COMMUNITIES' CLIMATE CHANGE ADAPTIVE CAPACITY AND COST IMPLICATIONS IN KILOSA DISTRICT

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DISSERTATION SUBMITTED IN PARTIAL FULFILIMENT OF REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE IN ENVIRONMENTAL AND NATURAL RESOURCE ECONOMICS OF SOKOINE UNIVERSITY OF AGRICULTURE. MOROGORO, TANZANIA.

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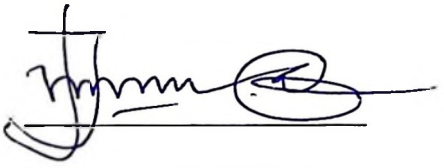
ABSTRACT

Currently, the concern, among social scientist is to know communities' capacity to adapt with changing climate and variability. Studies conducted on climate change adaptive capacity and cost estimates associated with adaptation measures are at global level, and were conducted outside Tanzania, in the countries with different environment, economic level, governances, therefore, fail short in reflecting local reality. This study assessed communities' climatic change adaptive capacity and cost implications in Kilosa district. It was conducted in Ilonga Kwambe, Kisongwe, and Mkundi villages. Household survey and interviewing methods were used in data collection where primary and secondary data were collected. Data were analysed by means of descriptive statistics, mult responses and chi-square analysis. The software used in data analysis was SPSS version 16 and Microsoft excel. The result indicate that most of the attributes used to analyse community adaptive capacity show low, moderate and exceptional was in land size index which shows high adaptive capacity index than the rest. The variations of adaptive capacity between the villages are significant at 1% and 0.5% probability level. The result on adaptation strategies show that there were about 22 adaptation strategies that communities used in the course of adaptation with climate change and variability which vary significantly between the villages at 1% probability level. Adaptation cost was observed to have no greater variation with total cost, in the study area because of low adaptive capacity indexes in various adaptation strategies. The major challenge was in quantification of adaption cost because most of the copping strategies are autonomous.

DECLARATION

I, **Nassoro J. Shelukindo** do hereby declare to the Senate of Sokoine University of Agriculture that this dissertation is my own original work and has not been submitted for a degree award in any other institution.



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DEDICATION

This work is dedicated to my, Grandmother Kiagha Ayubu Shelukindo who laid the basis and encouragement in my education.

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LIST OF ABBREVIATIONS

AC	Adaptive capacity
ACI	Adaptive capacity Index
AIACC	Assessing of impact and adaptation to climate change
CSIRO	Commonwealth Scientific and Industrial Research
CCIAM	Climate Change Impact Adaptation and Mitigation Programme
CSERGE	Center for Social and Economic Research on Global Environment
DADPs	District Agricultural Development Programe
DFID	Department of Foreign and International Development
FAO	Food and Agriculture Organization
KDC	Kilosa District Council
IIED	International Institute for Environmental Development
IPCC	International Panel for Climate Change
LACF	Local Adaptive Capacity Framework
RASC	Regional Agricultural Sample Census
SPSS	Statistical Package for social Science
UK	United Kingdom
UNEP	United Nation Environmental Programme
UNFCCC	United Nation Framework for Climate Change Conversion
VEO	Village Executive Officer
VLS	Village loan and saving Organization
WEO	Ward Executive Officer

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background Information

It is clear that climate change will, in parts of the world, adversely affect socio – economic sectors, which include water resources, agriculture, forestry, fisheries and human settlements, ecological systems and human health. Developing countries are the most vulnerable (IPCC, 2000a). Projected or existing impacts of climate change and variability require some adaptation measures, which could minimize or avoid negative impacts (IPCC, 2007; Chamwera and Stage, 2010). The resources put into adaptation represent an investment, in which decision making is to be done in relation to the competing demands for the available resources (Chamwera and Stage, 2010).

Tanzania is not spared from the impact of climate change. Hepworth, (2010) report that the adverse impact of climate change and variability are already having their toll in the livelihood of the people and in many sectors of economy in Tanzania. Frequently and severe drought, flood and strong wind in many part of the country are being felt with their associated consequences on food production, water security and many more. Kilosa District is likely to be vulnerable to the impact of climate change due to frequent occurrence of drought, flood, strong wind and pests which are common phenomena in the district that consequently affect food production and natural resources in general and finally peoples livelihood. It has been reported that, the impact of climate change may mostly affect livelihood of poor communities

because of poor adaptive capacity and high dependence on the rainfall agriculture, which is particularly sensitive to climate change.

According to Smit and Johanna (2006); Vicent (2007); Jones *et al.* (2010); Turnbull *et al.* (2013), adaptive capacities depend on several factors and level of analysis which includes social, political, economic, technological and institutional factors and the interaction of these factors differs depending on the scale of application: from the country level down to the individual. Smith (2003), reported that, at the country level, it reflected by not only financial resources available but also the degree of organization and institutional capacity for effective allocation of resources to the most vulnerable people and areas. At the household level, it depends to knowledge base, which enables them to anticipate change, identify new livelihood opportunities; and resources required to achieve livelihood diversification. Thus, concern rises to identifying adaptive capacities of communities, households and individuals that are vulnerable to the impact of climate change (chamwera and Stage, 2010).

1.2 Problem Statement and Justification of the Study

Climate change is fast pushing the poorest and most marginalized communities beyond their capacity to respond (Pattengell, 2010). In Tanzania, there were unexpected, intense and more frequent extream weather events like drought, flooding, tropical storms and cyclones that occurred in some parts of the country (Hepworth, 2010). The extreme weather conditions, such as the El Niño episode of 1997-98, heavy rains that happened at Kilosa and Dar es Salaam resulting floods in 2009 and 2011 respectively, these climate events indicates climate change and

variability in the country (Agrawala *et al.*, 2003). Thus, the intension of this study was to assess capacity of communities to adapt to climate variability and change. However, there are many studies conducted on climate change adaptive capacity at country and local level (i.e. Wilson *et al.*, 2010; Kuriakose *et al.*, 2009; Maguire *et al.*, 2008; Marlin *et al.*,2007; Osman *et al.*, 2005) but were conducted outside Tanzania, in the countries with different environment, economic level, institutional arrangement and climatic hazards. Moreover, there is a range of studies that were done to estimate cost associated with adaptation measure, but these estimates were at global and regional level (Leichenko and O'Brien, 2002; Brenkert and Malone, 2005; Haddad, 2005; Parry *et al.*, 2009; Chamwera *et al.*, 2010). These findings are too general hence do not reflect local reality.

There is limited information on communities' climate change adaptive capacity and the cost needed to improve communities to cope with climate change and variability. Since we do not know, manifestation and challenges local communities will have to face particularly in poor countries like Tanzania and lack of reliable model for predicting future climate at local level, the best we can do is to focus on the adaptive capacity of the community as a case for setting readiness strategies. (Aase *et al.*, 2010). Therefore, the output of this study could be a base for setting local and national strategies and policy formulation and judging how much investment or aids needed from governments or donors to promote particular adaptation interventions, which could focus on improving ability of the community to cope with current climate variability and change.

1.3 Objectives

1.3.1 Overall objectives

The general objective of this study was to assess communities' climatic variability and change adaptive capacity and its cost implications in Kilosa district.

1.3.2 Specific objective

The specific objectives were to:

i. analyze community capacity to manage and adapt to risk associated with climate variability and change

ii. identify and assess communities' adaptive measures due to climate change; and

iii. determine cost of each adaptive measure in sensitive sectors due to climate variability and change.

1.4 Research Question

1.4.1 First specific objective

i. What are the socio economic attributes that determine climate change adaptive capacity at household or community level?

ii. How adaptive capacities vary between communities?

1.4.2 Second specific objective

i. What is communities' perception on climate change and variability?

ii. What are the climate events facing Kilosa communities?

iii. What are communities' responses to climate change and variability?

1.4.3 Third specific objective

i. What are the quantities of resources needed to improve communities' capacity to cope with changing climate?

ii. What are the costs of each resources used per household to a specific adaptive strategy?

1.5 Conceptual Framework

The study was guided by the argument that; communities' climate change adaptive capacity and copping strategies are linked to the exposure, sensitivity of the system and local adaptive capacity framework which includes asset base i.e. human, social, physical, natural and financial capital; Institutional capacity, knowledge and information, innovation and flexible forward decision making which are key determinants of communities' adaptive capacity to climate change and variability.

Figure 1, presents the structure of conceptual framework showing the linkage or relationship between communities' climate change adaptive capacity and adaptation strategies with exposure, sensitivity and local adaptive capacity framework which are believed to have greater influence on communities adaptive capacity. The system are said to be **sensitive** to climate change if livelihoods mainly depend on agriculture and livestock keeping. For the case of **exposure,** it refers to how often the climate related events occurred in a given system. Communities with limited local adaptive capacity framework variables are likely to be more vulnerable to the negative impact of climate change. Exposure, sensitivity and local adaptive capacity framework variables could have reciprocal relationship i.e. local adaptive capacity framework

variables could have influence on adaptive capacity but may be limited by exposure and sensitivity of the system. Therefore, communities' climate change adaptive capacity mainly depends on the magnitude and intensity of the climate extremity and variability as well as resources available to pursue appropriate adaptation measures.

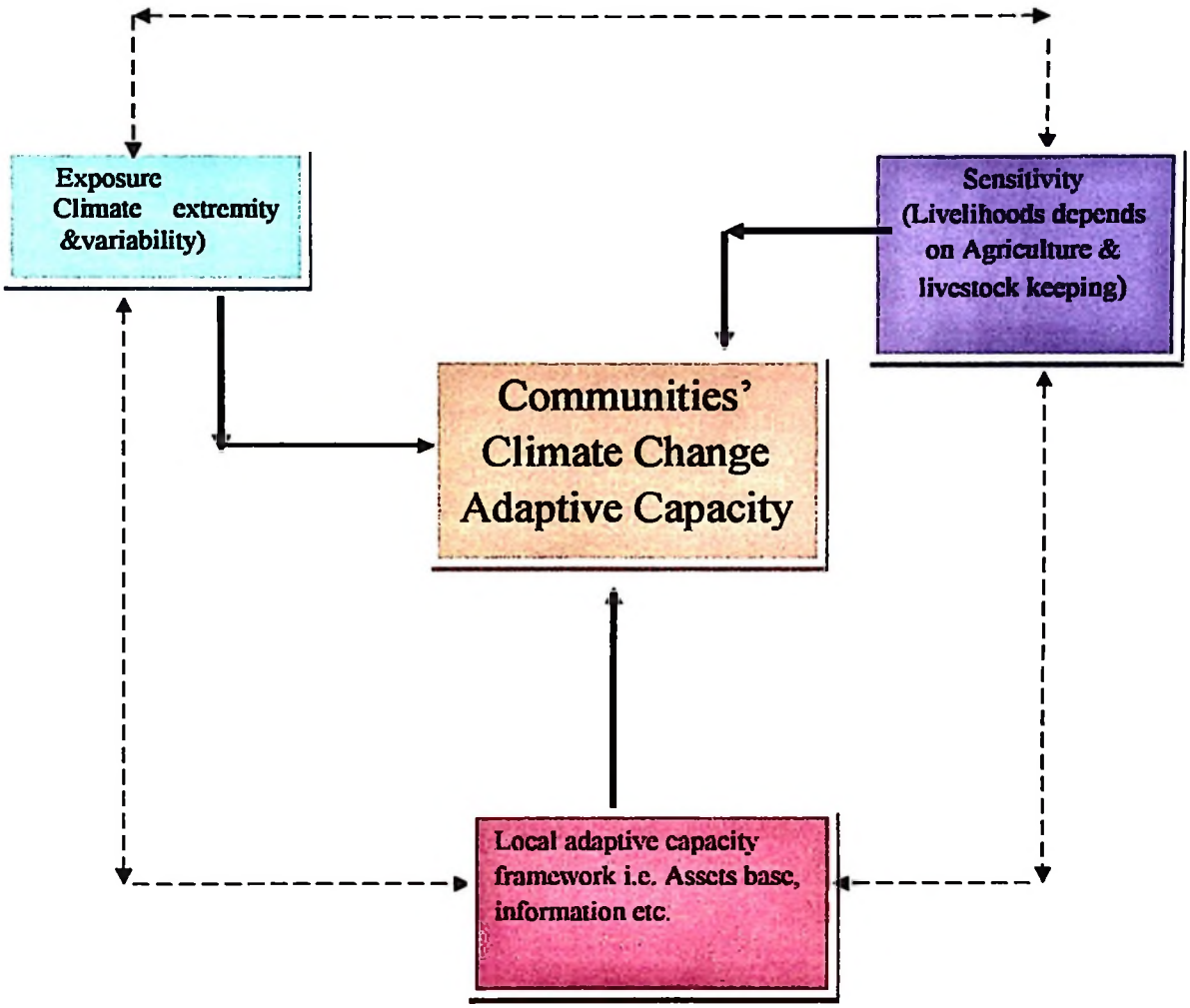

Figure 1: Conceptual Framework

Key ----------▸ **Interrelationship between components that influence adaptive capacity**

Direct influence on community adaptive capacity

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Climate Change Situation in Tanzania

Tanzania is likely to feel the impacts of climate change more than most (Earhart and Twena, 2006). According Agrawala *et al.* (2003), climate change is expected to raise mean annual temperatures by 3-5°C, and average daily temperatures by 2- 4°C and annual rainfall is predicted to increase by 10% in different part of the country especially coastal zone and southern highland. The seasonal variations will become accentuated, with a six percent decline in rainfall between June and August (traditionally the 'dry' season), and a 16.7 per cent increase between December and February (the main rainy season) (Agrawala *et al.,* 2003).

In recent years, climate variability and extremity events observed to mount in Tanzania, such as heavy rains, flood, droughts and strong wind affects peoples' livelihoods in several parts of the country. A vivid example is Morogoro region in Kilosa District which tends to be affected by floods almost every year.

Other parts of the country received little rainfall which resulting to droughts, for example the central part of the country (Dodoma, Singida and Tabora Regions) and in northern parts (Kilimanjaro, Arushia and Manyara Regions) (Initial National Communication, 2003). In southern highland, climate variability has altered planting season calendar. Meanwhile, flooding damaged human settlements, infrastructure, property and livelihoods, and was associated with the spread of malaria; cholera and

diarrhea (Initial National Communication, 2003: 42, IPCC, 2003) and drought impose water shortage, food shortage and massive rural –urban migration.

2.2 Climate Change Adaptation and Adaptive Capacity

2.2.1 Adaptation

The challenges for climate change calls for action to assists vulnerable communities to cope and adapt to climate change and variability. Description of an adaptation requires the specification of who or what to adapt, the stimulus for what the adaptation is undertaken and the process and forms it takes (UNEP, 1998; Pittock *et al.,* 1999). Good adaptation in this sense should be understand as a measure which reduce vulnerability to climate change by means of increasing resilience to the negative impacts of climate change while at the same time promoting goal of sustainable development (Traerup, 2010).

2.2.2 Adaptive capacity

Refer to the potentials, capability, or ability of a system, households or communities to adapt to climate change stimulus or their effect or impacts (IPCC, 2007). Responding to climate change is the one of the principle challenges of our time. The impact of current and project in global and regional climate change have certain to have major implication for ecosystem; physical system and livelihood of those depend on them (Tompkins and Adger, 2004). One of the key components is to guarantee that individual, communities' and societies are actively involved in the process of change (Pattengell, 2010) in the way that relate to changes behavior as much as to resources and technology.

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Adaptation capacities at local level had been a challenge to access due to the interaction of various factors. However, social scientists had developed mechanisms or frameworks which are expected to assessment of guide in assessing climate change adaptive capacity at local level. One of the frameworks for assessing climate change at local level was sustainable livelihood approach, i.e. encompasses five capitals: social, natural, physical, human and financial capital. The approach is used by UK's Departments Foreign and international Development (DFID). The approach mainly looks at how an individual behave under specific frame of condition .The framework encompasses, Asset base (five capitals), knowledge and Information, Institutions and entitlements, innovation and flexible and forward thinking decision making and governance. The underplaying assumption under this framework was that the individual, households, communities, or country endowed with these factors are capable to withstand climatic stress or shock compared to those with less endowed. The major shortfall of these frameworks is that, they do not give clear cut to what extent the communities' or households had low or high adaptive capacity. Thus, Nakuja *et al.* (2012) and Medina *et al.* (2010), generased mechanism of assessing adaptation capacity by creating indexes from framework's variables in which could be ease to judge either a community or household had low or high adaptive capacity by creating standards which are comprehensive.

2.3 Adaptation Cost

One of the challenges of this study is operationalize the definition of *adaptation costs*. The concept is intuitively understood as the costs incurred by societies to adapt to changes in climate. The Intergovernmental Panel on Climate Change (IPCC, 2010)

defines adaptation costs as the costs of planning, preparing for, facilitating, and implementing adaptation measures, including transaction costs. It requires deciding whether the costs of development initiatives that enhance climate resilience ought to be counted as part of adaptation costs.

Bali Action Plan calls for "new and additional" resources to meet adaptation costs; the *report defines adaptation costs as additional to the costs of development.* Consequently, the costs of measures that would have been undertaken even in the absence of climate change are not included in adaptation costs, while the costs of doing more and doing different thing are included (Margulis *et al.*, 2010).

Climate change impact cost studies assumed that, adaptation also should include the "adjustment of costs" of these adaptations (Reilly, 1998). Tol and Fankhauser (1997) provide a comprehensive summary of analysis of autonomous costs (but not exclusively) reactive adaptations, undertaken privately (i.e., not adaptation policies of government). A common basis for evaluating impact costs is to sum adaptation costs and residual damage costs (Fankhauser, 1996; Rothman *et al.*, 1998). Procedures for defining and calculating such adaptation costs are subject to ongoing debate. According to the above mentioned theoretical emphases, this study aimed to estimate the adaptation cost at ground level i.e. household and community level that are taken autonomously without external interventions.

CHAPTER THREE

3.0 METHODOLOGY

3.1 Description of the Study Area

Kilosa District lies between Latitude 5° 55' and 7° 53' South of the Equator and between Longitude 36° 30' and 37° 30' East of the Greenwich. The District is bounded by Kilindi District (Tanga Region) and Kiteto district (Manyara region) to the North; Mvomero district to the East; Kilombero and Kilolo (Iringa Region) districts to the south, Mpwapwa (Dodoma Region) to the west and Kongwa (Dodoma Region) to the south west. The District has total land area of 14 245 km^2.

The study was conducted in four villages namely Kisongwe, Ilonga, Mkundi and Kwambe located in Kilosa district, Morogoro region. It is among the district where pilot REDD+ project were implemented aiming to develop appropriate mechanism on how communities could benefit from their efforts to conserve natural forest. Also the District is vulnerable to the extremity events of climate specifically floods which tends to affects people and their livelihood frequently during rainy season since 1940 to date as reported in Kilosa district council report on evaluation of impact caused by flood in 2010.

3.1.1 Climate

The dominant climate in Kilosa district is warm and wet depending on the season of the year, the temperature is high and humid. The coolest month is June with minimum temperature of 20^0C and hottest month is December to February with the

maximum temperature of 32°C. It has the short and the long rainy seasons. The short rainy season (*Vuli*) is from November to January, and the long rainy season (*Masika*) is from March to May. The area receives average of 1400 and 1100 mm during long and short rainy season respectively (URT, 2012).

3.1.2 Biophysical features

Kilosa District is characterized by flat gently undulating plans covered with sparse vegetation (Miombo woodland) in the low land and thick vegetation in high land. The soils found in the study area evolved and dominated by rocks with intermediate genesis The area characterized by strongly dissected mountains with steep outer slopes, steep foot slopes, broad or narrow valleys and limited plateau crests found in the high altitude (1 500-2 000 m.asl).

The high attitude susceptible to erosion, thus making the lower part of Kilosa District vulnerable to climate events. The undulating to rolling foot slopes (2-10%) of semi-humid plains found in the low to medium altitude (500-1 000 m.asl), The mountainous plateau with dissected, rolling to hilly mountains plateau with a slope range 10-60%. The units are more affected by erosion and are at the medium to high altitude (1 000 – 2 000 m.asl). Soils in these areas are generally well-drained, reddish friable clays, moderately deep-to-deep, red and yellowish red, and yellowish or reddish sand clays to clays with high organic matter content. They are also well-drained deep yellowish or reddish sand clays to clays (KDC, 2007).

3.1.3 Land uses

Crop cultivation, livestock husbandry and forestry are the main land uses in Kilosa District. The District has a total of 138 275 ha of land that are suitable for crop cultivation. About 95% of land in Kilosa District is suitable for agriculture and livestock activities since it has noticeable differences in rainfall amount and pattern, land form, soil types and practices in land use.

3.1.4 Population and socio-economic activities

According to 2012 Population and housing census Kilosa district has a total of 438 175 people of whom 218 378 were males and 219 797 females. Between 2002 and 2012 the District had a population growth rate of 2.7 % per year. According to this growth rate, the District population is expected to double in the next 26 years. Population density is estimated to be 59 persons per km^2.

The main socio-economic activities are agriculture, animal husbandry and business in administrative centers. According to URT (2012), Agricultural sample Census of Morogoro Region, 84.8% of the households are engaging in crop production and livestock keeping and the remaining percent are small business specifically in small Admistrative centers.

3.2 Research Design

3.2.1 Sample size and sampling procedures

A cross sectional research design was used in this study, According to De Vaus (2002), a cross-sectional research design involves collection of information from

representative population sample in one time duration at a single point. The choice of this research design is grounded on the fact that it is more flexible to provide opportunity for onsidering different aspects of a problem under study (Kothari, 2004). Multistage sampling was adopted where by two wards, one with village under REDD+ pilot project and other ward out of the project in Kilosa district were selected. From each ward two villages were purposive selected specially those villages under REDD+ project. A sample frame was villages register and sampling unit was households. In each sampling frame, 30 of households were randomly selected for interview.

3.3 Data Collection and Analysis

3.3.1 Assessment of communities' adaptive capacity to climate change

Households' survey was conducted where each household representative or leader in the sample was interviewed. The tools used in data collection ware semi structured questionnaires and checklist (Appendix 1). The aims were to obtain information on communities' capacity to manage and cope with risk associated with climate variability and change in the context of local adaptive capacity framework (LACF). Depending on the scale and magnitude of the variable, the respondents were required to rank the variables starting from 1-5 score, where, 1 indicate very low, 2 indicate low, up to 5 which indicate very high, as indicated in Table 1. Based on the adaptive capacities of the attribute, the five indices were established.

Table 1: Score level of household, achievement of attribute

Data		Qualitative measure description	Score
Scale	Percent		
0	0	Non	0
1-2	1-20	Very low	1
3-4	21-40	Low	2
5-6	41-60	Moderate	3
7-8	61-80	High	4
9>	81-100	Very high	5

Source: Medina *et al.* (2010)

Qualitative data were coded and quantitative data was summarized then subjected to statistical analysis. The Statistical Package for Social Science (SPSS) version 16 and Microsoft Excel computer programs ware used. The data analysis for household survey data were analyzed by using descriptive statistics and Chi-square. Descriptive statistics, used were frequencies, percentage, measure of central tendency to obtain the magnitude and direction of qualitative variables. Chi-square was used to test the difference of adaptive capacity indices between the villages under REDD+ project and those out of the project. However, the measure of communities' adaptive capacity is normative thus the collected variables were converted into adaptive capacity index which were computed by using the following formulae.

$$\text{Adaptive capacity index (ACI)} = \frac{\text{Total adaptive capacity score}}{\text{Total maximum adaptive capacity}} \quad \ldots\ldots\ldots\ldots (1)$$

$$\text{Average adaptive capacity index (AACI)} = \frac{\text{Total adaptive capacity index}}{\text{Number of observation}} \quad \ldots\ldots\ldots\ldots (2)$$

Table 2 shows categories of adaptive capacity, in which each household or communities fall within. These categories of adaptive capacity indices were modified from Nakuja *et al.* (2012).

Table 2: Degree of adaptive capacity and related adaptation cost

Adaptive capacity	Range of indices	Decision criteria on adaptation
Very low	0< ACI<0.2	Development project(Total cost)
Low	0.2≥ACI<0.4	High adaptation cost
Moderate	0.4≥ACI<0.6	Minimum adaptation cost
High	0.6≥ACI<0.8	Low adaptation cost
Very high	0.8≥ACI≤1.0	Very low adaptation cost

Source: Modified from Nakuja *et al. (2012)*

3.3.2 Assesment of communities adaptation strategies to climate change

Primary and secondary data under this objective were collected; the primary data were collected through interviewing respondents based on checklist with arranged categories of adaptation strategies under different climate stress (Appendix 1). The households survey and focus group discuss methods were used to collect information on communities adaptation strategies. The secondary data were collected through reviewing project documents, and Consultancy reports of Tanzania Forest Conservation Group (TFCG) and MJUMITA, Morogoro Region Agricultural Sample Census (RASC) and District Agricultural Development Programme (DADPs).

Data were analysed by means of Mult responses analysis for household's adaptation strategies to climatic change and variability where descriptive statistics, such as frequencies and percentage were generated to determine distribution and magnitude

of variables among the households. In order to explore the variation on coping strategies between villages, chi-square was also used to test the significance of variation between villages.

3.3.3 Assessment of adaptation cost to communities due to climate change

Data collections methods used under this objective were key informant interview and market based approach. The key informant interview involved the following: Kilosa District agricultural, livestock, natural resource and economics officers and village or ward leaders (VEO/WEO). These informants helped the researcher to obtain accurate information on amount of inputs or resources that were necessary for a particular adaptation strategy. Marketing approach method was done by visiting various Agro chemical stores and shops in Kilosa and Morogoro Urban. The informations that were collected through this approach were mainly market price of various inputs which enabled to quantify cost for particular adaptation strategy.

The quantative data from different adaptation measures were computed by using Microsoft excel programme. The formulae below were used to estimate the cost needed to improve household capacity to cope with climate change and variability. In this formulae communities adaptive capacity (AC) index was used as smoothing factor which depending on factor under consideration i.e. the use of fertilizer, Pesticide and the total cost (TC) in this case refer the cost of interventions without considering adaptive capacity and the cost needed to enhance adaptive capacity (CI) which obtained through subtract Total cost (TC) with smoothed total cost ($TC_a x AC_a$).

$TC_a = A_1 x A_{ra} x MP_s$ .....(3)

$CI_a = TC_a - (TC_a x\ AC_a)$ .....(4)

$CI_a = TC_a\ (1 - AC_a)$ .....(5)

Whereby;

TC=Total cost for particular copping strategy

CI= Adaptation cost needed to improve household adaptive capacity

AC=Household/communities adaptive capacity

A1=Copping strategy variable

Ar =Amount or quantity of material needed for a particular intervention

a =Adaptation strategy

Mp =Actual market price for a particular quantity

CHAPTER FOUR

4.0 RESULTS AND DISCUSIONS

This chapter presents results and discussion of the study. The results are divided into five sub-section; household characteristics, communities perception on climate change and variability, communities' adaptive capacity, adaptive strategies to climatic change and costs of adaptive strategies.

4.1 Household Characteristics

4.1.1 Age

The findings in Table 3 shows that; about 83% of the respondents were within the age group of 3 1 to 64 years, whereby 13% were below 30 years and 3% were above 64 as presented. This implies that most of the household were in the economically productive age and have been in the area for more than 30 years so they have greater experience on the previous and existing climatic condition, and the adaptation measures that they adapt as climate keep on changing. According to Mandrata (1998) and Mtenga (1999) quoted by Mtui (2004), household members are considered economically productive from the age of 16-64 years. The age below 16 years are children whom some attend to school and some too young to participate in economic activities. The group above 64 years is considered less economically active. Adesina and Baidu (2003) also reported that, active age group have more experience and are able to access of new technologies/ideas.

4.1.2 Sex

Table 3 presents the distribution of respondents based on sex. The figure indicates that, a large proportion (52.3%) of respondents interviewed comprised of men, while women comprised only 47.5 %. The minor discrepancy between male and female response indicates that there isn't more gender segregation in terms of owning households among the surveyed villages and Kilosa communities as a whole.

4.1.3 Marital status

Respondents were asked to state their marital status based on whether they are married, single (not married), widow or widower. The study found that, about 91.7% of the population were married, the rest were divorced, single and widowers. The larger percent of population in marriage point toward higher social or family stability within communities, hence expected less vulnerable to climate stressors.

4.1.4 Education

The study findings in Table 3 show that, majority (81%) had primary school level of education, followed by those with higher education level. The repercussion of these results is that in each household, there is one or more members who can read and write. The result does not indicate the level of illiteracy because the intension was to know the highest level of education within the household and not individuals that is why the entire population seems to have certain level of formal educatition. Nelson and Phelps (1996) reported that, the presence of members in household with formal education, act as a vehicle for spreading skills and knowledge among household members and can make easer for the households to analyses things in deep.

Education is always valued as a key to life. Also it is perceived as a means of deliverance from ignorance and which enables one to perform effectively to any given task within a specified period of time (Kasanga, 2005).

Table 3: Household Demographic characteristic (n=120)

Variables	Kwambe	Mkundi	Ilonga	Kwambe	Total
Age of respondent					
Below 30 year	9(29.8)	1(3.3)	5(16.5)	3(9.9)	18(14.1)
Between 30 to 64	20(66.9)	28(93.4)	23(76.9)	26(86.8)	97(82.4)
Above 64	1(3.3)	1(3.3)	2(6.6)	1(3.3)	5(3.5)
Sex of respondent					
Male	17(56.7)	18(60.0)	14(46.7)	14(46.7)	63(52.5)
Female	13(43.3)	12(40.0)	16(53.3)	16(53.3)	57(47.5)
Marital status					
Single	3(10)	0(0)	0(0)	0(0)	3(2.5)
Married	26(86.7)	28(93.3)	27(90)	29(97.7)	110(91.6)
Widow	1(3.3)	0(0)	1(3.3)	0(0)	2(1.7)
Divorced	0(0)	2(6.7)	2(6.7)	1(3.3)	5(4.2)
Education Level					
Primary	27(90)	23(76.7)	23(76.7)	24(80)	97(81)
Secondary	3(10)	7(23.3)	6(23.3)	5(16.7)	21(17.5)
College/University	0	0	1(3.3)	1(3.3)	2(1.5)
Total	**30**		**30**	**30**	**120(100)**

Note: The values in the blanket are percent and outsides are frequencies

4.1.5 Household income

Table 4 reports household's average income per month. It was noted that, about 62.5% of the respondents had an income between TZS 100 000 and 200 000 per month which described as low level of income while only 20% had income less TZS 100 000 per month which indicate very low income as compared to standard head

count ratio TZS 240 000 which is below poverty line. However both were under poverty line. The rest of the findings indicate households whose income level is above poverty line and assumed to be able withstanding climate stressors which count about 17.5% of the surveyed households. The implication of the findings is that; majority of the households in the study site were living under poverty line which implies that they were not able to make saving for other socio-economic investments hence more vulnerable to climatic stressor. According to Jones *at el.*, 2010, "financial capital includes income play greater roles in social protection during climate change and variability. The household with high saving are more resilient to negative impact of climate change".

Table 4: Household income levels per month (n=120)

Data(Tsh)	Description	Kwambe	Mkundi	Ilonga	Kisongwe	Total
<100,000	Very low	1(3.3)	9(30)	7(23.3)	7(23.3)	24(20)
I00,000-200,000	Low	23(76.7)*	18(60)	15(50)	19(63.3)	75(62.5)
210,000-300,000	Moderate	4(13.3)	1(3.3)	6(20)	3(10)	14(11.7)
310,000-400,000	High	1(3.3)	2(6.7)	2(6.7)	1(3.3)	6(5)
400,000>	Very high	1(3.3)	0(0)	0(0)	0(0)	1(0.8)
Total						**120(100)**

Note: Classification criteria based on Head count ratio per month which is TZS 240 000/=
Note: The values in the blanket are percent and outsides are frequencies

4.2 Main Socio-Economic Issues of the Study Site

4.2.1 Economic activity

Table 5 reports various socio-economic activities conducted in the study site. The extent to which household involve in various activities varies considerably from

household to household mainly depending on the social economic conditions of households. The results revealed that majority (82%) of surveyed households were crop producers and there were large number of households practicing agro-pastoralism compared to pure pastoralism. Low diversification of livelihood increases vulnerability to climate change and variability stressors. Traerup (2010), reported that "changing of climate had influenced community to change their original economic activities including shifting from pure pastoralism to agro-pastoralism".

Table 5: Main Economic activities (n=120)

Main activities	Kwambe	Mkundi	Ilonga	Kwambe	Total
Farmers	18(60)	25(83.3)	30(100)	25(83.3)	98(82)
Agro-pastoralist	9(30)	5(16.7)	0	5(16.7)	19(15.8)
Pastoralist	3(10)	0(0)	0	0	3(2.5)
Total	**100**	**100**	**100**	**100**	**100**

Note: The values in the blanket are percent and outsides are frequencies

4.2.2 Household livelihoods diversification

Table 6 indicates proportionality of different source of income among the surveyed household. The results illustrate that majority of households depends on agriculture as source of income, because had higher contribution of 43.6% followed by petty business and livestock products as indicated in Table 6. The households with more diverse source of income are said to be resilient to the impact of climate change and variability. Also the households, whose sources of income mainly depend on agriculture, are more vulnerable to the negative impact of climate change. Therefore, as the research finding illustrated as many of the households depends on Agriculture

than other of farm activities, community were less resilient to the climate change and variability (Treaps, 2010).

Table 6: Households source of income (n=120)

Source of income (livelihood diversification)	Responses		
	Frequency	Percent	Percent of Cases
Agricultural product	116	43.6	96.7
Horticultural product	23	8.6	19.2
livestock product	43	16.2	35.8
Forest product	22	8.3	18.3
Non forest product	4	1.5	3.3
Petty business	47	17.7	39.2
Causal labour	11	4.1	9.2
Total	**266**	**100.0**	**221.7**

4.2.3 Crops types, land size and productivity

Table 7 reports findings which shows main crops produced in the study site, land size and crops production per hectare. The main crops produced were Maize, Rice, Millet, Pigeon peans, and Beans, Sunflower, Cassava, ginger, sweet potatoes and others. Over 90% of the sampled households were Maize producer. Other crop grown was Beans followed by Rice and other were indicated in Table 6. The average land size per crop indicate that, Maize had higher average land size per ha (2.41 ha) compared to others. Ginger had lowest average land size (0.4 ha), because communities were not familiar except in the villages where REDD+ project was implemented which was an initiatives to increase crop diversity so as they can

withstand climatic shocks. Crop productivity was very low. Most households produces almost 616 kg/ha of Maize as indicated in Table 7 compared to standard productivity of 2 000kg/ha -2 500kg/ha (FAO report crops yield in Tanzania, 2003).

It has been reported that, low use of appropriate agricultural inputs among farmers; inadequate rainfall, pest and diseases causes low yield to all crops in the Kilosa District. However, the villages under REDD+ initiatives were given special training which among other aims is to enhance crop productivity through on farm training school. The training involves conservation agriculture; influence the use of organic and inorganic fertilizer together with improved crops seed varieties. Not only that but also District Agricultural development program (DADPs) plays a greater roles to enhance small scale farmers to enhance crop productivity through various initiatives i.e. subsides on agricultural equipment, seeds and fertilizers.

Table 7: Crops type, land size and productivity (n=120)

Crops	Land size (ha)				Productivity per ha	
	Grower	%	Mean	Std. dev	Mean	Std. dev
Maize	111	92.5	2.41	1.53	616.20	198.00
Rice	25	20.8	1.70	0.80	933.60	253.90
Millet	13	10.8	0.92	0.67	305.30	125.27
Beans	56	46.7	1.20	1.33	375.00	133.8
Pigeon peas	23	19.2	1.06	0.45	348.00	59.31
Ground nut	21	17.5	0.98	0.51	-	-
Sun flower	34	28.3	1.06	0.43	275.90	118.80
Sesame	20	16.7	1.38	0.99	273.00	90.88
Cassava	18	10.5	1.03	0.68	4.67bag	1.75
Ginger	17	14.2	0.44	1.10	3.11bag	0.69
Sweet potato	5	4.2	1.00	0.61	4.00bag	1.58

4.2.4 Household crops diversity

The findings in Table 8 indicates that, in villages (Ilonga and Kisongwe) under REDD+ pilot project, most of the households produce more than two crops which is about 45% of the surveyed households and less households producing single crops which is 23.3% of the surveyed households, therefore, most of the households in the villages under REDD+ project have moderate and low crops diversity while in the villages (Mkundi and Kwambe) with no REDD+ it's inverse as indicated in Table 8. The variation in crop diversity influenced by REDD+ project initiatives due to training and introduction of new crops to project site as well as conservation incentives to communities'. According to Joan *et al.* (2013), growing number of different crops on the same plots or different plots reduce the risk of complete crops failure as different crops are affected differently by climate events. Therefore, the households growing more than two crops expect to have higher adaptive capacity to climate stressor.

Table 8: Household crops diversification (n=120)

No: Crops/hh	Description	Kwambe	Mkundi	Total	Ilonga	Kisongwe	Total
		No REDD+ Project			REDD+ Project		
0-1	Very low	9(30)	12(40)	**21(35)**	11(36.7)	3(10)	**14(23.3)**
2	Low	4(13.3)	1(3.3)	**5(0.83)**	1(3.3)	3(10)	**4(6.7)**
3	Moderate	14(46.7)	10(33.3)	**14(23.3)**	14(46.7)	13(43)	**27(45)**
4	High	1(3.3)	5(16.7)	**6(10)**	4(13.3)	11(36.7)	**15(25)**
5>	Very	2(6.7)	2(6.7)	**2(3.3)**	0	0	**0(0)**

Note: the values in the blanket are percent and outsides are frequencies

4.2.5 Households' technological adoption

Table 9 represents number of technologies adopted by households. The finding shows that, 38.6 % of the surveyed households were practicing modern farming, followed by soil conservation practice (23.7%) and the use of improved seed varieties which is 19.9% of the surveyed households and the rest were indicated in Table 9. Technological capacity in adaptation to climate change plays greater roles in making communities capable to withstand climatic shock. Repercussion of these results is that there are small numbers of households capable to adapt to these technologies. However, there are various factors hindering the adoption i.e. lack of extension services, poverty and conservativeness of the communities.

Table 9: Knowledge on adaptation (n=120)

Households knowledge on	Responses		
	Frequency	Percent	Percent of Cases
Modern farming practice	91	38.6	91.0
Modern livestock keeping	28	11.9	28.0
Rain water harvesting	5	2.1	5.0
Modern crops storage for future use	3	1.3	3.0
Use of improved seed verities	47	19.9	47.0
Soil conservation	56	23.7	56.0
Improved irrigation techniques	6	2.5	6.0
Total	**236**	**100**	**236.0**

4.2.6 Access to financial and other social services

4.2.6.1 Accessibility to micro credit or social network

The findings in Table 10 shows that, the civil sociaty organization encompassed in the study area were; SACCOS and Village loan and Saving (VLS). In Kwambe Village, all respondent report that there is no any organization in the village where Mkundi all respondent were aware on the availability of organizations but only 56.7% of the respondents were members of the organization. In a case Ilonga village, 93.3% of the respondent reported the availability and only 10% of the respondent or surveyed households were members of the organizations. For the case of Kisongwe, 83.3% of respondents report the availability of the organization and only 16.7% are members of the organizations. The presence of social networks or Village loan and Savings plays greater roles on communities' resilience to climate change and variability since communities help each other during stress and also enhance household servings Traerup (2010).

Table 10: Micro credit institutions (n=120)

Variables/Village	Kwambe	Mkundi	Ilonga	Kisongwe	Total
	No REDD+ Project		REDD+ Project		
Availability of organization					
Available	0	30(100)	28(93.3)	25(83.3)	53(44.2)
Not available	30(100)	0	2(6.7)	5(6.7)	67(55.8)
Membership					
Members	0	17(56.7)	9(10%)	5(16.7)	31(25.8)
Not Members	30(100)	13(43.3)	21(90%)	25(83.3)	89(74.2)
Type of organization					
SACCOS	0	0	28(93.3)	0	28(23.3)
Village Saving and Loan	0	30(100)	2(6.7)	25(83.3)	55(45.8)
Not existing	30(100)	0	0	5(16.7)	37(30.8)

Note: the values in the blanket are percent and outsides are frequencies

4.2.6.2 Water source

The result in Table 11 reports various kinds of water sources and average distance households take to fetch water. About 93.3% of the households in Kwambe village obtain drinking water from bore holes. In Ilonga village 70% obtained drinking water from both bore hole and nearby river. Distance to the water sources was cited to be very important to the most household interviewed. In Kwambe village, about 50% of the households were walked more than 1km to obtain drinking water and in Ilonga and Kisongwe about 70% people were walking more than 500 m but less 1km to obtain water. Therefore, availability of permanent water sources enhance community to withstand climate shocks but distance discourages people because they invest most of their time for fetching water rather than engaging in other socio-economic activities hence increase vulnerability of communities to climate change.

Table 11: Source of water and distance (n=120)

Variables/Village name	Kwambe	Mkundi	Ilonga	Kisongwe	Total
	No REDD+ Project		REDD+ project village		
Source of water					
River	1(3.3)	25(83.3)	4(13.3)	0	30(25)
Deep well	28(93.3)	5(16.7)	5(16.7)	0	38(31.7)
Both river and deep well	0	0	21(70)	0	21(17.5)
Spring	1(3.3%)	0	0	30(100)	30(25)
Distance from HH to Source of water					
100m>-< 500m	3(10)	7(23.3)	6(20)	9(30)	25(20.8)
500m>-< 1km	12(40)	14(46.7)	18(70)	21(70)	65(54.2)
>1km	15(50)	9(30)	6(20)	0	30(25)
Total	**30**	**30**	**30**	**30**	**120(100)**

Note: The values in the blanket are percent and outsides are frequencies

4.2.7 Ownership of productive tools

The fundings in Table 12 indicate that, Kisongwe village had a large propositional households using hand hoe compared to the rest of villages under the study. Ilonga village had a higher proportional of households using a mixture of hand hoe and tractor for agriculture activities. The ownership or using tractors for land preparation is assumed to enhance capacity of household to cope with climate change and variability in case of early or delay of rains. Since the study site had large number of households using hand hoe for agricultural activities the capacity is very low and vulnerability climate variability is high.

Table 12: Ownership and access to productive assets (n=120)

Equipment/Villages	Kwambe	Mkundi	Ilonga	Kisongwe	Total
	No REDD+ project			REDD+ project	
Hand hoe	23(76.7)	20(66.7)	20(66.7)	30(100)	**93(77.4)**
Tractor and hand hoe	5(16.7)	8(26.7)	10(33.3)	0	**23(19.2)**
Plough and hand hoe	0	2(6.7)	0	0	**2(1.7)**
Non	2(6.7)	0	0	0	**2(1.7)**
Total	**30**	**30**	**30**	**30**	**120(100)**

Note: The values in the blanket are percent and outsides are frequencies

4.3 Climate Change Situation in the Surveyed Villages

4.3.1 Climate change fact and communities perception

The respondents were asked to give out their perception on the climate trend on the past ten years. Amount of precipitation, temperature and duration of dry and wet seasons were used used to assess household perception on climate change. Result indicated in Table 13 shows that there is decline in the amount of precipitation as compared to the past. About 97.5% of the responds experienced an increase in temperature. In the case of duration of dry and wet seasons in a year, respondents experienced the increased /prolonged in duration of dry seasons and short/decline in duration of wet season in the past ten years. These results suggest that respondents were more likely to make links between warming temperatures and climate change, but not attribute perceived changes in rainfall amounts and variability to climate change. According to Msalilwa *et al.* (2013), the main factors that influence communities' perception to climate change are age, education and residence to the particular locality.

Table 13: Communities' perception on climate change (n=120)

Variable	Frequencies	Percent
Amount of precipitation		
Increased	0	0.00
Moderate	0	0.00
Decreased	120	100.00
Temperature		
Increased	117	97.50
Moderate	3	2.50
Decreased	0	0.00
Duration of dry Season		
Increased	120	100.00
Moderate	0	0.00
Decreased	0	0.00
Duration of wet season		
Increased	0	0.00
Moderate	0	0.00
Decreased	120	100.00
Total	**120**	**100.00**

4.3.2 Common climatic problems facing communities

The results in Table 14 are mult-responces analysis results on common problems facing Kilosa communities. All respondents in both villages consistently reported drought as the main environmental stressor that adversely affects households' livelihoods. Other stressors reported were pest (97.5%) and diseases outbreak (25.8%). These problem affected crops, livestock and human being especially malaria, water borne diseases and skin diseases. One of the key informant said:

> "*there has been increase in pest and diseases due to the increase in temperature or warming for insistence stalk borers, which attack Maize, Sorghum and Rice, Armyworms were reported to be a major problem in Rice, Maize and Millet*".

In all Villages, qualeaqualea birds also reported to affect Millet, Rice and Sunflower. Climatic elements determine the occurrence and location of pest and diseases appear to be moisture and temperature (Dejene *et al.*, 2011). Generally, pest and diseases vector, do better when the temperature is high under condition of optimal water supply.

Strong wind and floods were reported but not as main stressor in the study area as it reported by few respondents as indicated in Table 14 that, only 2.5% of the respondent faced flood problem and 28.3% of the respondents faced the problem of strong wind in their localities. However, Kilosa district is an area which is vulnerable to flood occurrence, but the result indicate few respondents that faced such problem, this result is mainly influenced by location of the sampled villages that were not under vulnerable areas.

Table 14: Common climate related events facing communities (n=120)

	Responses		
Problems facing communities	**Frequency**	**Percent**	**Percent of cases**
Drought occurrence	120	39.3	100.0
Strong wind	34	11.1	28.3
Flood occurrence	3	1.0	2.5
Pest occurrence	117	38.4	97.5
Diseases out break to both livestock and crops	31	10.2	25.8
Total	**305**	**100.0**	**254.2**

4.4 Households' Climate Change Adaptive Capacity Indices

Table 15 shows some outputs from each adaptive capacity index. The indeces were driven from various determinants of adaptive capacity to climate change. The determinants that were used to develop adaptive capacity index are economic capacity, technological capacity, access of social services, crop diversity and social capacity as Illustrated in Table 15. The adaptive capacity were ranked from very low, low, moderate, higher and very higher depending on the level of scale which ranges from 0-1. The results in Table 15 indicate that the adaptive capacity varies from village to villages and with determinant also.

The adaptive index for Mkundi village was higher (0.48) compered with other village. Other village adaptive capacity were 0.38, 0.31 and 0.3 for Ilonga, Kwambe and Kisongwe respectively. In this case, only Mkundi village had moderate economic capacity while the rest falls under low economic capacity. This fact influenced by the presence of social network in Mkundi village which act like Village loan and saving groups (VLS) compared to other villages. Households who were members in these social groups to make savings and apply for loans as per their rules and regulations. However, in other cases there is no greater variation but Kisongwe village which is within REDD+ pilot project shows the lowest indexes as shown in Table 15. These findings supported by Smit *et al.* (2001) presence of institutions are key determinant of adaptive capacity ie "well-developed social institutions or networks help to reduce impacts of climate-related risks, and therefore increase adaptive capacity." In case of social services as indicated in Table 15, Ilonga village had higher index of 0.6 compared to Mkundi and Kwambe villages which had

indeces of 0.48 and 0.45 respectively which ranges in moderate adaptive capacity and Kisongwe had lowest index of 0.4 which fall in low adaptive capacity indexes range. The variation of indexes pertaining to social services influenced by location of each village where Ilonga is located few kilometer to District head quarter while Kisongwe is about 60 km away from the main administration unit. Thus, accessibility of social services in Ilonga village is in satisfactory condition compared to other villages.

Technological capacity, this was measured through assessing knowledge diversity and innovation capacity of communities. The result revealed that Mkundi village had higher average adaptive capacity index of 0.6 followed by Kisongwe with an index of 0.47 which are both under moderate range of adaptive capacity. Kwambe and Ilonga villages had adaptive capacity index of 0.31 and 0.4 which both fallow under low adaptive capacity index range. Higher index on Kisongwe village influenced by the implementation of REDD+ project which among the aims of the project was impart local people with technical skills which enable them to enhance crop productivity and hence resilience to the negative impact of climate change. For the case Mkundi village there is other project conducted by USAID Tanzania on improving agricultural productivity to rural communities. Therefore, through these project people were adopting the technology.

Ownership of productive assets specifically agricultural tools and natural capital example land was assessed to determine household capacity to withstand climate change. The results in Table 15 indicate that all villages had moderate capacity due

to ownership of various physical and natural capitals but Mkundi showed lowest index. Smit *et al.* (2001) revealed that "equitable distribution of resources increases adaptive capacity" and that "both availability of, and entitlement to, resources is important."

A social capital was among the determinants of household capacity to withstand climate stress. Family dependent ratio and family labor were used to determine social capacity of household. Household with high dependent ratio had low adaptive capacity and vice versa. Also the households with very high labor force has higher adaptive capacity to climate change. The result Table 15 indicates that households in Kwambe village had higher social capacity with an index of 0.58, followed by Ilonga, Kisongwe, and Mkundi with indexes of 0.55, 0.53, and 0.49 respectively. But all of these villages had moderate adaptive capacity since the indexes fallow under moderate range of climate change adaptive capacity as presented in (Table 2). Further results in Table 15 indicate crops diversity index which reflect the average number of agricultural crops produced per household. The findings indicate that Kisongwe had higher crops diversity index of 0.61 which ranges within higher adaptive capacity to climate change followed by Mkundi, Kwambe and Ilonga village with indexes of 0.49, 0.47 and 0.27 respectively. Both Mkundi and Kwambe had moderate adaptive capacity and Ilonga village had low adaptive capacity to climate change. The implication of these results is that the households which produce more than two crops are said to be more resilient to the negative impact of climate change compered to single crops producer household.

Table 15: Average climate change adaptive capacity indexes

Determinants	Indicators	Indexes			
		Kwambe	Mkundi	Ilonga	Kisongwe
		No REDD+ project		WithREDD+project	
Economic	Household Income	0.45	0.37	0.43	0.39
	Household Income source*	0.49*	0.5	0.42	0.33
	Access Micro credit services	0*	0.57	0.30	0.17
	Average	**0.31**	**0.48**	**0.38**	**0.30**
Access of social	Access to Hospital post	0.41	0.51*	0.45	0.2
services	Source of drinking water**	0.59	0.27	0.69	0.20
	Access to extension service*	0.40	0.47	0.48	0.51*
	Information*	0.4	0.65	0.69	0.60
	Average	**0.45**	**0.48**	**0.6**	**0.4**
Technology	Knowledge diversity*	0.21	0.49	0.35	0.5
	Innovations	0.4*	0.63*	0.4*	0.43*
	Average	**0.31**	**0.6**	**0.4**	**0.47**
Ownership/Equity	Productive assets *	0.24	0.32	0.35	0.20
	Private land ownership **	0.83	0.82	0.67	0.89
	Average	**0.54**	**0.57**	**0.51**	**0.55**
Social	Dependent ratio	0.62	0.49	0.69*	0.65
	Family labor	0.53	0.48	0.41	0.41
	Average	**0.58**	**0.49**	**0.55**	**0.53**
	Crop diversity *	0.47	0.49	0.27	0.61

Note: The distribution differ significantly between villages (level of sign *P>0.05 or **P≤0.01

4.5 Household Aadaptation Strategies to Climate Change

A number of adaptation options were mentioned by respondents. The options were classified into three groups: agricultural and water management practice, farms and crop management adjustments and diversification beyond the farmer as shown in Table 16. Analysis of the frequencies of these practices based on the household survey showed that most of the households were already using practices from all three categories. However, the frequencies differed from village to another.

4.5.1 Agricultural and water management practice

The options practiced include irrigation, rainwater harvesting and construction of water reserves and water wells. About 60% of households were practicing irrigation in Ilonga village. Over 13% of the households in Mkundi practiced rainwater harvesting which helped during water stress or dry period. The access to water pump was reported by only 3.3% of the respondents in Ilonga. The water pump were used during dry period for irrigation. This difference can be explained by contracting biophysical condition of the study site, that Ilonga village is crossed with river Mkonda which enable farmers to utilize water resources for irrigation while in other villages there are hardly any permanent water bodies only occupied by seasonal rivers.

4.5.2 Farmer and crops management adjustment

The most affordable adaptation strategy in this category were, planting drought tolerant and fast mature crops, which were highly practiced in Kwambe and Mkundi villages. Other adjustments include modern farming, especially in Ilonga, Kisongwe and Mkundi villages. About 83.3% of households in Kisongwe were practicing soil conservation techniques, i.e. 'fanya juu fanya chini', crop rotation and mixed farming practiced in Ilonga and Mkundi as shown in Table 16. Application of organic and inorganic fertilizers was less adopted in both villages except in Ilonga village. The other options that adopted by household to cope with the problem of pest and disease were integrated pest and diseases control by using chemicals (pesticide) which practiced mainly in Mkundi, Ilonga and Kisongwe where 76.3%, 33.3%, and 23.3% of households were applying chemicals respectively. The other strategy which

geared control diseases to livestock was vaccination to livestock but only 11.3% of household in Mkundi village were practiced. Research finding identified some adaptation strategy which had negative impact to the environments, here are few strategies that were applied in the study area; shifting cultivation, which accelerate forest degradation. Bushfire as land preparation tool, Bottom valley, particular practice in Kisongwe the practice is conducted near water sources, which is against environmental roles and regulation. The other cropping strategy due to pasture shortage during drought is encroachment to the protected area or unauthorized area for grazing.

4.5.3 Diversification beyond farming

Only three adaptation strategies in this category were practiced in the course of household to adapt to climate change and variability. Apart from farming, petty business, natural resources and casual/ wage labour were practiced in the study area but the magnitudes varies between the villages as indicated in Table 16. Petty business like small shops (Kiosk) and Mama lishe was highly practiced in Ilonga village followed by Mkundi in which about 40% and 13.3% of households were practiced respectively. In Kwambe, only 3.3 % of household practiced petty business while in Kisongwe there is no such business at all. The difference of the findings on diversification beyond the famer can be explained by location factor of villages under concern. Ilonga village is located near District head quarter compared to Kisongwe which is located about 60 km from the district headquarters thus there is less households engaging in petty business in Kisongwe than in Ilonga Village. Charcoal fire wood collection and beekeeping were practiced in Kwambe and

geared control diseases to livestock was vaccination to livestock but only 11.3% of household in Mkundi village were practiced. Research finding identified some adaptation strategy which had negative impact to the environments, here are few strategies that were applied in the study area; shifting cultivation, which accelerate forest degradation. Bushfire as land preparation tool, Bottom valley, particular practice in Kisongwe the practice is conducted near water sources, which is against environmental roles and regulation. The other cropping strategy due to pasture shortage during drought is encroachment to the protected area or unauthorized area for grazing.

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Kisongwe with 17.7% and 16.7% proportional of households respectively. This explained by the factor that these villages are endowed with community forest where they are able to extract such resources. Also, during dry period some households engage in casual labor activities in order to subsidize household income.

a. Valley bottom farming land

b. Bush fire as means of preparation

Plate 1: Farming system in Kisongwe at Kilosa District

Table 16: Households adaptation strategies (n=120)

	Adaptation practice	NO REDD+ Project		REDD+ Project village	
		Kwambe	Mkundi	Ilonga	Kisongwe
	Agricultural and water management practice				
1	Public irrigation structure*	0	6.7	60	3.3
2	Use of water pump	0	0	3.3	0
3	Construction of water reserve	0	0	0	0
4	Rain water harvesting	0	13.3	3.3	0
	Adjustments of farmer and crop - management				
5	Planting drought tolerant and early mature crops*	53.3	76.7	43.3	30
6	Practice modern farming	53.3	76.6	76.6	96.7
7	Practice modern livestock keeping*	16.7	23.3	20	33.3
8	Agro forestry (agro pastoral)	30	16.7	0	16.7
9	Soil conservation practice	3.3	73.3	26.7	83.3
10	Use of integrated pest and diseases control	0	76.7	33.3	23.3
11	Crop rotation*	23.3	40	56.7	13.3
12	Mixed farming*	46.7	60	56.7	40
13	Shift cultivation*	0	6.7	3.3	3.3
14	Apply farm yard manure*	0	6.7	13.3	3.3
15	Apply inorganic fertilizer*	0	0	60	3.3
16	Vaccination to livestock	0	11.65	0	0
17	Valley bottom farming	0	0	0	15
18	Encroachment to protected area for grazing	20	0	0	0
19	Changing planting and harvesting calendar*	45.5	24.4	57.6	2.3
	Diversification beyond the farmers				
20	Business (Petty business)*	3.3	13.3	40	0
21	Natural resources(forest &non forest, fish & others)	17.7	0	0	16.7
22	Causal work	10	10	10	6.7

Note: the distribution differ significantly between both villages ($p < 0.01$)

4.6 Adaptive Cost Estimation

Only adapatatition measures linked to livelhoods was considered in adaptive cost estmation in this study. However, the costs estimated were not the total economic adaptation cost rather was only the cost needed to improve household capacity to use different interventions that enhance to overcome the negative impact of climate change and variability. The costs estimated were for use improved Seed varieties, Inorganic fertilizers, Pest control, treatment of livestock and vaccination. The assumptions underlying the estimation of adaptation cost shown in summary in Table 16 is that, the households produce all crops, keep all livestock, uses fertilizer to all types of crops and had similar land size. Appendices from 4 to 9 show the details of each adaptation strategy.

4.6.1 Cost for improving households capacity to use improved seeds varieties

The cost needed for improved seed variety to enhance crop productivity and resilient to climate change summarized in Table 17 and detailed in Appendix 5. The results indicate that for the household to be capable of using improved crops seed varieties had to use TZS 335 200 without considering adaptive capacity and TZS 236 636 with consideration of average household adaptive capacity. The difference between total cost and adaptive cost can be explained by Fankhauser (1998) that "the lower adaptive capacity the higher adaptation cost".However, the household can incur the initial cost of buying seed and can continue to produce seed in his or her own farm. Examples of crop seeds that can be reproduced by farmers are Maize, Bens and Cassava.

4.6.2 Cost needed to improve households in the use of inorganic fertilizers

The results in Table 17 indicate the cost for improving household capacity to use inorganic fertilizer. If the households decide to apply fertilizer to all crops it produces, the household is expected to incur cost of TZS 1 024 900/= and TZS 768 800/=Tsh for phosphorus and ammonium respectively. Regarding available capacity of households the adaptive cost which is TZS 862 965/= and TZS 723 078 for phosphorus and ammonium respectively. However, if the farmer decides to do otherwise, the adaptive cost will differ considerably as indicated in Appendix 7.

4.6.3 Cost needed to improve households to control pest and crops storage

The broad-spectrum pesticide had been selected as a base to estimate the relative cost needed per household to control the problem. The cost had been calculated under the assumption that the farmer produces all crops and uses the pesticide. If the household use the pesticide to all crops it could incur the following cost TZS 400 200/= and TZS 389,460/= as a total and adaptive cost respectively. In this case, the difference between the total and adaptive costs is because the capacity of the household to use pesticide to control pest is very low.

The results in Table 17 indicate that, total cost and adaptive cost had little difference because of very low adaptive capacity of the communities to use storage chemical. The total cost for using pesticide was TZS 64 452.2/=Tsh for Acelic super dust and adaptation cost was TZS 63 367.1/=. The estimates was under assumption that household produce all crops indicated in the Appendix 7 and store them by means of chemicals and if the farmer decide otherwise, the cost will vary considerably as

indicated in the Table 17. Therefore, the use of crops storage pestcide plays crucial roles to the household's resilience to climate change by store crops for a long time and make use for household consumption or otherwise for selling when the price for crops is high hence big returns from agriculture.

4.6.5 Cost for improving households capacity vaccinate and treats livestock

Appendix 8 show various common diseases and pest that affect livestock, various vaccination and drugs that are recommended to be used to livestock. Table 17 indicate cost based on the adaptive capacity of the households to treat livestock. The results show the minor difference between total cost and adaption cost is TZS 2 266 000/= and TZS 2 156 422/= respectively the little difference was influenced by low adaptive capacity of the household. The cost will vary considerably if the farmer does not keep all livestock indicated in the Appendix 8.

Table 17: Summary of total cost and adaption cost of various adaption strategy

Adaption strategy	Total cost(Tsh)			Adaption cost (Tsh)		
	TC1	TC2	TC3	Ci1	Ci2	Ci3
Use improved seed varieties	335 200			236, 636		
Use of inorganic fertilizer	Nitrogenous 1 024 900	Phosphorus 768 800		Nitrogenous 862 965.8	Phosphorus 723 078.4	
Pest control	400 200	389 460				
Storage chemical	64 452.5		19 194	63 367.1		16 063.15
Vaccination and treatments	2 266 000			2 156 422		

CHAPTER FIVE

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The primary objective of this study was to show the synopsis of communities' climate change adaptive capacity and the cost needed to improve their capability on adaptation or withstanding with climate change and variability in different socio-economic aspects that households as well as communities depend on. The specific areas under concentration were on determinants that influence communities' adaptive capacity and identify the specific household adaptive strategies and finally the local perception on climate change and adaption cost needed to improve household capacity to achieve different adaptive strategies.

The results indicate a greater variation of adaptive capacity between the household as well as the villages. The other villages had low adaptive capacity, moderate and high in some variables. The main reason for communities to have low adaptive capacity is due to the lack of appropriate assets that are potential for assisting or supporting households during climatic shocks. Communities' perceive changes in climate through decreasing in amount of precipitation, increases in temperature, shortening of wet seasons and longtime of dry seasons of the year. Most of households' copping strategies due to climate change are through self-initiatives without external interventions.

Regarding adaption cost, the results indicate minor difference between total cost and adaption cost because of low adaptive capacities of households in respective adaptive measures under consideration.

5.2 Recommendations

Based on the study findings the following recommendations are pertinent;

i. The effort should be made to improve communities' adaptive capacity through improving farming system, which gears to improve crops productivity, and diversity, and introduce new crops that are less sensitive to climate variation.

ii. Special attention should be paid to livelihood diversifications, which are less sensitive to climate change and variability, for example, the use of natural resources like non timber forest product i.e. mushroom cultivation, beekeeping (honey production) and so forth would enhance communities stability during the climate change and variability. The diversification of livelihood or income sources could increase the income earnings of the households thus; enhance households' stability against climate stressor.

iii. Improve modality of information dissemination to communities, the specific information such as climate seasonal forecast data; climatic hazards information could help communities' to be prepared and make informed decision hence less vulnerable to the negative impact of climate change.

iv. Ensure transfer of appropriate and sufficient knowledge on adaption practice to climate change and variability to the communities. Exposing adaptation technology to communities that; are economic efficient, environmental friendly, flexible, applicable and affordable to everyone.

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APPENDICES

Appendix 1: Questionnaire for household interview

1. General Household Information

Location

Village name; _____ Ward; _____

Division; _____ District; _____

Data; _____

Name of household owner; _____

Number of household members, Male _____ female_____ age _____

Marital status; i. Single, ii. Married, iii. Divorced, iv. Widowed

Size of land owned by hh _____

Main socio-economic activities _____

2. Communities Adaptive Capacity

1. What are the assets do you own? Tick to the appropriate asset that you own and give the quantity.

i.equpment	**availability**	**quantity**
Tractor		
Power tiller		
Plough and oxen		
Hand too i.e. hoe, axes etc		
ii.On farm structure		
Irrigation canal		
Dipping		
Dam/rain water harvesting		
House		
iii. Domestic animal		

Cow		
Sheep		
Goats		
Pigs		
Poultry		

2. Are there schools in your village/ward? 1. Yes 2. No ☐

3. If yes, how many are they? ; secondary and primary ☐

4. What is the distance from your household to school? Please tick to the appropriate range.

1.>100m but <500m	
2.>500m but< 1km	
3.>1km	

☐

5. Is there a hospital in your village? 1. Yes, 2.No

6. If yes how far is it from your home?

1.<1km	
2.1km -3km	
3.3km- 6km	
4.>6km	

☐

7. Do you get the following information and knowledge pertaining to climate change and variability? (Yes...../ No)

Information on	**Mark**
Weather forecast data	
Climate hazards i.e. drought or flood	
Drought resistance seed varieties	

Drought and diseases resistant animal husbandry	
Fund for investment on agriculture	
Diseases outbreak	
Knowledge on	
Modern farming practice	
Modern animal husbandry	
Best adaptation option	
Rain water harvesting	
Food storage for future use	
Application of new seed varieties	
Flood and soil erosion control	

8. What are the income generating activities do you depend on among the following Tick (√) against the appropriate answer (multiple response is allowed).

Agricultural products	
Livestock products	
Forest products (charcoal and fire wood)	
Non timber forest products	
Fishing	
Casual labour	
Business	
Permanent employment gvt/private sector	

9. What is your income per month in TZS.....

10. What is your expenditure per month in TZS.....

11. Is there any savings and credit organization in your village? 1.Yes, 2.No

12. If yes in which form. Tick (√) against the appropriate option. (Multiple responses are allowed).

SACCOS	
Bank	
Revolving fund	
Others	

13. Are you a member of any organization mentioned above? 1. Yes, 2. No, ☐

If "NO" why? / If "YES" have you benefited by being a member?

.....

.....

14. How many are you in the household?? .....

15. How many members are responsible for different economic activities? Mention number please .....

16. What is the highest level of education does your hh member have? Tick against appropriate answer.

Primary	
Secondary	
Collage/university	
None	

17. What is the health status of your hh members? 1. Good..., 2.Not good

18. Do you have access to training or extension services on crops and liv ☐

production? ☐

Yes, 2. No

19. Are there any organizations/social groups in your community? 1. Yes, 2. No

20. What organization work in your community, what activities do they have? How have they worked in the area? Do you think they produce the result?

21. If yes, please fill the Table below.

No	Name of organization	Activities performed	Time year	Achievement
1				
2				
3				

22. In what organization do or your families participate? Please indicate the number…

23. What have the organization helped you/ your family during natural disaster? Please tick against the appropriate option.

24.

1.Technique assistance	
2.credit	
3.Capacity building	
4.Information	
5.others	

25. What are the sources of drinking water? Tick against appropriate answer (multiple response is allowed)

1.Basin	
2.River	
3.Well	
4.Dam	
5.others	

26. How far do you have to travel to obtain water? Tick against appropriate answer

1.Does not apply	
2.>100m but <500m	
3.>500m but< 1km	
4.>1km	

27. Do you own a land? 1. Yes, 2. No, if yes of what size? .....ha.

Do you have property right for the land? 1. Yes, 2. No

28. If yes, of what kind?

.....

3. Communities Response to Climate Variability and Change

29. What are the severe changes the community is previously/currently facing? (Multiple response is allowed) tick against the appropriate answers.

Drought	
Foods	
Rise in temperature	
Change of rainfall pattern	
Flood	
Pest occurrence	
Diseases occurrence	

30. What are livelihood activities/ socio-economic sector that are more sensitive to the changes you selected above? Mention them

1 .....2 .....

3..... 4.....

31. What are the measures did you take to overcome or cope with the above severe changes you had faced? (Multiple responses is allowed)

Adaptation measure	**YES**	**NO**
A. Agricultural and water management		
1. Public irrigation		
2. Use of water pump		
3. Construction of water reserves		
B. Adjustment of farmer and crops management		
1. Planting drought tolerant and early mature crops		
1. Practice modern farming		
2. Modern livestock keeping		
3. Agro forestry (Agro-pastoralism)		
4. Use intergraded pest and diseases control		
5. Soil conservation practice i.e. mulching, fanya juu or terracing		
6. Crop rotation		

7. Mixed farming		
8. Shift cultivation		
9. Applying farm yard manure		
10. Applying inorganic fertilizer		
11. Vaccination to livestock		
12. Valley bottom farming		
13. Encroachment to protected area for grazing		
14. Changing planting calendar		
C. Diversification beyond the farmer		
1. Petty business		
2. Natural resources i.e. forest products, NFPs, fishing and others		
3. Causal labour		
4. Charging eating behavior		
5. Reduce number of livestock by selling or slaughter		
6. Rural-urban migration and		
7. Others (if possible mention them)		

4. Communities Adaptive Cost

32. What are the inputs or materials that have been used to form the identified adaptive measures and their associated cost?

Adaptive measures	**Inputs/materials**	**Price/unit**	**cost**

Appendix 2: Checklist for district level

1. How your District governments have been prepared for whatever climate variability and change hazards?

In term of

a. Information dissemination to community

b. Materials/resources

c. Cost for each resource

d. Source of fund/financial support

Agriculture (drought or pest)

1. **Crops production in a case of drought/flood**

Seed variety	Land size(ha)	Quantity (kg/ha)	Price/kg	Total cost
Maize				
Rice				
Millet				
Sorghum				
Simsim				
Cassava				
Sweet potatoes				
Beans				
Cowpeas				
sunflower				
Others				
Total				

2. **Livestock production in cases diseases eruption related to climate change**

Cattle	**No**	**Common diseases**	**Cost/unity (TZS)**	**Total cost**
Cow				
sheep				
Goat				
Pigs				
Poultry				
Total				

Appendix 3: Type of crops, average land size (ha) and average productivity per ha in kg (n=120)

Variables		Land size in ha				Productivity per ha per kg			
Crops	No: grower	Min	Max	Mean	Std. d	Min	Max	Mean	Std. dev
Maize	111	0.50	10.00	2.41	1.53	300	1000	616.20	198.00
Rice	25	0.50	4.00	1.70	0.80	210	1400	933.60	253.90
Millet	13	0.50	3.00	0.92	0.67	140	560	305.30	125.27
Beans	56	0.50	10.00	1.20	1.33	100	700	375.00	133.8
Pigeon peas	23	0.50	2.00	1.06	0.45	300	500	348.00	59.31
Ground nut	21	0.50	2.00	0.98	0.51	-	-	-	-
Sun flower	34	0.50	2.00	1.06	0.43	140	560	275.90	118.80
Sesame	20	0.50	4.00	1.38	0.99	140	490	273.00	90.88
Cassava	18	0.50	2.00	1.03	0.68	2bag	10 bag	4.67bag	1.75
Ginger	17	0.25	0.50	0.44	1.10	2bag	4 bag	3.11bag	0.69
Sweet p	5	0.50	2.00	1.00	0.61	2bag	6 bag	4.00bag	1.58

Note: The households grow more than one crops thus the number exceed 120.

Appendix 4: Summary for cost needed to improve communities' capacity to use improved seed varieties' (n=120)

		Land size (ha)	Seed variety	Rate per ha in kg		Market price per kg (Tsh)		Total cost (Tsh)		Adaptation cost (Tsh)		Expected output per ha
Types of crops	**No :**	**AI**		**Ar_1**	**Ar_2**	**MP_1**	**MP_2**	**TC_1**	**TC_2**	**CI_1**	**CI_2**	
Maize	111	2.41	MV2 &TMV1ST	5	5	2 000	4 000	24 100	48 200	14 653	29 306	4 t or 4 000kg/ha
Rice	25	1.7	Various	50		700		59 500	-	36 176		3.5t/3 500kg/ha
Millet	13	0.92	Various	10		2 000		19 600	-	11 918		3.5t or 3 500kg/ha
Beans	56	1.2	Various	20		2 000		48 000	-	29 184		2.5 t/2 500kg/ha
pigeon peas	23	1.06	Komboa	20		1 800		42 400	-	25 780		3.3t or 3 300kg/ha
Ground nut	21	0.98		20		5 000		98 000	-	59 584		-
Sun flower	34	1.06		10		4 000		42 400	-	25 779		2.0t or 2 000kg/ha
Sesame	20	1.38	Lindi o2	10		4,000		55,200	-	33562		0.5t or 500kg/ha
Cassava	18	1.03	Munda	-	-	-	-	-	-	-	-	25t or 2 5 000kg/ha
Total								**335 200**	**48 200**	**236 636**	**29 306**	

Appendix 5: Summary of cost needed to improve communities' capacity to use inorganic fertilizer (n=120)

		Land size (ha)	Rate per ha in kg		Market price per kg		Total cost (Tsh)		Adaptation cost (Tsh)	
Types of crops	No :	AL	Ar_N	Ar_P	MP_N	MP_P	Tc_N	Tc_P	Ci_N	Ci_P
Maize	111	2.41	80	40	1500	2 000	289 000	192 800	243 338	165 337.6
Rice	25	1.7	80	40	1500	2 000	204 000	136 000	171 768	114 512
Millet	13	0.92	80	40	1500	2 000	110 400	73 600	92 956.8	61 971.2
Beans	56	1.2	80	40	1500	2 000	144 000	96 000	121 248	80 832
pigeon peas	23	1.06	80	40	1500	2 000	127 200	84 000	107 102.4	70 728
Ground nut	21	0.98	80	40	1500	2 000	117 600	78 400	99 019.2	66 012.8
Sun flower	34	1.06	80	40	1500	2 000	127 200	84 000	107 102.4	70 728
Sesame	20	1.38	80	40	1500	2 000	165 600	110 400	139 435.2	92 956.8
Total							**1 024 900**	**768 800**	**862 965.8**	**723 078.4**

Appendix 6: Summary for cost needed to improve household capacity to control crops pest (n=120)

		Land size (ha)	kind of pest	Application rate (Agrothrin 5 ec 200ml (Ar)		Market price (Tsh)	Total cost (Tsh)	Adaptation Cost (Tsh)
Types of crops	**No :**	**AI**		**Mil/ha**	**Mil/20Lt**	**Mp**	**Tc**	**Ci**
Maize	111	2.41	Armyworms, Aphids, Stalk bores.	400	40	2x 20 000	96 400	93 990
Rice	25	1.7	Aphids, armyworms and sucking pest.	400	40	2x20 000	68 000	66300
Millet	13	0.92	Armyworms ,Aphids, Stalk bores	400	40	2x20 000	36 000	35 100
Beans	56	1.2	Aphids, bores, battles , thrip and etc	400	40	2x20 000	48 000	46 800
pigeon peas	23	1.06	Thrips, beetles, and caterpillars	400	40	2x20 000	42 400	41 340
Ground nut	21	0.98	Aphids, bores, battles , thrip and etc	300	60	1.5x20 000	29 400	27 930
Sun flower	34	1.06	Leaf caterpillars, Jassida leaf warms and strainers	400	40	2x20 000	40 000	39 000
Sesame	20	1.38	Leaf caterpillars, Jassida leaf warms and strainers	400	40	2x20 000	40 000	39 000
Total							**400 200**	**389 460**

Appendix 7: Summary of cost needed to improve Household capacity the use of chemicals for crop storage (n=120)

		Amount stored in Kg	Chemicals per 100kg		rate) 10g	Market price per			Total cost (Tsh)			Adaptation cost (Tsh)		
Crops	No:	As	1	2	3	Mp_1	Mp_2	Mp_3	Tc_1	Tc_2	Tc_3	Ci_1	Ci_2	Ci_3
Maize	111	616.20	1pc	-	-	2 500	-	-	15 405	-	-	15 020	-	-
Rice	25	933.60	1pc	-	-	2 500	-	-	23 340	-	-	23 282	-	-
Millet	13	305.30	1pc	-	-	2 500	-	-	7 632.5	-	-	7 442	-	-
Beans	56	375.00	1pc	-	-	2 500	-	-	9 375	-	-	9 140.6	-	-
pigeon peas	23	348.00	1pc	-	-	2 500	-	-	8 700	-	-	8 482.5	-	-
Ground nut	21	-	-	-	-	-	-	-	-	-	-	-	-	-
Sun flower	34	275.90	-	-	10g/kg	-	-	3000	-	-	8 277		-	8 070.1
Sesame	20	273.00	-	-	10g/kg	-	-	3000	-	-	8 198		-	7 993.05
Cassava	18	4.67bag	4	-	-	-	-	-	-	-	-	-	-	-
Ginger	17	3.11bag	4	-	-	-	-	-	-	-	-	-	-	-
Sweet potato	5	4.00bag	4	-	-	-	-	-	-	-	-	-	-	-
Total	-	-	-	-	-	-	-	-	**64 452.5**		**19 195**	**63 367.1**		**16 063.15**

Appendix 8: Summary for cost needed to improve household capacity to use different vaccination for livestock (n=120)

Livestock type	Number	Mean (X)	Diseases	Dose Vaccine (Ar)	Market price Tsh (Mp)	Net adaptive cost (Tc) in Tsh	Cost needed (Ci)in Tsh
Cow			Rift valley favor (RVF)	RVF vaccine	12 000 @dose	348 000	336 516
			East coast favor (ECF)	Buterits 20ml/cow@ 1dose	25 000@dose	725 000	701 075
	19	29	(CBPP)	CBPP vaccine 20ml @cow	15 000@dose	435 000	420 645
			Foot and mouth diseases (FMD)	FMDV 40mil/cow @ dose	12 000@dose	348 000	336 516
			Intestinal warms	Various Tablets for intestinal worms	2 000@dose	58 000	56 086
Goat			Warms	Various Tablets for intestinal warms	2 000@dose	20 000	19 340
	38	10	Foot and mouth diseases (FMD)	FMDV 10mil/goat @ dose	4 000@dose	40 000	38 680
			CBPP	CBPP vaccine 20ml @goat	15 000@dose	15 000	14 505
Sheep			Warms (parasites	Various Tablets for intestinal worms	2 000@dose	18 000	17 406
	21	9	Foot and mouth diseases (FMD)	FMDV 10mil/goat @ dose	4 000@dose	36 000	34 812
			CBPP	CBPP vaccine 20ml @goat	15 000@dose	135 000	130 545
Pigs	23	6	Warms (internal parasite)	Various Tablets for intestinal worms	2 000@dose	12 000	11 604
			Colibacillous (E-coil)	Antibiotic	3000@dose	18 000	17 406
			Respiratory diseases	Amoxillin/Ampicillin	3000@dose	18 000	17 406
Poultry	104	11	Newcastle (mdondi)	New castle(S)20ml/400 chicken	7,000@pc 20ml	7 000	6 769
			Cocidedisis	Two drugs coccidiostats and coccidiocides	3000@dose	33 000	31 911
						2 266 000	**2 156 422**