livestock keeping is not doing well because there is no stable market for their products. There is no stable market for animal product such as milk and meat. The market is available in Dar es Salaam but no traders to buy milk and take them to Dar es Salaam. The market available is not stable; prices are very low and keeps on changing. Another problem with animal keeping is pasture. Pasture is not enough especially during the farming and drought seasons. It is during cultivation where you hear a lot of conflicts or complains between farmers and pastoralists. Pastoralists sometimes intentionally or unintentionally do graze their animals in farmers' land, as the result leads into conflicts

between farmers and pastoralists. With all these challenges, people's lives have changed. Now people are dealing with different activities as coping strategies for their survival. Some of the survival strategies are petty trading activities, charcoal making, bricks making and others are working in the stone crushing factories.

CHALLENGES FACING FOOD PRODUCTION

The interview indicated that, respondents faced several challenges in food production. Some of the challenges are poor infertile soil, long distance to the field, drought and limited rainfall, thieves, wild animals (wild pigs), livestock, unstable market of their produce, lack of agricultural officers and veterinary officers.

Shortage and small size of land to some farmers is a bottleneck to food production. In 2008 – 09 about 60% of respondent households were rotating their fields. Fallow rotation is not possible nowadays due to population increase. Distance to farms is also a constraint to food production. The average home-to-field distance is 3.5 km where about 40 minutes per direction is lost on the way to the farm and the same is spent on the way back home. The lost time would be used in the farm if the farms are close to dwellings. The decline in soil fertility is another challenge to food production as concurred by 10% of the respondents. Decline in soil fertility led into low harvest which lead some families to food shortages and hunger.

Drought and limited rainfall (Appendix 1) was claimed to hinder farming and grazing. The villagers depend on rain-fed agriculture. If it does not rain people have no alternatives. No rivers flowing throughout a year which could be used for irrigation, also no dam to supply water to villagers. The area have experienced drought in many years. Whatever they grow or planted in their farms stunted and die. Animals also lacked grasses to eat during the drought, this forces some people to sell their animals at low prices. Edward Mesariiek, told the researcher that, *“he sold his bull at Tshs 300,000 because he lacked grasses to feed his animals. He sold it at loss, because a right price for a bull is Tshs 800,000”*.

Thieves, wild animals and livestock are another challenge to food production in Lunga village. The respondents claimed that, their effort to produce is retarded by thieves, wild animals and people feeding animals in their farms.

Unstable market of crops is also a bottleneck to farmers. Crops are seasonal as it is rainfall. During the harvest most people have crops or harvest which saturate the market, the situation which leads to lower the price. Livestock keepers have the same comments. There is only one station in the village buying milk from livestock keepers. The buyer set low prices as no competitors in the village. The low prices set do not cover the cost of production.

Shortage of agricultural and veterinary officers is another challenge to food security in Lunga village. Most farmers complained that, agricultural officers are not visiting them frequently. They used to visit them in case of outbreak of diseases or vermin like locust. Some respondents said that, agricultural and veterinary officers are not residing in the village. Also other said that, the agricultural officer in the area is saving three villages which become difficult to visit all farmers in Lunga village.

AGRICULTURE, CLIMATE CHANGE AND FOOD INSECURITY

Agriculture is an important source of food and income in almost all rural areas in the world. It provides food and is a primary source of livelihood for about 36 percent of the world's total workforce or population (FAO, 2008). In the heavily populated countries of Asia and the Pacific, this share ranges between 40 and 50 percent, and in Sub-Saharan Africa, two-thirds of the working population still make their living through agriculture (ILO, 2007). Agricultural production in the low-income developing countries of Asia and Africa is adversely affected by climate change and related problems. In eastern Africa the problem is aggravated by erratic rainfall, poor technology and climate change. Tanzania is not exempted from the problem facing other countries. Dependent on rainfall, low technology, soil infertility and climate change lead to decline in food production. The livelihood of large number of the rural people is at a risk due to increase of food insecurity compounded by climate change. The study by Lazzaron and Bed (2014) found that weather variations, especially higher temperatures and low rainfall, have an adverse effect on food production and consumption. Food insecurity is the inability to acquire food through production, purchase and transfers of sufficient food for a healthy and active life (Devereux, 1997).

Climate change variables influence biophysical factors, such as plant and animal growth, water cycles, biodiversity and nutrient cycling, and the ways in which these are managed through agricultural practices and land use for food production. However, climate variables also have an impact on

physical/human capital such as roads, storage and marketing infrastructure, houses, and human health which indirectly changes the economic and socio-political factors that govern food access and utilization and can threaten the stability of food systems. All of these impacts manifest themselves in the ways in which food system activities are carried out.

The Climate Systems Analysis Group (CSAG) recently investigated the long-term effects of climate change on rain-fed agriculture in southern Africa where the majority of farmers depend on rainfall as a main water source for their crops as they cannot afford irrigation systems (FAO, 2007). People in the study village depend on nature for their life. Agriculture is the main stay of almost all people in Lunga village (Table 2). They all depend on rain-fed farming. The study found that, not a single person in the Lunga village can afford irrigation. If it doesn't rain nothing will grow as the result nothing will be harvested. In recent years the area has been getting low average rainfall below 500mm (Appendix 1) which forced people to plant or grow drought tolerant crops like cassava, millet and sweet potatoes. When rainfall is low below 500mm or rains come late, rural people suffer. The interviews conducted in Lunga village show that there are changes in time when rain season starts and when it ends. Mr. Musa, the cell leader narrated;

“Rain is our life. If it does not rain most of us and our families starve because there is no river or stream which could provide water for irrigation. For example, last year I cultivate one acre of maize, but I end up getting two sacks of maize of 100kgs. Harvest was bad in 2013 because of drought. It rained shortly and stopped”.

Climate change has forced and influenced people to change land use activities as a coping strategies.

REASONS FOR LOW YIELD AND FOOD INSECURITY IN LUNGA VILLAGE

According to the Lunga village chairman Mr. Ibrahim Kizuka and Village Executive Officer Mr. Hussein Omary, Lunga village is one of the villages in Lugoba ward in which the villagers are suffering from hunger. They have no food to eat, each family is given 4 kg of maize and 1kg of beans. This is aid from the president. When asked how often this happen they declared several times, because the rain is not coming as used to and when it comes it lasts shortly. For example in 2013 people harvested food crops which was sufficient for 2 to 4 months only. In 2012 they also received aid from the government. Reasons given for low yield are presented in Table 4.

Table 4: Perceptions on causes of low harvest (n-66)

Reasons for low harvest	Responses	Percentage
Don't use fertilizers/manures	45	68
Climate change	55	83
Poor farming techniques (using hand hoe, no use pesticides and fungicides)	42	64
Poor quality of seeds (use local seeds)	45	68
Others (low education, diseases, no irrigation etc)	35	53

Source: Field survey, 2009

People interviewed had different perceptions with climate change. Climate change influenced people to grow crops which are drought resistant. Rainfall is the major determinants of what crops to grow. Other reasons people perceive as causes of low harvest are presented in Table 4. Table 4 provides a summary of what contributed to low yield in Lunga village. The claim was that climate change is what leads to low yield but through interviews and focus group discussion it was found that there are other factors as presented in Table 3. Climate change was mentioned by 83% of the respondents as the major cause of low harvest. They associated low yields with the shortage of rainfall and long period of drought. Agricultural Extension Officer interviewed commented that,

Climate change is the major cause of low agricultural yield in Lunga village and surrounding villages like Saleni, Mboga and Mindu-Tulieni as rain is not coming as is used to be. And if it rains it last shortly, and it is difficult to predict when it is going to rain. Drought is also causing low harvest as the village does not get enough rain and no river or stream which can be used for irrigation, he further explained.

One, Mzee Chanzi stated, "In 1960s, 1970s and the beginning of 1980s Lunga village used to get reliable rainfalls and harvests were good. It is recently when we experienced drought, where rainfall is not raining as it is used to".

The interviews with farmers in Lunga village revealed that rain season patterns have changed. Rain sometimes starts early or late, and lasts shortly. Maize which is a staple food for people in the village requires higher amounts of rainfall. Alternatively, farmers in the village and other areas turned to plant drought tolerant crops like sorghum, millet and cassava, which need less rainfall compared to maize. According to FAO (2007), sorghum and millet are staple foods in many western African

countries, such as Mali, where farmers grow these crops because of severe water shortages facing these countries. In Tanzania including the study village, maize is the staple food. There is no way you can convince villagers to abandon maize cultivation and go for other crops. Other crops are grown to supplement maize.

A potential solution to declining maize yields could be for farmers to grow different crops that are more resilient to weather changes and require less rainfall. The problem with the people in Lunga village is the tradition and habit they have in mind. They prefer stiff porridge “*ugali*” made from maize flour than anything else. I asked Mama Ashura, why she preferred *ugali* than rice and other food stuffs. She said,

Flour for making *ugali* is cheaper compared to rice, it cost Tshs 1,000 per kg, while 1 kg of rice is Tshs 2,000. *Ugali* is also good because it stay in the stomach longer and it gives energy for doing activities like farming and cutting trees for making charcoal.

People living in southern Africa have been eating roasted maize and stiff porridge for centuries. People in Lunga village will not easily switch to sorghum or to other crops than maize. Rain patterns have also started to change in different part of East Africa and Tanzania in particular. This problem is also prevailing in Lunga village where people are engaging in other activities like business and charcoal making to supplement farming products.

Despite the fact that climate change was mentioned as major cause of food insecurity in the study village, other causes were also pointed out. Sixty eight percent (68%) of the interviewees pointed out that the harvest was low because people are not using fertilizers or manure. Most interviewees declared that they are not used to this technology of using fertilizers and manure. This problem of not using fertilizers or manure was different to migrants. Michael Mrema migrated to Lunga 7 year ago from Kilimanjaro. When Mr. Mrema was interviewed he had the following to say,

I do grow maize, sweet potatoes, banana, cassava and vegetables in my farm. I do use manure and fertilizer which nourish my crops. People in this village are not using manure which is available for free from people keeping animals, I don't know why.

Above all, people in Lunga village do not use pesticides, insecticides or vaccinations to control crops and animal diseases. This is so because most

villagers lack knowledge on using fertilizers and pesticides. There is a need of educating villagers on how to use fertilizers and pesticides. Extension officers should introduce demonstration farms in the village where villagers will be trained on the use of fertilizers and pesticides. About 16% of the respondents mentioned lack of education or knowledge about improved agriculture as constrain to their activities. Seeds not available in time were also mentioned as the problem to their farming. Most interviewees declared that they do use seeds they select from the previous harvest. They are not able to buy seeds from the shops, and sometime they do get seeds late, after sown seasons had ended. It was mentioned in the focus group discussion that agricultural officers or veterinary officers are not visiting farmers or livestock keepers regularly to educate them on farming activities and taking care of their animals, respectively. They do visit them occasionally in case there is an outbreak of crop or animal disease like cassava diseases, pests, or in case some government officials is intending to visit the farmers or animal keepers.

Poor farming equipment was also mentioned as a contributory factor to low yield. About 47.1% of farmers interviewed are still using hand hoe which is difficult and time consuming. The villagers don't have a tractor. They hire it from neighboring villages or private organs. In most cases they do get tractors late after sown seasons. And it is very expensive to hire a tractor. It was noted that using a tractor of one hectares cost 40,000 to 45,000 Tshs (22 to 25 Euro). Plough is used by few families with trained bulls to pull the plough. Recently, government introduced *Kilimo Kwanza* slogan as a strategy to improve agriculture. Mr. Mesarieki, an adult man living in Lunga village complained that, "*Kilimo Kwanza has not reached in their village because villagers expected to get power tillers which would help them to expand their farms and reduce cost of hiring tractors*". Without the government support, the villagers will remain poor and seek for food support forever.

In this study the researcher asked elder farmers how they perceive today's temperature and rainfall patterns and what the situation was when they started farming in their late teens and early twenties, the following was their comments, "*Rainfall was plenty and the harvest was good*". The majority of respondents about 50.6% complained about higher temperatures, rain retardation and failing crops. They relate falling of harvest with shortage of rainfall, high temperature and drought.

Other issue discussed with the respondents is about meals. Seventy five percent of the people interviewed declared that they are taking one or two

meals a day. Most families cannot afford three meals a day because of poverty and shortage of food stock. Food affordability is a problem as most families don't have money to buy food. Food is sometimes available in the shops and in the market; problem is that people don't have money to buy food. During harvesting seasons they do take three meals because they had food to eat. The food they harvest did not last long because of shortage of rainfall and soil is now infertile leading to less harvest. There are no rivers in the village which can be used for irrigation, no reservoirs which can be used to harvest rain water and most rivers are seasonal, they do flow during the rain seasons only. It was last noted that food insecurity is caused by many factors and not climate change only.

RECOMMENDATIONS

Farmers and livestock keepers have several options to counter food insecurity. Farmer adapt to climate change thorough switching to other crop varieties such as drought tolerant crops, introducing more suitable crops and shifting from farming to animal keeping. Animal keepers can reduce the number of animals and apply scientific method of keeping small number of animals in small areas or apply zero grazing. Also animal keepers can store fodder for animals to use during drought time.

Government institutions such as Tanzania Meteorological Agency (TMA) should provide reliable predictions of weather projections in advance and information about suitable crops to grow and livestock to keep. People should be advised to grow fast maturing crop varieties including sweet potatoes, maize, millet and cassava.

Government should encourage agronomic research for the development of traditional breeding or biotechnology of new varieties of crops able to withstand the effects of global warming (climate change) or drought. The findings of the research should be disseminated to rural villagers.

Application of irrigation and building water reservoir for tapping or harvesting rain water is a best alternative to increase yield. Although this is a big and long term investment it requires cooperation with government, farmers and other members of the society.

Education is lacking to most of rural residents, most of them have not gone to school. With this problem, rural people should be given education on how to apply new technologies in farming and keeping animals. For example in Lunga village most interviewees were complaining that they don't know how to use fertilizers including manure (cow-dug).

Agricultural Extension Officers and Veterinary Officers should not stay in the offices rather visiting famers and livestock keepers. These officers should train farmers and direct them on what to do to improve their produce. This will help in addressing problems facing famers and livestock keepers. Market for crops in the study area is a problem. People don't have cash crops which could provide them with stable income. They abandoned cotton because they lacked market for the crop. Some people were still with bags of cotton in their house. Government should find market for crops produced in rural areas.

CONCLUSION

Climate change is reducing agricultural production in the Tropics, where many developing countries are located. Policy options that could help farmers adapt to climate change should encourage agronomic research, encourage irrigation, increasing its efficiency and encouraging people to grow drought resistant crops. Despite recent advances in analyzing the economic impacts of climate, however, information about climatic threats to food security in developing countries is still extremely limited. And it is worse to rural people who know nothing about climate change. Food deficit in the study village is the result of several factors, climate change being one of the factors.

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