CLIMATE VULNERABILITY AND CAPACITY ANALYSIS IN DODOMA REGION OF TANZANIA

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Abstract

This paper examines the climate change vulnerability and adaptive capacity analysis of seven villages in Dodoma Municipal, Bahi district, Chamwino and Kongwa districts of Dodoma Region with the aim of selecting best climate change adaptation technologies for scaling up from Chololo ecovillage to other semi arid areas. Assessment was done using a combination of participatory tools from the Climate Vulnerability and Capacity Analysis toolkit developed by CARE International (2009), facilitated by two teams of staff from the six Chololo Ecovillage Project partners plus district officials to gather information on the local livelihoods, hazards, livelihood resources and climate context. The participatory tools used to gather information in the field included seasonal calendars, historical time lines and climate change vulnerability matrices. A total of 218 community members were involved in this analysis (average of 30 people in each village).The key livelihood resources identified by participants in all villages are land, water, agriculture/livestock, forest, roads, primary school, dispensary and human resources. Deforestation, drought, and diseases are the main hazards affecting the livelihood resources in all surveyed villages. The communities pinpointed deforestation as a major hazard affecting all the livelihood resources. Cutting trees for charcoal, fuel wood and building materials for sale, as well as overgrazing, are the reported causes of deforestation. This deforestation has resulted in soil erosion, scarcity of firewood and building materials as well as drying up of water sources. The communities in the surveyed villages recognise a link between forests and rainfall and consider that severe deforestation has resulted in less rainfall. Drought is the second most important hazard that significantly affects livelihood resources in the surveyed villages, with a significant effect on water availability, agriculture (crops and livestock) and the human population. Diseases (both humans and livestock diseases) are reported to have a moderate effect on the livelihood resources. They include nutritional diseases due to acute food shortage and occasional water borne diseases (e.g. diarrhoea and dysentery).Rural communities in Dodoma, in semi-arid central Tanzania, are aware of climate change and have considerable experience of the impacts of drought and deforestation. They have tried various strategies to overcome the impacts of climate change but with limited / differing levels of success. The poor performance of such strategies is mainly attributed to poverty, weak institutional capacity, and low take-up of improved technology. This has resulted in frequent hunger and food insecurity. Such conditions are anticipated to worsen in future as climate change challenges increase as predicted, unless adaptation strategies are improved.

Key words: Climate change, vulnerability, capacity analysis

1.0 INTRODUCTION

This paper examines the climate change vulnerability and adaptive capacity analysis of Dodoma Municipal, Bahi district, Chamwino and Kongwa districts of Dodoma Region. Assessment was done using a combination of participatory tools from the Climate Vulnerability and Capacity Analysis toolkit developed

by CARE International (2009), facilitated by two teams of staff from the six Chololo Ecovillage Project partners plus district officials to gather information on the local livelihoods, hazards, livelihood resources and climate context. The participatory tools used to gather information in the field included seasonal calendars, historical time lines and climate change vulnerability matrices.

A participatory climate vulnerability and capacity analysis exercise carried out to inform the design of a new project aiming to scale up climate change adaptation interventions in semi arid areas of Tanzania. The study assessed climate vulnerability and adaptive capacity of communities in four districts of Dodoma Region and identified climate change adaptation strategies to improve resilience and reduce poverty in these communities.

The study was conducted by six partner organizations that collectively implemented the pilot Chololo Ecovillage climate change project.The partners are the Institute of Rural Development Planning (IRDP), Tanzania Organic Agricultural Movement (TOAM), Dodoma Environmental Network (DONET), Majina Maendeleo Dodoma (MAMADO), Dodoma Municipal Council (DMC), and Agriculture Research Institute-Hombolo (ARI).

2.0 MATERIALS AND METHODS

The study was conducted in Kongwa, Bahi, Chamwino and Dodoma Districts which are located in Dodoma Region in Central Tanzania.Dodoma is one of three regions ranked top in the list of drought stricken areas of the country (NAPA p38).Kongwa, Bahi and Chamwino are the three least food-secure districts in the Region.Seven wards in the four districts were selected for study, in consultation with local authority staff, based on their vulnerability and resource poverty.

Climate vulnerability and capacity assessments were conducted to better understand climate change impacts, to prioritise the most vulnerable wards, and to identify adaptation activities that can increase community resilience to climate change. Assessment was done using a combination of participatory tools from the Climate Vulnerability and Capacity Analysis toolkit developed by CARE International (2009), facilitated by two teams of staff from the six Chololo Ecovillage Project partners plus district officials.

The facilitators carried out participatory workshops in each district to gather information on the local livelihoods, hazards, livelihood resources and climate context. The participatory tools used to gather information in the field included seasonal calendars, historical time lines and climate change vulnerability matrices. Seasonal calendars help to analyse changes in seasonal activities and identify periods of stress and hazards. Historical time lines helped to get an insight into hazards and climate trends. The climate change vulnerability matrix exercise helps to quantify the impact of each key hazard on the most important livelihood resource, then identify and evaluate copying strategies currently used to address the hazards identified. The community consultations also provided an opportunity to raise community awareness of the impacts of climate change and how communities can increase their resilience.

The fieldwork was undertaken from 29th July to 1st August 2013. It took four days, one day per district, and involved 218 community members (137 women and 81 men). Each village community was represented by 30 people on average, aiming for gender balanced representation and a varied age range, and included village leadership and extension staff. On the first day, before splitting into two teams, facilitatorsworked

together to test and become familiar with the proposed study tools in Kikombo Village, Dodoma Municipal District. Table 1 indicate the number of respondents in each district.

3.0 RESULTS AND DISCUSSIONS

This section presents the results of the CVCA exercise which included seasonal calendars, identification of key livelihood resources and climate change/hazards, evaluation of the impact of the climate change hazards on livelihood resources, and discussion of climate change adaptation strategies.

3.1 Seasonal calendar

The surveyed districts fall under similar semi-arid climate conditions, and generally experience similar seasonal calendar activities (Table 2).

Rainfall in these districts starts from late November. The peak rainfall is in December/January. In February/March the districts often experience a long drought spell during the growing season, which sometimes can last for 40 days. The rainfall ends in April. The dry season in these districts is for six months, starting from May to early November. Agriculture and livestock are the main livelihood activities and are heavily depend on natural rains to enable crops and pasture to grow and produce human food and livestock feed.

Typically the agricultural activity starts by land preparation, which involves farm clearing, from August to September. This activity is followed by distribution of farmyard manure in September to October, by some farmers who own livestock and others who have ability to buy manure. Land cultivation (e.g. ox ploughing or hand tillage) and planting depend on the start of rainfall - once there is enough rain, cultivation and planting starts. Because of unpredictable rainfall and poor distribution of rains, and the nature of the particular crop, cultivation and planting of different crops is done in successive waves. The first cultivation and planting is done from November, the second in late December to January and the third in late February. Weeding and thinning is mainly done in January to March. Crops are ready to harvest from April to June.Early harvested crops are threshed in June and late harvested crops are threshed in July/August. Crops are ready to be sold by August to September although some farmers sell their crops earlier to get cash to meet urgent needs. Some horticultural crops are cultivated from April to October using the water stored in ponds and seasonal riverbeds. In all surveyed villages there are some farmers using oxen for cultivation and pulling ox carts. Training of oxen is done from July to November.

Circumcision, wedding and funeral celebration are done after harvest from June to August when there is adequate food and less farm work. Circumcision is done in June when the school pupils are in holidays and when the temperatures are low for easy healing. The period of acute food scarcity is from November to February and it is this period where many male household migrate to urban centres and to Cheusi (a famous farmer to seekwork as casual labourers.

Digging of traditional water wells starts from June and as the water level goes down, and continues up to November when the rain starts.

Calving for cattle is mostly in January to February where there is adequate pastures and water. Treatment and control of livestock diseases is normally done all the year. In November to December and in May to June there is less disease therefore livestock treatment is minimally done. Many livestock are sold in

June to August for the farmers to get cash for buying food when there is poor harvest. Selling of livestock is also done to reduce the number of livestock especially during the years where rainfall is not adequate for pasture growth as observed in year 2013. Crop residues and hay are collected after harvest in June to August. This feed reserve is utilised in November – December where there is acute feed shortage. This feed reserve is normally fed to oxen and sick animals.

Building of houses starts in May after the end of rainfall because many people use earth bricks for building. During this period there is adequate water in water sources. The earth bricks are left for drying then building of houses is done up to October/November.

Changes in rainfall patterns may delay or hasten some of the activities such as planting and harvesting dates, cultivation and weeding as well as house building.

3.2 Main livelihood resources

The livelihood resources identified by participants in all villages were land, water, agriculture/livestock, forest, roads, primary school, dispensary and human resources (Table 3). The communities in these districts derive their livelihood from these resources. Only Kikombo Village has a railway station. Electricity is only available in Manungu village located in Kongwa district. Land availability enables the community to farm and keep livestock; however the productivity of land is limited by poor farming practices, low rainfall, pests and diseases, and unskilled human resources. Land in all villages is susceptible to soil erosion when there is heavy rain.Crops which are mainly grown are sorghum, pearl millet, groundnuts, sunflower, simsim, maize and bambara nuts (Table 4). Due to deforestation, poor agriculture and overstocking, the soils are bare and susceptible to gully and sheet erosion. Livestock kept in these villages are local breeds of low genetic potential. These include Tanzania Short horn Zebu cattle, local goats and sheep, pigs and local poultry (Table 5). Despite their low genetic potential, they are the main source of protein, draught power and cash for rural communities.

Natural forests have been the source of firewood, charcoal, building materials, local medicines and fruits for many years. Unfortunately, the forests have been severely deforested to the extent that they can no longer meet the need for ecosystem services.

Water is available in all villages. All the villages except Manungu have boreholes which supply water using diesel engine pump. Manungu village borehole is connected with electricity and therefore does not use diesel engine pump. Water is also obtained from traditional shallow wells that are often along the valleys. These traditional wells dry few days after the rain season, mainly from July – November. The traditional wells are often not secure, thus hazards like floods may cover them up or contaminate them with human or livestock wastes thereby exposing people to water borne diseases (e.g. cholera, dysentery). In addition water sources often dry up during the dry season, forcing people (mainly women) to travel long distances and opt for unsafe water.Other constructed resources include primary schools, dispensary, houses and road network (Table 6), however these resources may also be damaged by seasonal floods, and winds.

3.3 Hazards identified in surveyed villages

The impacts of climate change in the surveyed villages are indicated in Table 7.

Drought/unpredictable rains, deforestation and diseases are the major hazards reported in the villages.Triangulated data from other studies in Tanzania such as Risks, Vulnerability and Capacity Assessment for Chamwino District, Dodoma (PMO, 2012) and the Disaster Risks and Capacity Needs Assessment for Mainland Tanzania (2008) identified similar hazards such as drought, pests and epidemics as the main hazards affecting the central plateau agro ecological zone.

The average rainfall in Dodoma region ranges from 500 – 800mm. Data recorded from Dodoma airport meteorological station from year 1980 – 2013 indicates that years with less than 500mm rainfall (dry years) were observed to be 1981, 1986, 1988, 1992, 1998, 2003, 2005, 2010. In most cases drought affect the whole villages, lasting for months (Figure 1). In the year 2012/13 drought was acute in almost all districts in Dodoma region and rainfall was below 500mm. Rainfall data recorded in Bahi-Chikola ward, Dodoma Municipal and Kongwa shows that rainfall was below 500mm and was poorly distributed - it rained for an average of 32 days only (Table 8). This has resulted in serious food shortage in many areas of the region.

In all surveyed villages it was noted that drought has significant impact on agriculture (crops and livestock), water, forest and human resources. Drought had low impact on land. Historical timeline (Table 9) indicates that years with acute drought were accompanied with hunger, as the majority (>90%) of the community in semi-arid central Tanzania depend on rain fed agriculture. Failure of rainfall results in crop failure / low productivity, significantly reducing food production. In all surveyed villages food harvested can only suffice 6 - 9 months. Food insecurity is acute from December to February.

3.4 The impacts of climate change/hazards on the key livelihood resources

Deforestation, drought, and diseases are the main hazards affecting the livelihood resources in all surveyed villages (Table 10). Other hazards include unreliable rainfall, strong winds, pests, soil erosion, overgrazing, poor education, seasonal floods and bush fire.

The communities pinpointed deforestation as a major hazard affecting all the livelihood resources. Cutting trees for charcoal, fuel wood and building materials for sale, as well as overgrazing, were reported as causes of deforestation. This deforestation has resulted in soil erosion, scarcity of firewood and building materials as well as drying up of water sources. The communities in the surveyed villages recognise a link between forests and rainfall and consider that severe deforestation has resulted in less rainfall. For them, deforestation has seriously affected their livelihood resources.

Drought is the second most important hazard that significantly affects livelihood resources in the surveyed villages. Drought has a significant effect on water availability, agriculture (crops and livestock) and the human population.

Diseases (both humans and livestock diseases) are reported to have a moderate effect on the livelihood resources.They include nutritional diseases due to acute food shortage and occasional water borne diseases (e.g. diarrhoea and dysentery).

3.5 Local climate change adaptation practices

Communities have adopted a range of strategies - innovations, practices and coping mechanisms - in response to the effects of climate change (Table 11).

In short, the adopted strategies can be grouped into the following categories

- Use of agro-ecological specific agronomic practices
- Use of improved crop varieties
- Use of animal power in farming activities
- Engagement in petty businesses
- Use of accessible and affordable alternative resources

However, adopted strategies cumulatively haven't reached optimal levels of effectiveness because of some limiting factors including;

i. Weaknesses in enforcement of local government established by-laws to protect environment degradation
ii. Ineffective functioning of legally established bodies (committees) for safeguarding communities interests.
iii. Low adoption and utility levels of introduced technologies in some of assessed areas. For instance, observed low uses of energy saving stoves introduced by other projects in Mgunga and Manungu villages.
iv. Poor combination of adopted strategies at individual/family level to bring significant desired results. For example all villages in the surveyed wards there was sensitization of using drought power for cultivation but there are few village farmer who use drought animals for cultivation. Local traditional farming (kuberega) is still widely practiced and is the main source of crop failure in case of acute drought.

4.0 CONCLUSION

Tanzania is predicted to warm by 2 – 4°C by 2100. The inner parts of the country are likely to experience higher temperature increases than the coastal areas and cold and dry seasons will warm more than warm and wet seasons. Rainfall is predicted to decrease by 0 – 20% in the central parts of the country. In contrast, rainfall may increase by 25 – 50% in the north east and the Lake Victoria basin. Changes in the mean temperature, rainfall patterns and rainfall variability are likely to prolong dry seasons and to increase severity of periodic droughts. This will be pronounced in the interior part of the country, which will experience higher temperature increases and reduced rainfall (See Clark, Webster and Cole, 2003; IPCC, 2001).

Rural communities in Dodoma, in semi-arid central Tanzania, are aware of climate change and have considerable experience of the impacts of drought. They have tried various strategies (Table 13) to overcome the impacts of climate change but with limited / differing levels of success. The poor performance of such strategies is mainly attributed to poverty, weak institutional capacity, and low take-up of improved technology. This has resulted in frequent hunger / food insecurity. Such conditions are anticipated to worsen in future as climate change challenges increase as predicted, unless adaptation strategies are improved.

4.1 Proposed new climate change adaptation in semi-arid areas

The following interventions are proposed to increase the adaptive capacity of vulnerable communities of semi-arid areas of Central Tanzania:-

- Education on CC adaptation practices
- Afforestation / reforestation
- Sensitization of communities on adoption and use of newly introduced technologies
- Introduction of alternative energy (e.g. energy saving stoves, solar, wind)
- Enforcement of established environmental by-laws
- Strengthening established bodies such as environmental committees
- Improved agriculture practices (e.g. improved seeds, GAP)
- Education and inputs on use of animal power in agriculture
- Introduction of improved livestock breeds (cattle, goats and chicken) for high production potential
- Improved livestock disease control and management
- Small irrigation schemes
- Rain water harvesting, roof catchment, charkodams, sub surface dams
- Increased use of farmyard manure
- Pasture establishment
- Modern beekeeping
- Leather making

4.2 Barriers to success

Financial capability

Given the fact that the majority of the population in the rural areas in the districts surveyed are engaged in agriculture as their main source of livelihood and income, and given the susceptibility of agriculture to drought that was identified as the main hazard, it follows that the vulnerability of the agriculture sector is high, exacerbating rural poverty. Field data reported by PMO (2012) indicates that the income of the majority of households in semi-arid central Tanzania is between 10,000shs and 50,000shs per month (less than 1 Dollar per day per household), which is not enough to enable communities to invest in climate change adaptation technologies. Lack of access to capital / finance is clearly a barrier to the uptake of adaptation innovations, suggesting that scalable technologies must be low cost, and access to microfinance needs to be improved.

Technical skills

The majority of farmers in the surveyed villages use traditional practices in agriculture. The community's resistance to change, perhaps due to cultural traditions and aversion to risk, hinders the uptake of improved agricultural practices. During the survey in Manungu and Minganga village it was found that village communities were empowered on the use of drought resistant seed (sorghum –macia variety) and use of improved energy saving stoves but they were unwilling to use them because they are used to growing maize and using traditional stoves. Agriculture extension officers are too few to service all villages. Traditional knowledge is now not adequate for this changing climate. More modern technologies

in improved agriculture, water harvesting, disease control, energy use etc. are needed to equip the community to adapt to the impacts of climate change,and adequate time is needed for people to change their practices and behaviours.

4.3 Selected ward for scaling up Ecovillage innovations

We suggest to scale up eco-village innovations in Idifu ward in Chamwino district. The ward seems to be the most vulnerable to the impact of climate change (particularly drought).

Typically this ward experiences food shortage between 6 and 9 months per year. In this year 2013, the rainfall was minimal (400mm) leading to very poor harvests, with farmers anticipating food shortages of more than 9 months. The majority of farming communities practice traditional agricultural practices where land is not tilled before planting. Less than 40% of households in Idifu ward can afford to cultivate the land using ox plough.

Water shortage is very common in Idifu ward. The ward has 2 boreholes, one at Idifu and the other at Miganga village. In the dry season these are the main source of water. All local shallow wells dry up in the dry season. There are no water distribution points in Miganga village, although a pipeline and water distribution points were currently under construction by MAMADO funded by Action Aid, with assistance from UK youth volunteers.

The ward has no cattle dip, no tractor, no power tiller. The ward is entirely dependent on firewood and charcoal as the source of energy for cooking using traditional three stone stoves. There is no other source of fuel, and no energy saving stoves are used. According to Ward Executive Officer, in the past tree planting was possible but in the last 10 years tree planting is not possible because of serious water shortage.

The ward is located about 80 km from Dodoma town, about 35km tarmac road (Dodoma-Bwigiri) and 30 km rough road (Bwigiri – Idifu).

Innovations needed to empower the community to adapt to the impacts of climate change, especially drought, will be on agriculture, livestock, water, and afforestation using farmer managed natural regeneration and tree planting, and other income generating activities such as beekeeping and leather making.

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References

1. Clark CO, Webster PJ, and Cole JE. Interdecadal variability of the Relationship between the Indian Ocean Zone Zonal Mode and Eastern African Coastal Rainfall Anomalies Journal of climate 2003;16:548-554.
2. Intergovernmental Panel on Climate Change (IPCC). Climate Change 2001: Impact, Adaptation, and Vulnerability. Cambridge University Press.
3. Prime Ministers Office. Risk, vulnerability and capacity Assessment report for Chamwino district – Dodoma 2012.
4. United Republic of Tanzania 2012. Population and Housing census 2013.
5. Vice President's Office, Division of Environment. National Adaptation Programme of Action (NAPA) 2007

S/no	District	Ward	Village	Respondents		
				Men	Women	Total
1	DMC	Kikombo	Kikombo	15	11	26
2	Kongwa	Ugogoni	Machenje	17	12	29
		Sejeli	Manungu	15	16	31
3	Bahi	Mwitikira	Mwitikira	23	9	32
		Chikola	Chimendeli	26	13	39
4	Chamwino	Msamalo	Mgunga	19	12	31
		Idifu	Miganga	22	8	30
TOTAL				**137**	**81**	**218**

Table 1: Number of respondents in each village

Event	Jan	Feb	March	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Rain season												
Cultivation												
Planting												
Weeding												
Dry season												
Harvesting												
Threshing												
Selling produce												
Farm preparation												
FYM application												
Building houses												
Circumcision												

Wedding												
Funeral celebration												
Training oxen												
Period of food scarcity												
Tradition well digging												
Horticulture												
Labour selling												
Culving												
Disease control to livestock/ chicken												
Selling livestock												
Collection and storage of livestock feed												

Table 2: Seasonal calendar

Livelihood Resources	Villages						
	Kikombo	Chimendeli	Mwitikira	Machenje	Manungu	Miganda	Mgunga
Land	√	√	√	√	√	√	√
Water	√	√	√	√	√	√	√
Agriculture/livestock	√	√	√	√	√	√	√
Forest	√	√	√	√	√	√	√
Road	√	√	√	√	√	√	√
Railway station	√	χ	χ	χ	χ	χ	χ
Human	√	√	√	√	√	√	√
Primary School	√	√	√	√	√	√	√
Dispensary	√	√	√	√	√	√	√
Electricity	χ	χ	χ	χ	√	χ	χ
Houses	√	√	√	√	√	√	√

Table 3: Livelihood resources at the villages

Ward	Major crops grown							
	Pearl millet	Sorghum	Maize	Gnuts	Sunflower	Simsim	Bambara nuts	Rice
Kikombo	√	√	√	√	√	√	√	χ
Sejeli	√	√	√	√	√	√	√	χ
Ugogoni	√	√	√	√	√	√	√	χ
Msamalo	√	√	√	√	√	√	√	χ
Idifu	√	√	√	√	√	√	√	χ
Mwitikira	√	√	√	√	√	√	√	χ
Chikola	√	√	√	√	√	√	√	√

Table 4: Major crops cultivated

Wards	Livestock type					
	Cattle	Goats	Sheep	Donkey	Chicken	Pigs
Kikombo	1802	3900	290	11	865	85
Sejeli	7,434	4,521	1580	17	24,684	177
Ugogoni	3,701	4,465	2087	487	1,990	165
Msamalo	5,687	3,731	1,362	230	20,368	109
Idifu	5,263	149	1676	277	1866	322
Mwitikira	6,092	3,029	557	185	-	-
Chikola	13,942	7,006	7,701	334	6,860	117

Table 5: Livestock population

Ward	**Social services**									
	Health centre	Dispensary	Veterinary centre	Primary school	Secondary School	Cattle dip	Extension officer	Borehole	NGO	Tel
Kikombo	1	1	0	2	1	1	2	2	6	1
Sejeli	0	2	0	1	1	1	5	1	3	1
Ugogoni	1	3	0	5	2	0	4	1	0	1
Msamalo	0	3	0	5	1	1	3	3	2	1
Idifu	0	2	0	3	1	0	1	3	1	1
Mwitikira	1	2	0	2	1	1	2	2	3	1
Chikola	1	3	0	3	1	1	3	3	2	1

Table 6: Social Services

Impact/hazards	**Villages**						
	Kikombo	**Chimendeli**	**Mwitikira**	**Machenje**	**Manungu**	**Miganda**	**Mgunga**
Drought and unpredictable rains	√	√	√	√	√	√	√
Deforestation	√	√	√	√	√	√	√
Diseases	√	√	√	√	√	√	√
Strong winds	√	√	χ	√	√	√	χ
Birds	√	χ	χ	χ	√	χ	χ
Pests	χ	√	√	χ	χ	√	χ
Soil erosion	√	√	χ	χ	χ	√	√
Bush fire	χ	χ	√	χ	χ	χ	χ
Lack of education	√	√	√	χ	√	√	χ
Salt water	χ	χ	χ	√	√	χ	χ
Overgrazing	χ	χ	χ	χ	√	χ	χ
Floods	χ	χ	χ	χ	χ	χ	√

Table 7: Major climate change hazards to livelihood resources

Location	Number of rain days	Amount (mm)
Kongwa district	29	481.3
Dodoma Municipal	39	476.5
Bahi–Chikola	28	437.9
Average	**32**	**465.2**

Table 8: Rainfall in year 2012/2013 in some locations in Dodoma region

Year	Village						
	Kikombo	**Chimendeli**	**Mwitikira**	**Machenje**	**Manungu**	**Miganga**	**Mgunga**
2013	Drought, hunger	Drought, pests, hunger	Drought, hunger	Drought, hunger	-	-	Drought, hunger
2012	-	-	Drought, hunger	-	-	-	-
2011	Quelaquelea birds	-	-	-	-	-	-
2009	Political conflicts	-	-	-	-	-	-
2007	Rift Valley Fever	Rift Valley Fever	Rift Valley Fever	Rift Valley Fever	-	-	-
2006	Death of livestock, hunger and drought	-	Drought, hunger, death of livestock	Drought, hunger, livestock diseases	-	-	Drought, hunger
2004	Train accident	Drought, hunger	-	Pests	-		-
1999	-	-	-	Drought, hunger	-	-	-
1997/98	Elinino, dysentery, pests	Elinino, floods	Elnino, Floods, hunger, pests	Elinino, floods hunger	-	-	Elnino, Floods, hunger, pests
1994	-	Queleaquelea, hunger	-	Meningitis	-	-	-
1993	-	-	-	Drought and hunger	-	-	-
1992	-	-	-	Drought, hunger	-	-	-
1990	-	Measles and Meningitis	-	-	-	-	-

Year	Village						
	Kikombo	**Chimendeli**	**Mwitikira**	**Machenje**	**Manungu**	**Miganga**	**Mgunga**
1989	-	Malaria/ death of children	-	Good harvests	-	-	-
1987	Train and car accident	-	-	-	-	-	-
1984	-	Drought, hunger	-	-	-	-	-
1981	Hanger , army warms	-	-	-	-	-	-
1980	-	Child deaths due to malaria	Dysentery, death of people	-	-	-	-
1978	-	-	-	Stress on Army camp from South Africa	-	-	-
1975	-	-	Dysentery, death of people	-	-	-	-
1974	-	Ujamaa villages, pests	-	-	-	-	-
1973	Queleaquelea	-	-	-	-	-	-
1971/72	Hunger, army warms	-	-	-	-	-	-
1969	Drought, hunger	-			-	-	-
1966	-	-	-	-	-	-	Drought, hunger
1964	Drought, hunger	-	-	-	-	-	-
1963	Drought and hunger	-	-	-	-	-	-
1953-1959	Drought and hunger	-	-	-	-	-	-
1952	-	-	-	-	-	-	Drought, hunger
1953	Drought and hunger	-	-	-	-	-	
1947	-	-	-	-	-	-	Drought, pests and hunger
1943	-	-	-	-	-	-	Drought and hunger

Table 9: Historical time lines

Village	Livelihood Resource	Hazards										
		Drought	Deforestation (Charcoal & firewood)	Unreliable rainfall	Diseases	Strong wind	Pests	Soil erosion	Over grazing	Ignorance	Floods	Bush fire
Kikombo	Land	1	3	1	0	1	N/M	N/M	N/M	N/M	N/M	N/M
	Forest	3	3	1	0	2	N/M	N/M	N/M	N/M	N/M	N/M
	Water	3	3	2	2	1	N/M	N/M	N/M	N/M	N/M	N/M
	Agriculture/ livestock	3	3	3	3	2	N/M	N/M	N/M	N/M	N/M	N/M
	Human	3	3	2	3	2	N/M	N/M	N/M	N/M	N/M	N/M
	Average	2.6	3	1.8	1.6	1.6	N/M	N/M	N/M	N/M	N/M	N/M
Chimendeli	Land	1	2	N/M	0	N/M	2	2	N/M	N/M	N/M	N/M
	Forest	3	3	N/M	1	N/M	1	1	N/M	N/M	N/M	N/M
	Water	3	3	N/M	1	N/M	0	2	N/M	N/M	N/M	N/M
	Agriculture/ livestock	3	3	N/M	2	N/M	2	2	N/M	N/M	N/M	N/M
	Human	3	3	N/M	2	N/M	0	2	N/M	N/M	N/M	N/M
	Local Institutions	2	1	N/M	0	N/M	0	2	N/M	N/M	N/M	N/M
	Average	2.5	2.5	N/M	1	NM	0.8	1.8	N/M	N/M	N/M	N/M
Mwitiki	Land	1	3	N/M	0	N/M	0	N/M	N/M	N/M	N/M	3
	Forest	3	3	N/M	1	N/	1	N/M	N/M	N/M	N/	3

Village	**Livelihood Resource**	**Hazards**										
		Drought	**Deforestation (Charcoal & firewood)**	**Unreliable rainfall**	**Diseases**	**Strong wind**	**Pests**	**Soil erosion**	**Over grazing**	**Ignorance**	**Floods**	**Bush fire**
ra						M					M	
	Water	3	3	N/M	2	N/M	0	N/M	N/M	N/M	N/M	2
	Agriculture/ livestock	3	3	N/M	2	N/M	2	N/M	N/M	N/M	N/M	3
	Human	3	3	N/M	3	N/M	1	N/M	N/M	N/M	N/M	2
	Average	2.6	3	N/M	1.6	N/M	0.8	N/M	N/M	N/M	N/M	2.6
Machenje	Land	1	2	N/M	0	N/M	N/M	N/M	N/M	N/M	N/M	N/M
	Forest	2	3	N/M	0	N/M	N/M	N/M	N/M	N/M	N/M	N/M
	Water	3	2	N/M	1	N/M	N/M	N/M	N/M	N/M	N/M	N/M
	Agriculture/ livestock	3	2	N/M	1	N/M	N/M	N/M	N/M	N/M	N/M	N/M
	Human	3	3	N/M	2	N/M	N/M	N/M	N/M	N/M	N/M	N/M
	Average	2.4	2.4	N/M	0.8	N/M	N/M	N/M	N/M	N/M	N/M	N/M
Manungu	Land	1	3	N/M	0	N/M	0	N/M	3	2	N/M	N/M
	Forest	3	3	N/M	1	N/M	0	N/M	2	2	N/M	N/M
	Water	3	3	N/M	1	N/M	0	N/M	1	3	N/M	N/M
	Agriculture/ livestock	3	3	N/M	2	N/M	3	N/M	3	3	N/M	N/M
	Human	3	3	N/M	3	N/M	2	N/M	2	3	N/M	N/M

Village	Livelihood Resource	Hazards										
		Drought	Deforestation (Charcoal & firewood)	Unreliable rainfall	Diseases	Strong wind	Pests	Soil erosion	Over grazing	Ignorance	Floods	Bush fire
	Average	2.6	3	N/M	1.4	N/M	1	N/M	2.2	2.6	N/M	N/M
Miganga	Land	1	3	N/M	0	N/M	N/M	N/M	N/M	N/M	1	N/M
	Forest	2	3	N/M	0	N/M	N/M	N/M	N/M	N/M	1	N/M
	Water	3	3	N/M	2	N/M	N/M	N/M	N/M	N/M	1	N/M
	Agriculture/ livestock	3	2	N/M	2	N/M	N/M	N/M	N/M	N/M	1	N/M
	Road infrastructure	1	3	N/M	0	N/M	N/M	N/M	N/M	N/M	3	N/M
	Average	2.0	2.8	N/M	0.8	N/M	N/M	N/M	N/M	N/M	1.4	N/M
Mgunga	Land	1	3	N/M	0	N/M	0	N/M	N/M	2	N/M	N/M
	Forest	3	3	N/M	1	N/M	1	N/M	N/M	3	N/M	N/M
	Water	3	2	N/M	1	N/M	1	N/M	N/M	2	N/M	N/M
	Agriculture/ livestock	3	2	N/M	2	N/M	2	N/M	N/M	2	N/M	N/M
	Human	3	3	N/M	2	N/M	2	N/M	N/M	2	N/M	N/M
		2.6	2.6	N/M	1.2	N/M	1.2	N/M	N/M	2.2	N/M	N/M

Table 10: Climate change vulnerability matrix

Key 3 = Significant impact on the resource 2 = Medium impact on the resource

1 = Low impact on the resource 0 = No impact on the resource N/M = Not Mentioned

District	Adopted strategies	Effectiveness
Dodoma municipality	• Early planting • Planting at different times • Farm yard manure application • Intercropping • Use of drought resistant crops. • Use of early maturing varieties • Food loans "Songoleda" • Labour selling • Livestock temporal movement • Government and non-government food relief • Use of traditional wells	The effectiveness level (in terms of food sufficiency) of employed strategies is only 30%. Only 1 village (Kikombo) assessed
Bahi District	• Afforestation • FYM application • Use of proper spacing • Use of traditional wells. • Controlled charcoal business • Ox-plough tillage. • Early planting • Planting time isolations	On average, effectiveness level (in terms of food sufficiency) of employed strategies is 40%.
Kongwa District	• Planting of drought resistant crops/varieties • Labour selling • Charcoal making • Afforestation • Use of traditional wells • Fetching water from nearby villages • Land tillage • Use of FYM • Use of early maturing varieties • Intercropping • Plating time and location isolations • Livestock feed storage • Livestock temporal movement	On average, effectiveness level (in terms of food sufficiency) of employed strategies is 52.5%. Two villages assessed each with food sufficiency level as follows Manungu= 75% Machenje = 30%

Chamwino District	• Labour selling • Use of drought resistant crops • Use of by-laws • Charcoal making • Food reserve • FYM uses	On average, effectiveness level (in terms of food sufficiency) of employed strategies is 40%. Two villages assessed each with food sufficiency level as follows Mgunga= 50% Miganga = 30%

Table 11: Local climate change adaptation practices by farming communities

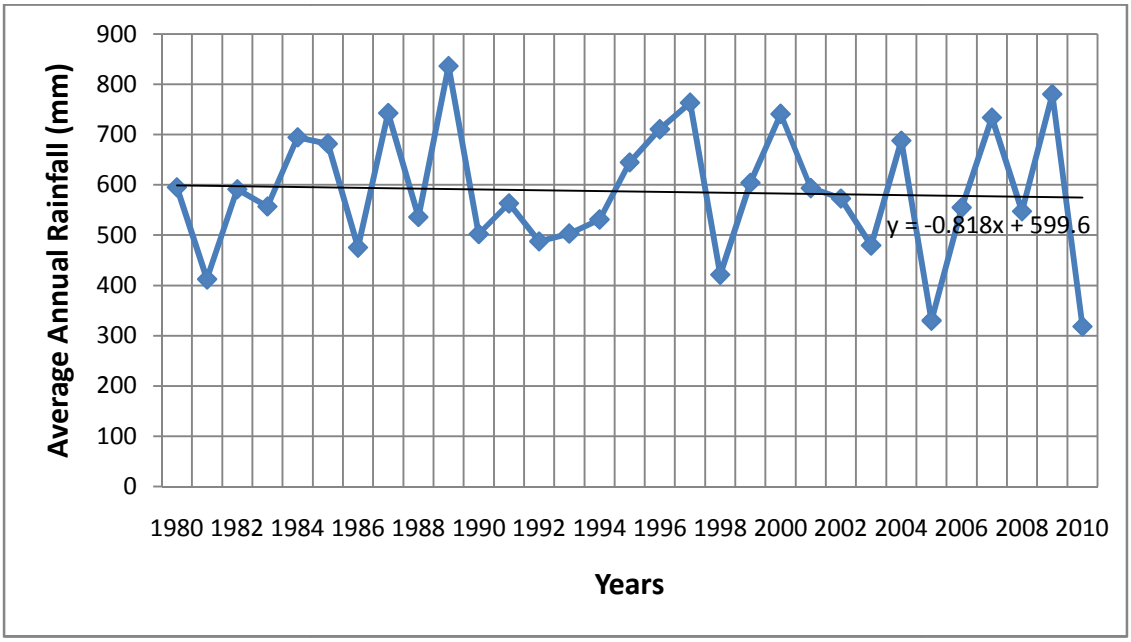

Figure 1: Annual rainfall from 1980 – 2010 in Dodoma Municipality