

Evaluation of Farmers' Adaptation Strategies towards Climate Change on Maize Production in Kishapu District, Shinyanga, Tanzania

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ABSTRACT

This study aimed at assessment of farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania. Specifically, the intention was to identify the indicators of climate change and variability in Kishapu district Shinyanga, Tanzania, examine the impacts of climate variability towards maize production in Kishapu district Shinyanga, Tanzania and identify farmer's adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania. In this study the cross-sectional research design was used because of its high degree of accuracy and precision in social science research. Data would be collected through observations, interviews and questionnaires. A questionnaire was set to a sample of 100 in Kishapu district Shinyanga, Tanzania. Data would be summarized, coded and analyzed by using SPSS and the data were presented in different ways including descriptive statistics such as charts, graphs, tables, maps, images and statements. The research design that would be used was a surveying design methodology that included a cross sectional design that focused on the objectives and the questions that were prepared.

Keywords: Climate change; Variability; Maize; Adaptation; Farmer

Abbreviations: SPSS: Statistical Package for Social Science; FAO: Food and Agriculture Organization; URT: United Republic of Tanzania; NAPA: National Adaptation Plan of Action

INTRODUCTION

Background of the study

The well-being of large populations around the world depends on access, stability and availability of food. Besides a series of non-climate related factors, the vulnerability of these smallholder and subsistence farmers was greatly influenced by changes. Available observational evidences around the world indicate that global changes in climate, particularly global warming, have already affected the adverse sets of physical and biological systems in any parts of the world. It has been broadly shown that mankind was causing global warming with the emission of greenhouse gases [1].

According to IPCC, the drastic increase in the emission of CO₂ (carbon dioxide) within the last 30 years caused by burning fossil fuels has been identified as the major reason for the change of

temperature in the atmosphere. In some parts of the world, climate changes were manifested through shrinkage of glaciers, thawing of permafrost, later freezing and earlier break-up of ice on rivers and lakes, lengthening of mid to high latitude growing season, pole-ward and altitudinal shifts of plant and animal ranges, declines of some plant and animal populations and earlier flowering of trees. In some other parts of the world the changes were observed through frequent drought and flood and emergence of unexpected insects [2].

Global changes in climate have been found to impact various sectors of the global economy. Agriculture was one of the sectors largely affected by climate changes. The effects of climate change on the agricultural sector, however, differ from region to region, with benefits mostly for the developed world and strongly negative impacts for developing nations. Climate change was a global problem; although the associated impacts and adaptation strategies vary across the [3].

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Developing countries mostly found in Africa including the sub Saharan African countries were expected to be severely affected by climate change Mendelsohn. Africa was among the continent most vulnerable to climate change and climate variability. Socio-economic developments exacerbate the effects of climate change on ecosystems and humanity. The economies of many African nations were dependent on sectors that were vulnerable to climate conditions, such as agriculture, fisheries, forestry and tourism. Agriculture and natural resources provide the livelihood for 70% to 80% of the population, and account for 30% of GDP and 40% of export revenue in Sub-Saharan Africa. Climate variability has a direct adverse influence on agricultural production in Africa because nearly 80% of agricultural production in these countries was rainfall and temperature dependent. Changes in climate have already decreased crop yields in several regions across Africa, for example, were estimated to have reduced global maize production by a year between 1981 and 2002 Berck [4].

In sub-Saharan Africa agriculture employs 60% to 90% of the total labour force. Tanzania was not different from the rest of sub-Saharan African countries; agriculture was the dominant sector accounting for 75.1% of employed persons National Bureau of Statistics [5]. In Tanzania where 75.1% of the employed persons were in the agriculture sector, the continued impacts of climate change have and will continue to have devastating effects on the economy, food security and threaten the stability of the country. Thus, Tanzania has invested much in terms of financial resources and research on adaptation measures farmers could implement to cope with climatic changes in the agriculture sector. Using local persons was believed to lead to development of effective mitigation and adaptation strategies that were cost-effective, participatory and sustainable NBS.

Tanzania has a good foundation of policy framework to address adaptation and mitigation of climate change in agriculture. It needs very complex and accommodating methods and tools that will capture differences in agro-ecologies farming systems, agricultural input levels and other land management, the government of Tanzania through 'Kilimo Kwanza' has made additional thrust into mechanization by massive importation of tractors and other farm implements. This has made the farming implements readily available together with their spare parts and thus triggered more demand and usage B. Mabhuve.

The impacts of climate variability on agriculture sector in Tanzania include shifting in agro-ecological zones, prolonged dry episodes, unpredictability in rainfall, uncertainty in cropping patterns, increased weed competition with crops for (moisture, nutrients and light) and ecological changes for pests and diseases [6]. The recent droughts and associated crop failures have led to severe hunger to many places in Tanzania that forced the government to organize food aid to the people. For example, in Dodoma region there had been an 80% decrease in harvests as a direct result of poor or late arrival of rainfall. In 2016, the short rains were very poor in many regions including areas where the rains were usually plenty, such as Kilimanjaro region. The shortage of the mentioned rains again triggered food aids to the starving people especially in coastal and north-east regions

united republic of Tanzania URT. Therefore, this study seeks to assess farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania.

Statement of the research problem

Rainfall was highly variable spatially and in total amount. In Tanzania, climate change possesses its worst impact through interference with food security to the growing population. Thus, changes in temperature, rainfall patterns and rainfall variability were likely to prolong dry seasons and to increase the severity of periodic droughts and thus decreased crop yields in several regions, therefore adaptive strategies were needed to overcome the problem. The agriculture sector in Tanzania is particularly vulnerable to climatic change because it is customarily dependent on rainfall [7].

In Tanzania the capacity of farmer households to adopt crop adaptation strategies was low. Evidence on how factors affect the adaptive capacity of farmers and their subsequent crop yields was scarce. Deffersha argues that the adaptation strategies affect yields of different crops differently, thus, the impacts of adaptation strategies should be estimated to each crop type suggested that rain-fed crop production was dominant farming system was rural areas and will continue to support the majority of an increasing population thus understanding local climatic risks was one of many adaptation options to increase crop yield in rain-fed rural areas with minimum financial capital [8].

Therefore due to continuous changes in both rainfall and temperature patterns with decreasing in crop yields (maize) enhance food insecurity in the areas despite of the adaptation strategies put on sight, changes using several indigenous adaptation strategies that will minimize the impact of the problem and therefore the aim of this study was to assess the farmers adaptation strategies at micro levels by using local persons in Kishapu district, Shinyanga, Tanzania so as to develop the effective mitigation and adaptation strategies that were cost-effective, participatory and sustainable.

General objective

The aim of this study was to assess the farmers' adaptation strategies towards climate change on maize production in Kishapu district, Shinyanga, Tanzania.

Specific objectives

- To examine the indicator of climate change and variability in Kishapu district, Shinyanga, Tanzania.
- To determine the impacts of climate variability on maize production in Kishapu District, Shinyanga, Tanzania.
- To identify farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district, Shinyanga, Tanzania.

Research questions

- What were the indicators of climate change and variability in Kishapu district, Shinyanga, Tanzania?
- What were impacts of climate variability on maize production in Kishapu district, Shinyanga, Tanzania?

- How do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district, Shinyanga, Tanzania?

Significance of the study

This study aims at evaluating the farmers' adaptation strategies towards climate change on maize production in Kishapu district, Shinyanga Tanzania. Therefore, the study will benefit the natives by equipping them with appropriate knowledge and skills on how to cope with the climate change impacts. Also, this study would benefit different policy makers through including the problem of climate change to different policies such as that of National Agriculture policy. Also, this study would benefit government and different Non-Governmental Organizations (NGO's) and Community Based Organizations (CBO's) through participating in solving the problem of farmers depending on rain fed agriculture through equipping them with adaptation strategies.

Scope and delimitation of the study

The study was limited to the assessment of the farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania; the study was widely affected most of the parts in Tanzania especially in rural areas where agriculture was being conducted at high extent while most of the farmers depend on rainfall for the harvests. Therefore, Kishapu district Shinyanga, Tanzania was taken as a study case due to the reasons such as the place was conducive of doing research due to the factors as most of the people were conducting agricultural activities. Therefore, Kishapu district Shinyanga, Tanzania was taken as the case study representing the rest of the districts in Tanzania.

Conceptual framework

A conceptual framework was a couple of facts linked together and that assist in providing guidance towards realistic collection of information [9]. The conceptual framework of this study focuses on the challenges facing rain fed agriculture households and adaptation to climate change impacts.

A dependent variable is a variable whose value will change depending on the value of another variable, called the independent variable. In a scientific experiment, it is the variable being tested and therefore, it is called the dependent variable. Dependent variables are also known as outcome variables, left hand side variables or response variables. In this current study a dependent variable is climate change. For example, high temperature, rainfall variability and so on.

The independent variable is the characteristic of a psychology experiment that is manipulated or changed by researchers, not by other variables in the experiment. The independent variable of this current study is adaptation strategies like irrigation and mixed crop (Figure 1).

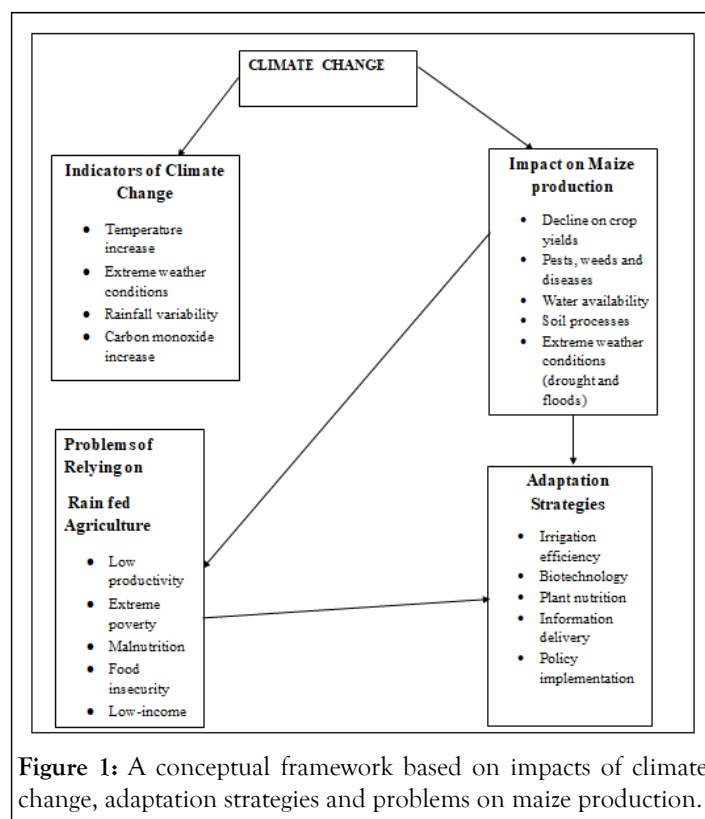


Figure 1: A conceptual framework based on impacts of climate change, adaptation strategies and problems on maize production.

The above framework is showing the relationship between variables as how the farmers' adaptation strategies towards climate change on maize production in Kishapu district, whereby the first frame was contained of dependent variables which is adaptation strategies, the second was contained the independent variables which is the climate change like temperature increase, extreme weather events, rainfall variability, the third was contain the impacts of the climate change on maize production in Kishapu district, Shinyanga-Tanzania which are decline of crop yield, diseases, extreme weather events such as drought.

Indicator of climate change

Temperature increases: Temperature increases are the rise of hotness in the earth's surface, this indicator has relationship with some adaptation strategies like irrigation, where by temperature increases can led to the drought so irrigation is favorable adaptation.

Rainfall variability: Rainfall variability is the degree to which rainfall amounts vary across an area or through time is an important characteristic of the climate of an area. This as relationship with water availability means when rainfall variability increases also water availability increases and vise verse.

Extreme weather condition: Extreme weather condition events such as heat waves and large storms re likely to become more frequent or more intense with human included climate change, it has significant impacts on human society.

Impact on maize production

Decline on crop yields: Decline on crop yields, the warmer temperature associated with climate change are projected to significantly reduce yields of the food crops, it estimates that the maize is likely to decrease as the planet warm.

Water availability: Water availability is the quantity of water that can be used for human purposes without significant harm to ecosystem or other users.

Soil processes: Soil processes is the addition losses transformation change and translocation of the soil the decrease in maize yield is associated with soil degradation under continuous cultivation.

Pests, weeds and diseases: Pests, weeds and diseases has relationship with temperature increases in different place due to the favorable conditions of some pests, weeds and diseases.

Adaptations strategies

Irrigation efficiently: Irrigation efficiently is the rates of the amount of water consumed by the crop to the amount of water supplied through irrigation, excess water can increase weed press and create an environmental favorable to diseases.

Biotechnology: Biotechnology is a broad area of biology involving the use of living system and organism to develop products. It contributes tremendous advances in maize production due to application of plant growth and resistant to pest and disease.

Plant nutrition: Plant nutrition, soil major source of nutrients needed by plant growth, there are three nutrients such as Nitrogen (N), Phosphorus (P) and potassium, plant need nutrient to germinate, growth fight of diseases and pest and to reproduce.

Policy: Policy is the set of law or action which adopt or proposed by gut or individuals, government implement agricultural policies with the goal of achieving a special outcome in the domestic agriculture products markets.

LITERATURE REVIEW

This chapter presents a review of literature to the study on assessment of farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania. The chapter begins with the operational definitions of key terms and explanation of different theories related to the study. Then review of the related empirical studies which were done by different researchers, lastly the demonstration of knowledge gap.

Operational definition of key terms

Climate change: There was a fundamental difference between climate change and climate variability. Climate change constitutes a shift in meteorological conditions that last for a long period of time IPCC while climate variability was short-term fluctuations happening from year to year or seasonally. In this study both definitions were adopted.

Climate change was a long-term change in weather conditions and patterns of unusual extreme weather events. On the other

hand, intergovernmental panel for climate change IPCC, describes a climate change as a change of climate which was attributed either directly or indirectly to anthropogenic activities that alter the global atmosphere composition and which were in addition to observed natural climate variability over comparable time periods. And this climate change was determined by changes in temperature and rainfall patterns. Climate change might be caused by various causes including both natural and anthropogenic factors including volcanic eruptions, variations in solar output, natural aerosol emissions, burning of fossil fuels, industrial activities, cement production, land use changes, deforestation Kershaw [10]. Places having climate change may led to some adaption in order to overcome that climate change.

Adaptation to climate change: Adaptation to climate change was generally defined as the process of adjusting or intervening in natural or human systems intending to respond to actual or anticipated climate change or its effects IPCC. It was the process of improving society's ability to cope with climate change and its effects across time scales, from short term. Adaptation in agriculture was identified as one of the policy options to reduce the negative impact of climate change on agricultural productions EPA. Adaptation in agriculture occurs at two main scales: Household-level (micro) and national level (macro). Micro level analysis of adaptation in agriculture focuses on tactical decisions that farmers make in response to seasonal variations in climatic, economic and other factors in which in this study would focus mainly on micro level. On the other hand, national level or macro-level analysis was concerned with agricultural production at the national and regional scales and its relationships with domestic and international policy [11].

Theoretical reviews

The Protection Motivation Theory (PMT): The Protection Motivation Theory (PMT) was used guiding research on protective health risks behavior, nuclear war, water conservation and marketing communication Floyd. Protection motivation corresponds to the desire of protecting oneself against health threats and to the intent to adopt a responsive action Tanner. More recently PMT appeared in research on environmental risks, natural hazards and climate change. PMT addresses four core elements of the cognitive mediating processes: Threat appraisal, coping appraisal, maladaptive coping and protection motivation. Regarding climate change, these elements were climate change risk appraisal, adaptation appraisal and avoidant maladaptation, risk perception of climate change, adaptation assessment, maladaptation and adaptation intention [12].

In this study paper an attempt to make the linkage between farmers' perception variables and their adaptation decision making through the protection motivation theory. A meta-analysis reported its application in studies of political issues, environmental concerns and protecting others. In this case, I applied PMT to climate changes to find out about the decision of farmers to adapt to the impacts of climate change and variability. PMT has been used as a suitable model to guide campaigns in the area of climate change towards food security.

The strength of the theory: The strength of PMT was that it offers a context to explore the importance of psychological

factors in determining farmers' adaptation to drought risk. It offers a comprehensive theoretical framework that fits this study's research objectives by including both risk appraisal and coping appraisal factors towards climate change.

Weakness of the theory: There were no PMT applications that statistically test its ability to explain farmers' adaptation to drought risk and it does not give direct solution towards combating climate change risks and adoption strategies.

Relevance of the theory: This theory of PMT was relevant to this currently study because it can find out about the decision of farmers to adapt to the impacts of climate change and variability. PMT has been used as a suitable model to guide campaigns in the area of climate change towards food security.

Capability theory: The theory examines capacities necessary for people to lead functioning lives. A person's functioning reflects the collection of "beings" and "doings", and can be viewed as various outcomes a person may achieve. A capability approach focuses on whether or not people possess capacities necessary to construct a fully functioning life. Such capacities were supported by among others, natural systems that directly depend on a stable climate system. Capabilities approach provides concepts that can encompass the current framing of climate justice, but in a way that was more applicable to the development of adaptation policy.

Since this approach addresses the basic requirements that were necessary for human life to function and flourish; it was important to align adaptation policies with climate justice that protects the basic functioning of human communities, including the environment.

Since climate change would affect what individuals were able to do with the resources that they have including agricultural activities, thus climate change was a barrier to functioning lives. Capabilities based approach to adaptation was needed in this study as it explains how communities need to be thoroughly involved in defining their own vulnerabilities and designing adaptation policies that were planned to protect them from climate change that threatens their ability to function (crop cultivation).

Review of empirical studies

Indicators of climate change and variability: Mwakisunga, says that both natural and anthropogenic factors were implicated as causes for climate change, natural factors include volcanic eruptions, variations in solar output, natural aerosol emissions and variations in the earth's orbital characteristics, whereas, anthropogenic factors include burning of fossil fuels, industrial activities, cement production, land use changes, deforestation and agriculture. Wu, et al., supports by stating that all these activities produce high emission levels of Greenhouse Gases (GHGs) which include Carbon Dioxide (CO₂), Methane (CH₄) and Nitrous Oxide (N₂O), thus mounting of GHGs concentration in the atmosphere was the leading cause of climate change.

Several studies including FAO and Shikukul clearly show that the GHGs were positively correlated with the burning of fossil

fuels, oils, forest destruction and agriculture. It has been indicated that, climate change takes place in the context of developmental stresses, poverty, food shortage and drought, outbreaks of infectious diseases, environmental change and land degradation. The same causes of climate change occur in Tanzania most in rural areas.

The according to Hope human activities such as burning of fossil fuels, industrial production, cutting down of rainforests change the atmosphere's composition by increasing the amount of greenhouse gases, which in turn traps heat in the atmosphere and thereby facilitating climatic changes. Thompson suggest that apart from projected warming or rainfall deficit the major cause of climate change could also be due to vulnerability of the population increase in sub-Saharan Africa. They further indicate that Africa was highly vulnerable to climate change due to 'socio-economic activities that determine the capacity of human systems to affect the environment. This was supported by Washington, et al., indicating that poverty and underdevelopment in sub-Saharan Africa was partly due to difficulty in coping with climate variability in a continent subjected to frequent droughts, floods, high temperatures and land degradation.

The impacts of climate change and variability towards maize production: The Yohe in their study illustrates that the global changes in climate have been found to impact various sectors of the global economy; agriculture was one of the sectors largely affected by climate changes. The effect of climate change on the agricultural sector, however, differs from region to region, with benefits mostly for the developed world and strongly negative impacts for developing nations. The negative impact was expected to be harsher on drought-prone areas of Sub-Saharan Africa (SSA). In this part of Africa climate change could reduce agriculturally suitable land area; some rain-fed crop yields as much as 50 percent by 2020 in which Tanzania was among the mentioned countries.

The URT states that given the nature of Tanzania's economy which heavily depends on weather-sensitive and small-scale agricultural practices and the low adaptive capacity of poor farmer households, the potential adverse effects of climate change on crop agriculture and food security would be increasing through time to time. According to NAPA decline of maize yields, the national food crop nationwide by 33% due to temperature rise; highest decline reported for Dodoma and Tabora and this was due to unpredictable rainfall, uncertainty in cropping patterns, shifting in agro-ecological zones, prolonged dry spells beyond normal patterns, increased weed competition with crops for moisture, nutrients and light and ecological changes for pests and diseases. This statement was supported by Paavola to whom he explained the impacts of climate variability on agriculture sector in Tanzania as shifting in agro-ecological zones, prolonged dry episodes, unpredictability in rainfall, uncertainty in cropping patterns, increased weed competition with crops for (moisture, nutrients and light) and ecological changes for pests and diseases.

The according to FAO on its annual report stated that the recent droughts and associated crop failures have led to severe hunger to many places in Tanzania that forced the government

to organize food aid to the people. For example, in Tabora and Dodoma region there had been an 80% decrease in maize harvests as a direct result of poor or late arrival of rainfall hence affecting maize production in 2017. Thus, the aggregate nature of the above studies does not consider the actual constraints faced by farm households in analyzing the impacts to different climate change risks at local level they portray it general thus this study aims at covering the gap.

Thus, this approach offers a way of analyzing the particular needs of communities to identify gaps which hinder people to adapt to climate change impacts and hence directing adaptation policy toward preserving and protection against climate change impacts.

Farmers adaptation and coping strategies towards climate change and variability on maize production: Adaptation in African agriculture has the potential to reduce food deficits from 20 to 50 percent, if the adaptive capacity of African farmers was improved. For example, Molla tried to analyze crop adaptation strategies in the Nile basins Ethiopia the results showed that irrigated farms were more resistant to changes in climate in the Nile basins of Ethiopia. But his findings showed that lack of information was the major constraint of adaptation. According to it, 43% of non-adapters did not adapt due to lack of information, whereas 22%, 16%, 11% and 8% did not adapt due to lack money, shortage of labor, shortage of land and poor potential for irrigations. However, this study did not identify and estimate factors that affect the decisions of farm households to choose among different adaptation strategies at local level. Thus, this implied that irrigation was an important adaptation option for reducing the negative impacts of climate change on crop yields [13].

Tanzania has engaged in various adaptation and mitigation projects, programs and initiatives and has developed policies, programmes and strategies to demonstrate its commitment to contribution to global efforts in combating climate change for example NAPA proposed several activities on agriculture and food security including and the activities covered a wide range of interventions that could address adaptation to impacts of climate change in agriculture including, increase irrigation to boost maize production in all areas, make better use of climate and weather data, weather forecasts and other management tools and expand climate and weather data collection network, create awareness on the negative effects of climate change, increase the use of manure and fertilizer and drip irrigation for specific regions NAPA.

These studies were crucial in providing information on the extent of the impacts of climate change on food productivity and giving insights about the importance of designing appropriate mitigation strategies at global or regional level. However, the aggregate nature of these studies makes it very difficult to provide insights about policy intervention areas in adaptation because the studies do not consider the actual constraints faced by farm households in adapting to different climate change risks.

Demonstration of knowledge gap

Different researchers around the world and in Tanzania have done studies concerning the impacts of climate change and lay up different adaptation strategies to overcome the problems for example Yohe, URT, NAPA and FAO had their say on the impacts of climate change and variability towards maize production in various perspectives including unpredictable rainfall, uncertainty in cropping patterns, shifting in agro-ecological zones, prolonged dry spells beyond normal patterns, increased weed competition with crops for moisture, nutrients and light and ecological changes for pests and diseases.

Molla and NAPA provided the adaptation strategies to overcome the impacts of climate variability including irrigation, make better use of climate and weather data, weather forecasts and other management tools and expand climate and weather data collection network, create awareness on the negative effects of climate change, increase the use of manure and fertilizer and drip irrigation for specific regions. However, the explanations still the researchers have failed to explained in detail at micro-level targeting the local areas and not at global perceptive, thus the researcher aims at filling the gap by assessing the farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania.

METHODOLOGY

This chapter would cover the research design and methodology to which it would include research design, description of the study area, target population, sample and sample size, sampling techniques, data collection techniques, description of data collection procedures, data analysis procedures and ethical consideration in research. This design was appropriate to the study because it provides accurate and required information in accomplishing the investigation in order to discover the problem.

Research design

The procedure for collecting analyzing interpreting and reporting data in research study. Miller defined research design as a master plan specifying the methods and procedure for collecting and analyzing the needed information. In this study the cross-sectional research design would be used because of its high degree of accuracy and precision in social science research. A cross-sectional research design allows the researcher to effectively describe change over time and to identify the various mechanisms associated with those changes. This design allows for relative quick and easy collection of variables only at once. Hence the reason of selecting this cross-sectional survey design would help the researcher to collect data from a large population within a short period of time because both data would be collected using both quantitative and qualitative methods of data collection.

Description of the study area

This section gives out information about the study area which was Kishapu district, Shinyanga, Tanzania that would cover areas

such as location, climate, agro-ecological zones and population size, growth and density.

Geographical location

Was the one of the three districts of the Shinyanga region of Tanzania. It was bordered to the north by Maswa district, to the south by the Tabora region, to the east by the Meatu district and to the west by the Shinyanga rural and Urban district. In terms of international identification, the district lies between latitudes 3°45' and 5°00' South of the equator and between longitudes 32°30' and 33°30' east of Greenwich (Figure 2).

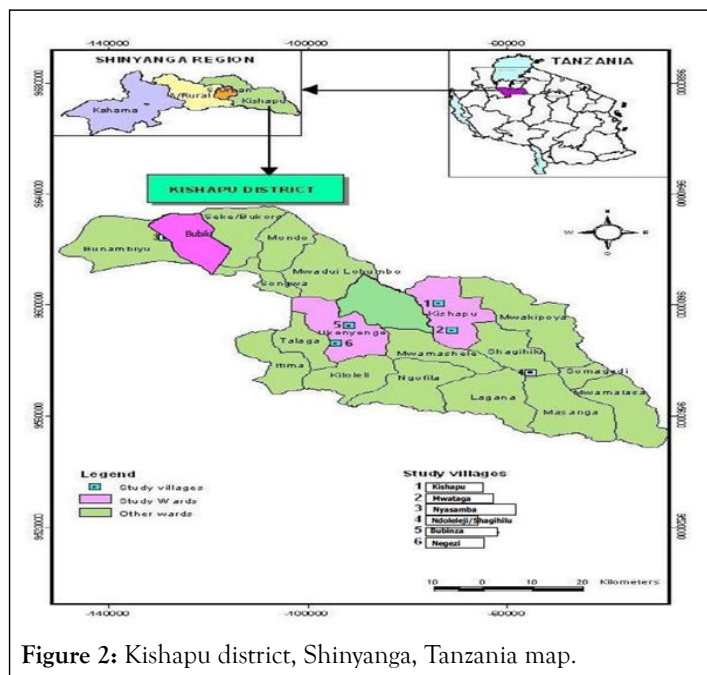


Figure 2: Kishapu district, Shinyanga, Tanzania map.

Climate

The district receives rainfall of between 650 mm and 1,200 mm annually, falling between the months of October or November and December and a dry period from January to February/March and a second lower peak occurring soon after the dry spell was over in February or March and the rains then tail off in April/May. Temperatures range from 28°C to 30°C. The highest temperatures were experienced in October just before the onset of rainfall. Temperatures fall gradually to December and thereafter remain relatively constant up to May. From May to August the district experiences low temperatures.

Sample and sample size

Sampling frame: A sampling frame was the set of the source material from which the sample has to be selected or drawn for research turner. The sampling frame in this study would involve house hold heads in the selected village from ward; the sample also would involve Village Executive Officers (VEOs and Ward Executive Officer (WEOs from selected villages and ward.

Sample size: Refers to the number of units for a sample which was usually the first question to be which was usually the first question to be addressed by a study team to the sampling consultant Henry. The sample size was importance. The

sampling size was an important feature on any empirical study in which the goal was to make inferences about a population from a sample Ahn. The sample size of the household heads in the selected villages, would determine by using the following formula;

$$n = \frac{N}{1 + N(e)^2}$$

Where;

N=Total population/population size

e= Level of precision

n=Sample size

The population of three selected areas was 16371 KISHAPU, 15043 Mwakipoya and 15467 Mwataga people given the house hold ratio as 4.0, the estimation of the household would be shown as follows:

$$\text{Total household} = \frac{\text{total population}}{\text{household ratio}} = n \frac{N}{1 + N(e)^2}$$

Where;

n=Sample size

N=Total population

e=Percentage of error rate at

100-90=10

$$\frac{10\%}{100\%} = 0.1$$

$$n = \frac{46881}{1 + 46881(0.1)^2} = 100$$

Therefore, the sample size of the population.

Sampling techniques

In this both probability sampling and non-probability sampling wellbeing used. In probability (random) sampling all eligible individuals have a chance of being chosen for the sample. There were various types of probability sampling but simple random sampling and stratified sampling would be used. Simple random sampling would be used because each individual would be chosen entirely by chance and each member of the population has an equal chance or probability of being selected. Stratified

sampling would be used because the population would be divided into subgroups or strata who all share a similar characteristic such gender, age and economic status.

Non probability sampling technique provides a range of alternative techniques to select samples based on the subjective judgments Larry, et al. There were various types of non-probability sampling but convenience sampling would be used because this was the easiest method of sampling, because participants would be selected based on availability and willingness to take part and thus useful results would be obtained.

Data collection techniques

The study would use both primary data and secondary data source of information. Primary data was data that was collected by a researcher from first-hand sources or directly from the source using methods like surveys, interviews or experiments thus this study would include primary data collection tools such as questionnaires, interview and observation.

Secondary data was data gathered from studies, surveys or experiments that have been run by other people or from another research. And this information would be gathered from books and internet browsing.

Interview

Interview involves a collection of information through live, oral or verbal communication between the researchers and the respondents Kothari [14]. This study would use both structured interviews which aimed at gathering information from a large number of people and open-ended interviews which were for more in-depth information. The reason of doing interview was to obtain pure information during data collection, whereby the provided answers by the respondents were relating to the research study and primary data were obtained, interview method was good on collecting the data on objective three in the study.

In the first objective on what were the indicators of climate change and variability in Kishapu district, Shinyanga, Tanzania? The interview was used to identify and collect the primary data from the respondent. If this method fails a researcher can use questionnaire guide as the alternative method of collecting information.

In second objective on what were impacts of climate variability on maize production in Kishapu district, Shinyanga, Tanzania? A researcher wanted to get real information from the respondents which will be the first hand information. In case this method is fails a researcher can collect data through observation method of collecting information in a targeted area.

The lastly, is how do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district, Shinyanga, Tanzania? A researcher used interview in order to obtain primary information from the respondents, if this method fails the alternative method will be questionnaire guide.

Survey questionnaires

Questionnaire was a simple way of gathering short responses to questions from respondents and were less time consuming as many more respondents would be reached within a short period of time Krishnaswami [15]. This technique was focus more to the respondents who were able to read and to write.

On the objective one of what were the indicators of climate change and variability in Kishapu district, Shinyanga, Tanzania this was a favorable method during collecting data due to the accurate data gathered. If the method fails the alternative method is interview.

On the second objective of what were impacts of climate variability on maize production in Kishapu district, Shinyanga, Tanzania? A researcher was used questionnaire method due to the accurate in data gathering but in case it fails a researcher can used in-depth interview.

The third objective is how do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district, Shinyanga, Tanzania? A researcher used a questionnaire method due to the efficiency on data collection, if the method fails the alternative method in this objective would be document analysis method.

Observation

Observation was a scientific tool of data collection for the researcher, the researcher instead of asking the brand of questions to the respondents he/she may himself look and watch what's going on or the situation in the study area Krishnaswami [15]. The information gathered where the few detailed information was obtained during the study. Data on objective one and two was collected through this method.

On first objective what were the indicators of climate change and variability in Kishapu district, Shinyanga, Tanzania? A researcher was used observation method due to the few detailed information needed in the study, but in case it fails the alternative method is questionnaire because can gather an accurate information.

Second objective what were impacts of climate variability on maize production in Kishapu district, Shinyanga, Tanzania? A researcher needs to gather few information from respondents through observation method but if it fails an interview guide would be the alternative method.

Lastly, how do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district, Shinyanga, Tanzania? The observation method is not favorable for this objective due to the difficulties in observing all adaptations used in Kishapu district, Shinyanga Tanzania. So, a researcher would use document analysis method or interview in order to obtain primary data.

Secondary data

Secondary data would be collected from various documents such as books, online journals, policy documents and official

reports available that were concerned with how farmers adapt towards climate change and increase maize production.

Descriptive of data analysis procedures

The descriptive statics would be used to analyze the study; the data would be reanalyzed in frequency and percentage and presented by using tables and graphs by aid of a Statistical Package for Social Science (SPSS) 22 version a computer software. Based on the summary each question would be summarized to provide bases for better interpretation of the result. The qualitative data analysis techniques would be employed in analyzing qualitative data obtained from open-ended items in questionnaires where by data collected would be coded and classified basing on their difference and similarities for identifying the emerging themes and presented in tables and graphs for interpretation and discussion.

Ethical consideration in research

In planning and conducting the study as in reporting research findings the researcher would observe all obligations of the research ethical standards such as privacy and confidentiality among each other. This would make sure that no any misleading of the result. The study would be ethically acceptable so any doubt would be solved early by consultation and review of ethical would be considered in the study to protect the dignity and welfare of all respondent as much no one would be affected by the outcomes of the study.

RESULTS AND DISCUSSION

This chapter presents the interpretation, presentation and discussion of research findings. The data has been analyzed by using SPSS (Statistical Package for Social Science) and the content matter analysis method as stated in research methodology and presented by frequency and percentage in form of tables. The interpretation and presentation of the finding is followed by general discussion of research findings, the findings which were presented according to the research questions starting with presentation of the demographic characteristics of the respondents involved in the study.

Demographic information

This section provides the characteristics of the respondents (farmers) in terms of their gender, age and duration that they have been cultivating maize as collected using questionnaires that were provided and they were asked to indicate their gender, age and duration that they have been cultivating maize. The summary of the findings of the demographic information of farmers are presented on below.

Gender of the farmers

Gender is the range of characteristics pertaining to and differentiating between, femininity and masculinity. Depending on the context, these characteristics may include biological sex, sex-based social structures (i.e., gender roles) or gender identity. Most scholars agree that gender is a central characteristic for

social organization. Most cultures use a gender binary, having two genders (boys/men and girls/women); those who exist outside these groups fall under the umbrella term non-binary or genderqueer. Some societies have specific genders besides "man" and "woman", such as the hijras of South Asia. Kevin L. Nadal, The SAGE encyclopedia of psychology and gender (2017, ISBN 1483384276), page 401 (Figure 3).

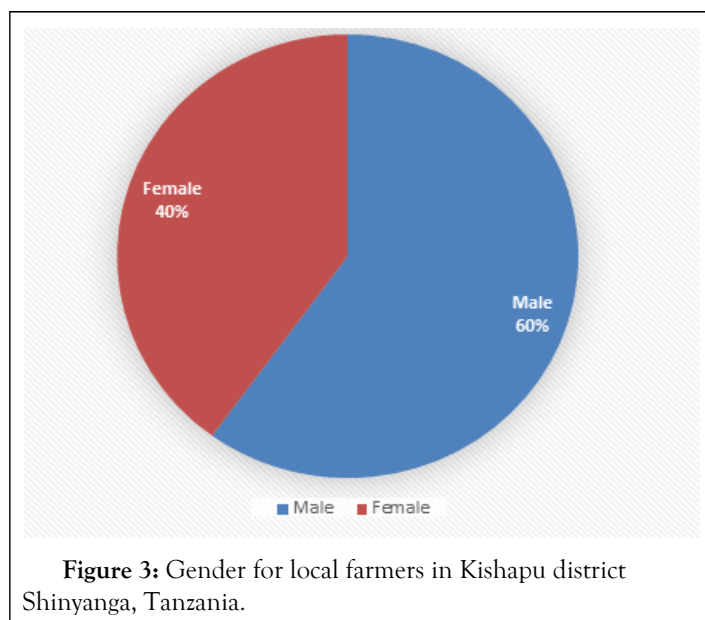


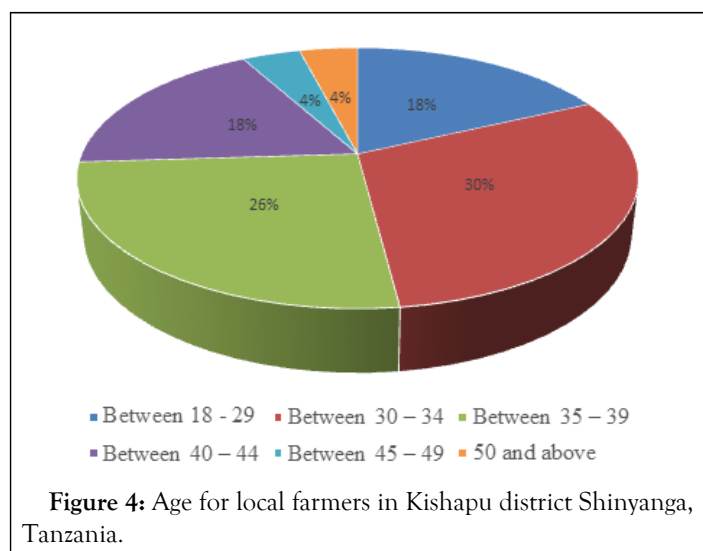
Figure 3: Gender for local farmers in Kishapu district Shinyanga, Tanzania.

Demographic information of the farmers by gender show that 40 (40.0%) of the farmers were females and 60 (60.0%) were males. This implies that more males responded to the study compare to female farmers in Kishapu district Shinyanga, Tanzania. This may be due to fact that there are more male farmers in Kishapu district Shinyanga, Tanzania compares to female farmers.

This current study findings are uncorrelation with that of Aryal, et al. [16]. Learning adaptation to climate change from past climate extremes: Evidence from recent climate extremes in Haryana, India. Due to large sample population targeted. Where by a sample population targeted were 184 farmers and the current study are 100 farmers.

Age of the farmers

Age is the time of life at which some particular qualification, power or capacity arises or rests. An individual's development measured in terms of the year's requisite for like development of an average individual (Figure 4).



years, 30.0% were aged between 30-34 years, 26.0% were aged between 35-39 years, 18.0% were aged between 40-44, 4.0% were aged between 45-49, while 4.0% were aged 50 years and/or above 50 years. This implies that most of farmers in Kishapu district Shinyanga, Tanzania was aged between 30 years up to 39 years.

This study findings are unlikely with that of Mtintsilana, et al [17]. Determinants of adaptation to climate variability among farming households in Tyhume valley communities, Eastern Cape province, South Africa. Due to lack of interest of a researcher to know age of the farmers, this means that a researcher does not have any significance important to know age of the farmers.

The Table 1 show demographic information of the farmers by time for cultivating maize, acres of land and kinds of agriculture.

From the study findings shows that the age of farmers who participated were as follows; 18.0% were aged between 18-29

Table 1: Demographic information of farmers.

Category		Frequency	Percentage
Time for cultivating maize	Less than five years	26	26.0
	More than five years	74	74.0
Acres of land	Less than five acres	44	44.0
	More than five acres	56	56.0
Kind of crops	Food crops	20	20.0
	Cash crops	22	22.0
	Both	58	58.0
Kinds of agriculture	Irrigation agriculture	18	18.0
	Rain fed agriculture	82	82.0

Data in Table 1 shows that the time or duration for farmers that have been cultivating maize as follows; 26 (26.0%) they have been cultivating maize for less than five years and 74 (74.0%) they cultivate maize for more than five years. This implies that most of farmers have experiences in cultivating maize due to the long time for cultivating maize.

Again, the same table study findings show that how many acres of land that farmers have for cultivating maize as follows; 44 (44.0%) have less than five acres and 56 (56.0%) have more than five acres form cultivating maize. This implies that most of farmers have more than five acres for cultivating maize in Kishapu district Shinyanga, Tanzania compared to that having less than five acres of land.

From the same table study findings shows that famers at Kishapu district Shinyanga, Tanzania cultivate different kind of crops as follows; 20 (20.0%) cultivate only food crops, 22 (22.0%) farmers cultivate only cash crops and 58 (58.0%) farmers cultivate both food crops and cash crops. This implies

that many farmers at Kishapu district Shinyanga, Tanzania cultivate both cash crops as well as food crops.

Also, in the same table study findings shows that in Kishapu district Shinyanga, Tanzania their different kinds of agriculture practiced as follows; 18 (18.0%) farmers practices irrigation agriculture and 82 (82.0%) farmers practices rain fed agriculture. This implies that most famers practices rain fed kind of agriculture; hence they depend on the rainfall.

This study is uncorrelation with that of Williams, et al. Participatory GIS and community-based adaptation to climate change and environmental hazards: A Cambodian case study. In climate-induced disasters in the Asia-Pacific region: Response, recovery, adaptation. Emerald Publishing Limited. Where a researcher is not interested know time for cultivating maize, acres of land, kind of crops and kinds of agriculture.

Indicators of climate change in Kishapu district Shinyanga, Tanzania

This is the first research question where by the researcher sought to find out indicators of climate change in Kishapu district Shinyanga, Tanzania. The researcher used questionnaire to collect required information from farmers and interview to collect information from agricultural officers in Kishapu district Shinyanga, Tanzania. The findings from farmers and interview are presented below as follows:

Table 2: Farmers responses on indicators of climate change in Kishapu district Shinyanga, Tanzania.

Statement	Category	Frequency	Percentage
Are there any indicators of climate change this area?	No	14	14.0
	Yes	86	86.0
Where do climate change indicators range to?	Low	8	8.0
	Moderate	54	54.0
	High	38	38.0

Also, in the same table the study findings shows that 54 (54.0%) farmers say that there is moderate range to indicators of climate change, 38 (38.0%) says there are high range to indicators of climate change and 8 (8.0%) says that there are low range on indicators of climate change in Kishapu district Shinyanga, Tanzania. This implies that in Kishapu district Shinyanga, Tanzania many people have moderate knowledge on indicators for climate change and the remain some have high knowledge on range of climate change.

Table 3 show that 96 (96.0%) agreed that high temperature is the one among the indicator on climate change, only 4 (4.0%)

Table 3: Farmers responses on indicators of climate change in Kishapu district Shinyanga, Tanzania.

Statements	SA		A		U		D		SD	
	f	%	f	%	F	%	f	%	f	%
High temperature	50	50.0	46	46.0	4	4.0	0	0.0	0	0.0
Rainfall availability	44	44.0	42	42.0	12	12.0	2	2.0	0	0.0
Floods	12	12.0	32	32.0	18	18.0	30	30.0	8	8.0
Drought	42	42.0	32	32.0	8	8.0	8	8.0	10	10.0
Water scarcity	54	54.0	30	30.0	10	10.0	6	6.0	0	0.0
Atmospheric composition	4	4.0	34	34.0	40	40.0	18	18.0	4	4.0

Table 2 shows that 86 (86.0%) farmers agreed by saying yes there are some indicators of climate change in Kishapu district Shinyanga, Tanzania and only 14 (14%) say there are no any indicators of climate change in Kishapu district Shinyanga, Tanzania. This implies that many people in Kishapu district Shinyanga, Tanzania they no changes of climate by observing indicators of climate change.

undecided and none of farmers disagreed that high temperature is one of indicator that shows there is climate change. This implies that in Kishapu district Shinyanga, Tanzania the main indicator for climate change is high temperature. The following table below show the indicators of climate change in Kishapu district Shinyanga, Tanzania.

Note: SA: Strongly Agree; A: Agree; U: Undecided; D: Disagree; SD: Strongly disagree

From the same table the study findings shows that 44 (44.0%) farmers strongly agreed that rainfall availability is one of the indicators for climate change in Kishapu district Shinyanga, Tanzania, 42 (42.0%) agreed, 12 (12.0%) undecided, 2 (2.0%) disagreed that rainfall availability is not the indicator for climate change in Kishapu district Shinyanga, Tanzania and none of farmers strongly disagreed. This implies that availability of rainfall in Kishapu district Shinyanga, Tanzania can indicate a certain climate change.

Again, from the same table study findings 12 (12.0%) strongly agreed that flood is the one among the indicator for climate change in Kishapu district Shinyanga, Tanzania, 32 (32.0%) agreed, 18 (18.0%) undecided, 30 (30.0%) disagreed and 8 (8.0%) strongly disagreed that floods is not one of the indicators for climate change in Kishapu district Shinyanga, Tanzania. This implies that in Kishapu district Shinyanga, Tanzania flood is not a major indicator for climate change due to responses from farmers in this district.

Moreover, from the same table the study findings shows that 42 (42.0%) farmers strongly agreed that drought is an indicator for climate change in Kishapu district Shinyanga, Tanzania, 32 (32.0%) agreed, 8 (8.0%) undecided, 8 (8.0%) disagreed and 10 (10.0%) strongly disagreed that drought is not an indicator for climate change. This implies that drought is a major indicator for climate change in Kishapu district Shinyanga, Tanzania because many people agreed that drought is one of the indicators for climate change.

Also, the study findings shows that 54 (54.0%) farmers strongly agreed that water scarcity is one of the indicators for climate change, 30 (30.0%) agreed that water scarcity is one among the indicator for climate change, 10 (10.0%) undecided, 6 (6.0%) disagreed and none of farmers how strongly disagreed that water is an indicator of climate change in Kishapu district Shinyanga, Tanzania. This implies that in a certain change in climate in Kishapu district Shinyanga, Tanzania water scarcity will be the major indicator for climate change.

Lastly, from the same table study findings shows that 4 (4.0%) farmers strongly agreed that atmospheric composition is one of

the indicators for climate change, 34 (34.0%) agreed, 40 (40.0%) undecided, 18 (18.0%) disagreed and 4 (4.0%) strongly disagreed. This implies that many farmers have no enough knowledge on atmospheric composition thus why many of respondents they are neutral that means they can agree or disagreed so; education must be provided to the farmers in order to be aware with atmospheric composition.

However, this question was asked to agricultural officers in Kishapu district Shinyanga, Tanzania through interview. One of the agricultural officers say that “the main indicator for climate change in Kishapu district Shinyanga, Tanzania is high temperature which led to the drought and water scarcity.”

These study findings are likely fall on the same line like that of Antwi, et al [18]. Evaluating rural farmers knowledge, perception and adaptation strategies on climate change in Ghana: A case study of the Wa West district, Ghana, noted that the high temperature and availability of the rainfall are the major impact that affect maize production in west district in Ghana.

Impact of climate variability towards maize production in Kishapu district Shinyanga, Tanzania

This is the second research question where by the researcher sought to find out impact of climate variability towards maize production in Kishapu district Shinyanga, Tanzania. The researcher used questionnaire to collect required information from farmers and interview to collect information from agricultural officers in Kishapu district Shinyanga, Tanzania. The findings from farmers and interview are presented below as follows.

Responses in Table 4 shows that 86 (86.0%) of farmers says yes, their areas have been affected by impact of climate change and only 14 (14.0%) says no their areas has not been affected by the impact of climate change. This implies that many farmers in Kishapu district Shinyanga, Tanzania experiences the effect or impacts of climate change.

Table 4: Impact of climate variability towards maize production.

Statement	Category	Frequency	Percentage
Has this area ever been affected by the impacts of climate change?	Yes	86	86.0
	No	14	14.0

To what extent has climate change affected maize cultivation?	Small extent	22	22.0
	Moderate extent	42	42.0
	Large extent	36	36.0

Also, from the same table the study findings show that 36 (36.0%) farmers experiences climate change affected maize cultivation to large extent, 42 (42.0%) climate change affected maize cultivation to moderate extent and 22 (22.0%) farmers experiences climate change effects on maize cultivation to small extent. This implies that in Kishapu district Shinyanga, Tanzania many farmers are affected highly in maize cultivation due to impact of climate change in Kishapu district Shinyanga, Tanzania.

However, this question was asked to agricultural officers through interviews and all of them (three) agreed that climate change affect maize cultivation in Kishapu district Shinyanga, Tanzania. These study findings are in correlation with that of Antwi, et al [18]. Evaluating rural farmers knowledge, perception and adaptation strategies on climate change in Ghana: A case study of the Wa West district, Ghana. The study noted that increasing temperature and rainfall fluctuation are the major impact

towards maize production. Therefore, due to increasing of temperature and rainfall fluctuation can affect maize production in different place inside the country and outside the country.

The following table has sub research questions, where a researcher wants to examine to what extent climate change has affected maize production in Kishapu district Shinyanga, Tanzania as illustrated.

Table 5 shows that 52 (52.0%) farmers strongly agreed that one of the impacts of climate change is decline on maize yields, 44 (44.0%) agreed that climate change led to decline on maize yields, 2 (2.0%) undecided and 2 (2.0%) farmers disagreed that decline of maize yields is not an impact of climate change. This implies that climate change has impact to the maize production to the farmers in Kishapu district Shinyanga, Tanzania which led to low production of maize yields.

Table 5: Impact of climate variability towards maize production.

Statements	SA		A		U		D		SD	
	f	%	f	%	F	%	f	%	f	%
Decline on maize yields	52	52.0	44	44.0	2	2.0	0	0.0	2	2.0
Pests, weeds and diseases	36	36.0	52	52.0	6	6.0	4	4.0	2	2.0
Soil processes	6	6.0	22	22.0	52	52.0	20	20.0	0	0.0
Hunger and famine	40	40.0	38	38.0	12	12.0	2	2.0	0	0.0
Increase in maize price	54	54.0	36	36.0	6	6.0	4	4.0	0	0.0
Poverty	48	48.0	34	34.0	12	12.0	6	6.0	0	0.0
Length of growing seasons	12	12.0	32	32.0	38	38.0	12	12.0	6	6.0

Note: SA: Strongly Agree; A: Agree; U: Undecided; D: Disagree; SD: Strongly Disagree

From the same table study findings shows that 36 (36.0%) strongly agreed that pests, weeds and diseases is one of impact due to climate change, 52 (52.0%) agreed, 6 (6.0%) undecided and 6 (6.0%) disagreed that pest weeds and diseases is not an impact of climate change towards maize production. This implies that climate change can led to the formation of pests, weeds and diseases which can affect maize production in Kishapu district Shinyanga, Tanzania.

Again, the study findings show that 28 (28.0%) agreed that soil processes is the one among the impact of climate change, 52 (52.0%) undecided, 20 (20.0%) disagreed. This implies that many farmers in Kishapu district Shinyanga, Tanzania have no enough knowledge on soil processes as the impact of climate change towards maize production.

From the same table the study findings show that 78 (78.0%) agreed that Hunger and famine is one among the impact of climate change towards maize production, 12 (12.0%) undecided and 2 (2.0%) disagreed. This indicate that climate change affects maize production and can led to Hunger and famine due low maize production.

Also, from the same table study findings shows that 54 (54.0%) strongly agreed that one of the impacts of the climate change is increase in maize price, 36 (36.0%) agreed, 6 (6.0%) undecided and 4 (4.0%) disagreed. This implies that when climate change the rate of production will be lowered that can led to the increase in maize price.

Moreover, the study findings show that 82 (82.0%) agreed that poverty is the one of the impacts of the climate change towards maize production, 12 (12.0%) undecided, 6 (6.0%) disagreed. This implies that when climate change led to low production of maize, then the price of maize will increase so for the family or a farmer to buy maize it cost high price which is not easy to be affordable for all people or farmers hence, it increases poverty among the famers.

Lastly, study finding show that 12 (12.0%) strongly agreed that Length of growing seasons is the one among the impact of climate change, 32 (32.0%) agreed, 38 (38.0%) undecided 12 (12.0%) disagreed and 6 (6.0%) strongly disagreed. This indicate that many farmers experience the impact of climate change which is Length of growing seasons but also there some people they are neutral in this question response means they can have enough understanding about the length of growing seasons as the impact of climate change.

This study is likely the same with that of Akanbi, et al. Climate change and maize production in the Vaal catchment of South Africa: Assessment of farmers' awareness, perceptions and adaptation strategies. Climate Research, 82, 191-209. The study noted that declines of maize production and poverty are the impact formed due to climate variability towards maize production in different areas.

Farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania

This is the third research question where by the researcher sought to find out farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania. The researcher used questionnaire to collect required information from farmers and interview to collect information from agricultural officers in Kishapu district Shinyanga, Tanzania. The findings from farmers and interview are presented below as follows:

In Figure 5 the study findings shows that 72.0% of the farmers say yes, they have found any alternatives toward adapting to the impacts of climate concerned with increasing agriculture yields and 28.0% of the farmers say no, they have not found any alternatives toward adapting to the impacts of climate concerned with increasing agriculture yields. This indicate that many farmers in Kishapu district Shinyanga, Tanzania they can adapt toward the impact of the climate change in order to increase maize production.

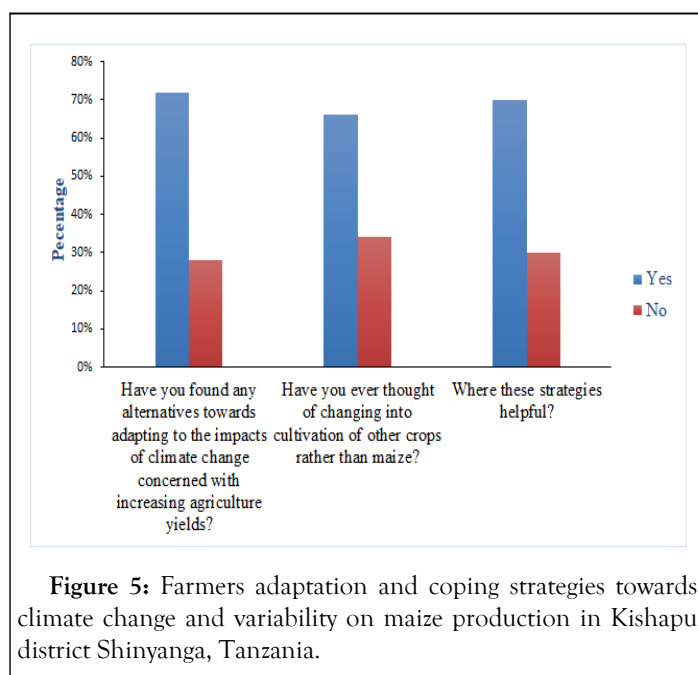


Figure 5: Farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania.

Again, study findings show that 66.0% of the farmers say yes, they have thought on changing into other crops rather than maize cultivation and 34.0% they say no, they have not thought to change into other crops rather than maize cultivation. This indicate that many farmers in Kishapu district Shinyanga, Tanzania they can adapt to the climate change due to the rotation of crops to be cultivated so if the climate is not favorable for maize cultivation, they can cultivate another crop which is favorable for that climate changed.

Also, 70.0% of the farmers they say yes, the strategies that they use to adapt towards climate change were helpful and 30.0% they say no, the strategies that they use were not helpful to them. This implies that many farmers they use helpful strategies on adapting the impact of climate change in Kishapu district Shinyanga, Tanzania.

This study findings are related with that of Destaw, et al. Climate change adaptation strategies and their predictors amongst rural farmers in Ambassel district, Northern Ethiopia. The result obtained from this study were many farmers who have been practice at least one adaption of climate change towards maize production in order to overcome the impact that can be formed due to the climate change.

Farmers adaptation and coping strategies towards climate change and variability on maize production

In this sub research question a researcher want to find out the

Table 6: Farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania.

Statements	SA	A	U	D	SD					
	f	%	f	%	f	%	F	%	f	%
Irrigation efficiency	42	42.0	36	36.0	6	6.0	12	12.0	4	4.0
Use of drought tolerant maize seeds	20	20.0	62	62.0	8	8.0	6	6.0	4	4.0
Increase the use of manure and fertilizer	48	48.0	30	30.0	14	14.0	6	6.0	2	2.0
Mixed cropping	54	54.0	34	34.0	10	10.0	2	2.0	0	0.0
Control pests, weeds and diseases	48	48.0	34	34.0	10	10.0	8	8.0	0	0.0

Note: SA: Strongly Agree; A: Agree; U: Undecided; D: Disagree; SD: Strongly Disagree

From the same table study findings show that 82% of farmers they use drought tolerant maize seeds, this implies that many farmers in Kishapu district Shinyanga, Tanzania they use drought tolerant maize seeds which can help them in overcome the impact of climate change also to increase rate of the maize production in Kishapu district Shinyanga, Tanzania.

adaption and strategies that will be used by the farmers in order to adapt and copy changes occurs due to the climate change which can lead to the variability on maize production as shown below.

Responses in Table 6 shows that 42 (42.0%) strongly agreed that they use irrigation efficiency in order to adapt towards climate change, 36 (36.0%) agreed, 6 (6.0%) undecided, 12 (12.0%) disagreed and 4 (4.0%) strongly disagreed. This implies that 78.0% of the farmers in Kishapu district Shinyanga, Tanzania they use irrigation when climate change in order to overcome the impact of the climate change which can led to the increase of the maize production.

Again, from the same table, the study findings show that 78.0% of the farmers in Kishapu district Shinyanga, Tanzania, they increase the use of manure and fertilizer. This implies that many farmers in Kishapu district Shinyanga, Tanzania they use manure and fertilizers when they cultivate maize in order to increase rate of maze production but also to overcome or to adapt the impact formed due to climate change.

Again, the study findings show that 88.0% agreed that they use mixed crop farming and 12.0% they disagreed. This implies that many farmers in Kishapu use mixed crop farming like mixing maize with legumes, legumes they increase soil fertility which can lead to the high production of maize.

Also, study findings show that 82.0% of the farmers agreed that they control pests, weeds and diseases and 12.0% disagreed. This implies that most of farmers in Kishapu district Shinyanga, Tanzania they use different ways of controlling pests, weeds and diseases that can affect maize production.

These study findings are likely fall on the same line like that of Mtintsilana, et al. Determinants of adaptation to climate variability among farming households in Tyhume valley communities, Eastern Cape province, South Africa. The study shown that the adaptation measures adopted by the farming households in the study area include irrigation, crop rotation, changing crop variety and change in cropping patterns and calendar of planting. The other methods of adaptation used included the use of ash to kill (Intuku) mole and using dirty water from washing dishes and clothes when irrigating to kill parasites on crops.

Summary

This chapter involves summary of the study, conclusion according to the study findings and recommendations from the study findings based on the assessment of farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania.

The study guided by three research questions which are; what are the indicators of climate change and variability in Kishapu district Shinyanga, Tanzania? What are impacts of climate variability on maize production in Kishapu district Shinyanga, Tanzania? How do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania?

Summary of the study

The purpose of this study was to find out the assessment of farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania. The study conducted to address three research questions namely; what are the indicators of climate change and variability in Kishapu district Shinyanga, Tanzania? What are impacts of climate variability on maize production in Kishapu district Shinyanga, Tanzania? How do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania?

The study was guided by social cognitive theory, social learning theory and career typological theory. The study employed quantitative and qualitative research approach and cross-sectional survey design was used for data collection, whereby

stratified and simple random sampling was used to get the required sampling. The population for the study involved agricultural officers from Kishapu district Shinyanga, Tanzania and local farmers from Kishapu district Shinyanga, Tanzania.

The questionnaires and interview method used for data collection. The data analyzed by using SPSS. The study findings revealed that there is different assessment of farmers' adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania such as use of drought tolerant maize seeds increase the use of manure and fertilizer and mixed cropping.

Summary of the study findings

What are the indicators of climate change and variability in Kishapu district Shinyanga, Tanzania: This is the first research question whereby the researcher sought to find out the indicators of climate change and variability in Kishapu district Shinyanga, Tanzania. The researcher used questionnaire to collect required information from farmers and interview to collect information from agricultural officers in Kishapu district Shinyanga, Tanzania. The study findings revealed that indicators of climate change and variability in Kishapu district Shinyanga, Tanzania are in different ways as follows; high temperature, rainfall availability, drought and water scarcity are agreed to the large number of the farmers, this means that these are mainly or commonly indicator for the climate change.

What are impacts of climate variability on maize production in Kishapu district Shinyanga, Tanzania: This is the second research question whereby the researcher sought to find out the impacts of climate variability on maize production in Kishapu district Shinyanga, Tanzania. The researcher used questionnaire to collect required information from farmers and interview to collect information from agricultural officers in Kishapu district Shinyanga, Tanzania.

The study findings revealed that impacts of climate variability on maize production in Kishapu district Shinyanga, Tanzania can vary due to the extent of that climate change as follows; decline on maize yields and pests, weeds and diseases, hunger and famine, increase in maize price and poverty. So, when the climate change to large extent can lead to the decline on the maize production, hunger and famine and increase of maize price.

How do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania: The researcher sought to find out the adaptation and coping strategies towards climate change and variability on maize production. The researcher used questionnaire to collect required information from the farmers and interview to collect information from agricultural officers. The study findings show that there are many adaptations used by the farmers to cope the climate change and variability on maize production in Kishapu district Shinyanga, Tanzania such

as irrigation efficiency, use of drought tolerant maize seeds, increase the use of manure and fertilizer, mixed cropping and control pests, weeds and diseases.

CONCLUSION

Based on the results, it can be concluded that increases in temperature could shorten the length of the growing season with temperature variation expected to have significant impacts on maize production. Also, the reduction in rainfall and increase in the minimum and maximum temperatures might results in encourage pollen viability and promotion of maize growth. The recent study has shown that maize is affected highly by climate change like high temperature, drought and water scarcity because many people practice rain fed agriculture. Although the minimum temperature can lead to the germination of maize seed and allows maize plant to grow well.

RECOMMENDATIONS

This study, as it titled “the assessment of farmers’ adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania”. This study has three objectives as follows;

First one is what are the indicators of climate change and variability in Kishapu District Shinyanga, Tanzania, in this objective a researcher recommends that;

- Same study and objective can be used by another study or researcher but in different case study because indicators of climate change can vary from one place to another place due to geographical differences.
- Education should be provided to the local farmers on the indicator of climate change and variability.
- Future study can focus on precautions to be taken when a farmer obtains a certain indicators of climate change and variability in Kishapu district Shinyanga, Tanzania or in different areas inside the country and outside of the country.
- There is different geographical location in Tanzania and has their climate so, future research study can address this issue in different areas inside and outside of Tanzania due to the different climatic condition which may led to different climate change and variability on maize production.
- There are different indicators for climate change so, future study can address this issue by relating each indicator with favorable crops to be cultivated and grow in a certain condition in Kishapu district Shinyanga, Tanzania or different areas inside and outside the country.

The second objective is what are impacts of climate variability on maize production in Kishapu district Shinyanga, Tanzania, a researcher recommends that;

- Other researchers can conduct different or relating research on impacts of climate variability on maize production in same area or different areas inside the country and outside the country. In order to educate the local farmers, the impacts that can be led to the climate change and to provide solution on how they can adapt to the climate change.

- Other researchers can conduct different research on impacts of climate variability and their solution in order to overcome consequences that may be formed from climate change variability.
- This study based on the assessment of farmers’ adaptation strategies towards climate change on maize production in Kishapu district Shinyanga, Tanzania only but other researcher can use the same study in other place or in large areas so that it can increases different literature reviews and solutions on to overcome impacts of climate change variability on maize production.
- Future study can base on the impacts of climate change and variability on maize production in Kishapu district Shinyanga, Tanzania or in another place inside or outside of Tanzania.
- Many farmers have been affected by impacts of climate change and variability so, future study can use the same or similar objectives and title but different case study in order to come with different solutions to overcome challenges of climate change towards maize production in Kishapu district Shinyanga, Tanzania and other places inside/outside the country.

Last objective is how do the farmers adaptation and coping strategies towards climate change and variability on maize production in Kishapu district Shinyanga, Tanzania, a researcher recommends that;

- Government and non-government organization to provide education to the local farmers on how they can adapt on climate change towards maize production and other crop cultivations.
- Government and non-government organization should provide support to the local farmers on adaptation and coping strategies towards climate change and variability on maize production by providing capital and improving facilities especially in irrigation agriculture.
- Farmers can change their calendar of planting crops and using mixed crops cultivation in order to coping with climate change.
- Other researchers can conduct a study on which strategies is more favorable for adapting and coping towards climate change and variability on maize production in different place especially in hot climatic areas.
- Climate change adaptation in agriculture through technology adoption is a crucial topic and has multiple dimensions. Therefore, future research at multiple locations is necessary to address the issues further at a broader scale and to generalize its impacts in Kishapu District Shinyanga, Tanzania and in different areas inside and outside of Tanzania.

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